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BOOK OF ABSTRACTS

INCLUDES ABSTRACTS OF SCIENTIFIC PRESENTATIONS

MAY 21 – 24

22ND ANNUAL MEETING AND POSTGRADUATE COURSE

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11:15 -12:45 **Palagalileo**

Scientific Session 1

HCC: diagnosis and treatment response (Liver 1)

SS 1.01

Low-voltage arterial phase scanning for the detection of hypervascular lesions of the liver

G.A. Zamboni, M.C. Ambrosetti, R. Pozzi Mucelli; Verona/IT

Purpose: To test a low-voltage protocol for arterial phase scanning in patients with hypervascular focal liver lesions (hFLL) to exploit the k-edge of iodine and reduce patient dose.
Material and Methods: We compared two groups of 20 patients with liver disease, who underwent multiphasic MDCT of the abdomen on a 64-row scanner. In the test group, the arterial phase was performed at 80 kVp and 370 mAs, while in the control group it was performed with 120 kVp and automatic tube current modulation; all other scan parameters were kept constant. Scans were compared for quantitative imaging parameters (attenuation and standard deviation in the liver, aorta and in the largest hFLL) and for dose parameters (CTDI, DLP) using an unpaired t-test.
Results: Mean attenuation was significantly higher in the test group than in the control group for the aorta (512.12 ± 159.98 vs 277.80 ± 54.08HU), liver (77.47 ± 13.05 vs 59.01 ± 10.85HU) and hFLL (150.27 ± 33.35 vs 103.22 ± 19.56HU) (all: $p < 0.0001$). Radiation dose was significantly lower in the test group than in the control group (CTDI 6.64 ± 0 vs 12.12 ± 4.37mGy; DLP 212.61 ± 25.25 vs 404.54 ± 137.16mGyxcm; $p < 0.0001$). Conspicuity of the hypervascular FLLs was significantly higher in the test group (72.71 ± 39.17 vs 44.21 ± 16.42HU; $p = 0.0112$).
Conclusion: The use of 80 kVp arterial phase scanning for abdominal CT increases the conspicuity of hFLL may help in their identification and, at the same time, gives a significant lower dose to the patient.

SS 1.02

Comparison of gadoxetate disodium-enhanced MRI and triple-phase MDCT for the detection of small (≤3 cm) hepatocellular carcinoma

Y.E. Kim, M. Kim, Y.E. Chung, M. Park, K.W. Kim; Seoul/KR

Purpose: To retrospectively compare the diagnostic accuracy of gadoxetate disodium-enhanced magnetic resonance imaging (EOB-MRI) and multidetector computed tomography (MDCT) for the detection of small hepatocellular carcinoma (HCC) in patients with chronic liver disease.
Material and Methods: Seventy-three patients (63 men, 10 women; mean age, 56 years; range, 30–72 years) suspected having small (≤3cm) HCC underwent EOB-MRI and triple-phase MDCT within one month. Final diagnosis was confirmed surgically (n = 35) or clinically (n = 38). Two radiologists independently and randomly reviewed the MDCT and EOB-MRI. The diagnostic accuracy was compared using areas (Az) under alternative free response receiver operating characteristics (ROC) analysis. Sensitivity and positive predictive value (PPV) were compared.
Results: Ninety-five HCCs were confirmed in 61 patients. The Az values on EOB-MRI (0.94 for both readers) were significantly higher than those on MDCT (0.84 and 0.80 for reader 1 and 2, respectively) for both observers ($p < .002$). Sensitivities were significantly higher with EOB-MRI (90.5% and 89.5%) than with MDCT (74.7% and 35.8%) for both observers ($p < .001$). PPV was significantly higher with EOB-MRI than with MDCT for reader 1 (95.6% vs 61.2%, $p < .001$), but was comparable between EOB-MRI and MDCT for reader 2 (98.8% vs 100%, $p = 1.00$).
Conclusion: EOB-MRI allows higher accuracy than MDCT for the detection of small HCC in patients with chronic liver disease.

SS 1.03

Additional value of gadoxetic acid-DTPA-enhanced hepatobiliary phase MR imaging in the diagnosis of early-stage hepatocellular carcinoma: comparison with dynamic triple-phase multidetector CT imaging

H. Haradome, K. Al Manea, T. Bonaventure, L. Grazioli; Brescia/IT

Purpose: To assess the value of hepatobiliary phase gadoxetic acid (EOB)-enhanced MRI for the diagnosis of early-stage hepatocellular carcinoma (HCC) (≤3cm) compared to triple-phase dynamic multidetector CT (MDCT).
Material and Methods: 52 patients with 60 pathologically proven HCCs underwent both EOB-enhanced MRI and triple-phase dynamic MDCT. Two radiologists independently and blindly reviewed three image sets: 1) MDCT, 2) dynamic MRI (unenhanced and EOB-enhanced dynamic MR images), and 3) combined MRI (dynamic MRI + hepatobiliary phase images) using a five-point rating scale on a lesion-by-lesion basis. Receiver operating characteristics (ROC) analysis was performed, and sensitivity and specificity were calculated.
Results: The area under the ROC curve (Az) of dynamic MRI was equivalent to that of MDCT for both readers. For both readers, Az and sensitivity of combined MRI for smaller lesions (<1.5cm) were significantly higher than that of dynamic MRI and MDCT ($P < 0.0166$). The majority of false-negative nodules on dynamic MRI or MDCT (75% and 62%, respectively) were due to a lack of identified washout findings.
Conclusion: Hepatobiliary phase images can increase the value of EOB-enhanced MRI in the diagnosis of early-stage HCC. The sensitivity and accuracy were significantly superior to MDCT for the diagnosis of lesions less than 1.5cm.

SS 1.04

Small ≤ (l 20 mm) enhancing lesions seen only during the hepatic arterial phase: evaluation with gadoxetic acid (Gd-EOB_DTPA) enhanced MR imaging during the hepatobiliary phase

M.L. Mennini, R. Di Miscio, V.C. Iombardo, S. Santinelli, C. Catalano, R. Passariello; Rome/IT

Purpose: To retrospectively assess whether gadoxetic acid (Gd-EOB-enhanced MR imaging during the hepatobiliary phase can improve the characterization of small (≤ 20 mm) hepatic arterial phase-enhancing (HAPE) lesions that are occult during portal and equilibrium phases and at unenhanced T1- and T2-weighted MR images.
Material and Methods: This study was approved by the institutional review board and a waiver for informed consent was obtained. 150 patients who underwent Gd-EOB-DTPA-enhanced MR imaging at 3.0T (Discovery, General Electric) were evaluated with breath-hold T2-weighted images and volumetric three-dimensional Gd-EOB-DTPA-enhanced T1-weighted GRE MR images acquired in the arterial (25s), portal venous (60s), equilibrium (180s),and hepatobiliary phase (20min). Two readers retrospectively reviewed the MR images in consensus for small HAPE-only nodules. The final study group included 31 patients aged 23-82 years with a total of 47 HAPE-only lesions. Qualitative analysis of MR enhancement features during the hepatobiliary phase was related to pathology reports or imaging follow-up (at least 6 months). Sensitivity, specificity and positive and negative predictive values with corresponding 95% confidence intervals (CIs) were determined.
Results: Of the 47 HAPE-only lesions, 34 (72%) were hepatocellular carcinoma (HCCs). The remaining 13 (28%) lesions were considered definite pseudolesions. The sensitivity and specificity of Gd-EOB-MR imaging during the hepatobiliary phase for depicting HCCs was 93% (31 of 33) and 85% (11 of 13), respectively. The positive and negative predictive values of gadoxetic acid MR imaging were 94% (31 of 33) and 85% (11 of 13), respectively.
Conclusion: Gadoxetic acid-enhanced MR imaging during the hepatobiliary phase has high specificity and sensitivity for the characterization of small HAPE-only lesions in cirrothic patients.

SS 1.05

The value of gadoxetic acid-enhanced hepatospecific phase MR imaging for characterization of hepatocellular nodules in the cirrhotic liver

R. Cianci, A. Filippone, F. Sabatino, V. Bianco, A. Tartaro, A.R. Cotroneo; Chieti/IT

Purpose: To retrospectively assess the value of adding hepatospecific phase images of gadoxetic acid-enhanced MR imaging to unenhanced and dynamic-enhanced MR images for the characterization of dysplastic nodule (DN) and hepatocellular carcinoma (HCC) in cirrhotic livers.
Material and Methods: Thirty-four patients with 39 HCCs and 15 DNs were enrolled and all lesions were pathologically proved except for 16 HCCs. Patients underwent gadoxetic acid-enhanced MR examination, including dynamic and 20 min hepatospecific phase imaging using a 1.5 Tesla system. Two radiologists independently reviewed two sets of MR images: set A, unenhanced and gadoxetic acid-enhanced dynamic images; set B, unenhanced and gadoxetic acid-enhanced dynamic images plus 20 min hepatospecific phase images. For each set and each observer, the diagnostic accuracy was compared using ROC analysis (Az). Sensitivity and specificity values were also calculated.
Results: For both observers, Az values for the diagnosis of HCC resulted to be higher with the addition of hepatospecific phase images, with a significant improvement for the less experienced observer ($p = .045$). Similarly, sensitivity values significantly increased with the addition of hepatospecific phase images for both observers ($p = .044$ for observer 1 and $p = .025$ for observer 2). No significant differences were observed for specificity values.
Conclusion: Adding the hepatospecific phase to unenhanced and dynamic gadoxetic acid-enhanced MR images helps to differentiate HCC from DN.

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SS 1.06

Accuracy of diffusion-weighted MR imaging for hepatocellular carcinoma compared with liver explantation

A. Hardie; Charleston, SC/US

Purpose: The goal of this study was to assess the diagnostic accuracy of diffusion-weighted (DW) MRI for HCC using liver explant pathology from patients who had undergone liver transplantation.

Material and Methods: 43 patients who had undergone liver transplantation and had had respiratory-triggered, single-shot, echo-planar DW-MRI were evaluated by 2 independent, blinded observers for HCC and comparison made with explanted specimens. Apparent diffusion coefficient (ADC) values for each visualized lesion were measured.

Results: On pathology, 30 HCC (mean largest diameter 2.2 cm) were identified in 21 patients and 17 benign lesions. Based on qualitative assessment, sensitivity and specificity for reader 1 was 60% and 89% and for reader 2 50% and 100% (Kappa 0.64, "substantial" agreement). For all visible liver lesions, ROC curve analysis of the ADC values was performed to assess the ability to characterize lesions based on a cut-off value of 1.5 x 10^{-3} mm^2/s. For reader 1, sensitivity for identifying HCC was 100% and specificity 90%, with A_z = 0.972. For reader 2, sensitivity of identifying HCC was 100% and specificity was also 100%, with A_z = 1.

Conclusion: DW-MRI had only a moderate sensitivity for identifying HCC in a cirrhotic population and thus is not recommended as a stand alone sequence. However, the high specificity of DW-MRI for HCC in cirrhotic patients suggests it likely has value as part of a routine liver MRI evaluation.

SS 1.07

Enhancement pattern of hepatocellular carcinoma (HCC) at contrast-enhanced US, MDCT, and MRI: intermodality agreement and comparison of diagnostic sensitivity between 2005 and 2010 American Association for the Study of Liver Diseases Guidelines

A. Furlan[1], D. Marin[2], P. Cabassa[3], F. Agnello[4], A. Taibbi[4], E. Brunelli[3], M. Midiri[4], G. Brancatelli[4]; [1]Pittsburgh, PA/US, [2]Durham, NC/US, [3]Brescia/IT, [4]Palermo/IT

Purpose: To evaluate agreement between CEUS, MDCT, and MRI for the assessment of enhancement pattern of HCC; and to compare sensitivity for the diagnosis of HCC between 2005 and 2010 AASLD guidelines.

Material and Methods: We prospectively included (Jan-08 to Dec-09) cirrhotic patients with newly diagnosed 10-20 mm HCC imaged at two contrast-enhanced imaging techniques among CEUS, MDCT, and MRI. Images were reviewed by two radiologists to assess enhancement pattern. Intermodality agreement was determined calculating percentage of cases with concordant findings and Cohen coefficient (k). McNemar's test was used to compare sensitivity between 2005 and 2010 AASLD guidelines.

Results: Population included 91 patients (69M; 22F; mean age 68 years) with 96 HCCs (15.2 ± 3.8 mm). Lesions were studied with a combination of CEUS and MDCT (n = 59), CEUS and MRI (n = 26), or MDCT and MRI (n = 11). Intermodality agreement for assessment of tumor enhancement pattern was 67% (k = 0.294, p = 0.001). Typical enhancement pattern (hypervascularity and washout) was detected coincidentally at two imaging modalities in 50 (52%) HCCs. Sensitivity increased significantly using 2010 AASLD criteria compared to 2005 AASLD criteria (84% vs. 52%, p < 0.001).

Conclusion: Typical tumor enhancement pattern was detected coincidentally at two contrast-enhanced imaging techniques in 52% of cases. Sensitivity for the diagnosis of HCC increased significantly to 84% when the visualization of typical enhancement pattern was required in one imaging modality (AASLD 2010).

SS 1.08

Long-term survival of HCC predicted by dynamic contrast-enhanced MRI

C.D.M. Witjes, F.E.J.A. Willemssen, J. Verheij, S.J. van der Veer, B.E. Hansen, C. Verhoef, R.A. de Man, J.N.M. Ijzermans; Rotterdam/NL

Purpose: Differentiation grade and presence of microvascular invasion predicts long-term survival of HCC after surgery. We examined whether pre-operative MRI characteristics can predict HCC differentiation grade and presence of microvascular invasion.

Material and Methods: All histological slides of the resected specimen of HCC patients and the pre-operative MRI were prospectively analysed. Clinical, pathological and imaging findings were evaluated in univariate and multivariate analyses.

Results: Between January 2000 and December 2008, 87 patients with 104 HCCs were detected. 55 lesions (53%) showed microvascular invasion, 15 lesions (14%) were well differentiated, 50 lesions (48%) moderate differentiated and 34 lesions (32%) poor differentiated. In 85 lesions (88%) wash-out of contrast during the dynamic phase was noted. 28 patients developed recurrence of HCC. These patients had significant more often microvascular invasion and a moderate or poor differentiated tumour. Moderate and poor differentiated HCC showed more wash-out compared to well differentiated HCC (p < 0.001). HCC with microvascular invasion showed significant more wash-out (p = 0.032). The shape of the time intensity curve (TIC) did not differ significantly between the three differentiation grades, presence of microvascular invasion, nor predicted recurrence.

Conclusion: Differentiation grade and microvascular invasion are predictors of long-term survival of HCC. Moderate to poor differentiated HCC and microvascular invasion are significantly associated with the presence of wash-out demonstrated on dynamic contrast-enhanced MRI.

SS 1.09

Three-dimensional contrast-enhanced ultrasound versus conventional two-dimensional contrast-enhanced ultrasound in the evaluation of therapeutic response of hepatocellular carcinoma after local therapies

T.V. Bartolotta, A. Taibbi, G. Brancatelli, L. Tortorici, M. Galia, G. Lo Re, M. Midiri; Palermo/IT

Purpose: To investigate diagnostic performance of three-dimensional contrast-enhanced ultrasound (3D-CEUS) compared with 2D-CEUS in the assessment of therapeutic response of hepatocellular carcinoma (HCC) treated with local therapies.

Material and Methods: Twenty patients (mean age: 65.6 years) with 20 HCCs (mean size: 2.8 cm) treated by radiofrequency ablation (n = 8), transarterial chemoembolization (n = 7), combined treatments (n = 3), alcoholization (n = 1) and wedge resection (n = 1) underwent one-month follow-up by 2D-CEUS and 3D-CEUS. Two readers reviewed by consensus both examinations considering in the arterial phase: 1) complete response (CR): the absence of enhancing portion within or at the margin of the treated zone and 2) residual tumour (RT): a portion of treated HCC showing persistent hypervascularity. MRI (n = 15) and CT (n = 5) provided final diagnosis. The influence of both methods on clinical outcome was evaluated on a 3-point scale. Intermodality agreement was calculated too.

Results: Either 2D-CEUS or 3D-CEUS correctly identified RT in 11/20 (55%) cases (mean size: 3.3 cm) and CR in the remaining eight (40%) (mean size: 2.3 cm). 3D-CEUS did not depict RT in one (5%) (size: 2 cm) deeply located lesion. Intermodality agreement was excellent (k = 95%) with no statistically significant differences in diagnostic performance and influence on clinical outcome (p < 0.001).

Conclusion: 3D-CEUS showed similar diagnostic value when compared with conventional 2D-CEUS in the detection of RT in HCCs treated with local therapies.

SS 1.10

Tumor enhancement at contrast-enhanced CT and Gd-enhanced MRI for the assessment of treatment response of hepatocellular carcinoma (HCC) after sorafenib

A. Furlan[1], G. Salvaggio[2], G. Cabibbo[2], L. Giannitrapani[2], D. Marin[3], F. Agnello[2], R. Lagalla[2], G. Brancatelli[2]; [1]Pittsburgh, PA/US, [2]Palermo/IT, [3]Durham, NC/US

Purpose: To investigate whether arterial enhancement of advanced HCC during pre-treatment and follow-up contrast-enhanced CT (CECT) or Gd-enhanced MRI (Gd-MRI) can be used to predict tumor response to sorafenib.

Material and Methods: Seventeen patients (12M, 5F; mean age: 69 years) receiving sorafenib for inoperable HCC between 2007 and 2010 were included. Median interval time between pre-treatment and follow-up CECT or Gd-MRI was 160 days. Tumor arterial enhancement was measured at baseline and follow-up: (tumor attenuation/intensity on arterial phase – tumor attenuation/intensity on unenhanced images)/(tumor attenuation/intensity on unenhanced images) x 100. Response was assessed according to modified RECIST (mRECIST) criteria (one-dimensional measurement of viable tumor). Mann-Whitney-U test was used to assess significance of difference of tumor enhancement at baseline, change in tumor enhancement at follow-up, and tumor response.

Results: Three (18%) patients had progressive disease (PD), 3 (18%) partial response (PR), and 11 (64%) stable disease (SD) according to mRECIST. Mean tumor enhancement at baseline was significantly higher in PD (281.6% ± 166.1) compared to SD (112.8% ± 50.7) or PR (141.4% ± 90.1) (p = 0.007). In patients with PR, the decrease in mean tumor enhancement at follow-up (-76.1% ± 13.6) was significantly larger than in patients with SD (8.8% ± 148.4) or PD (-32.9% ± 7.4) (p = 0.013).

Conclusion: Higher tumor enhancement at baseline CECT or Gd-MRI can predict response after treatment with sorafenib in patients with advanced HCC. Larger decrease in tumor enhancement at follow-up correlates with response according to mRECIST criteria.

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11:15 -12:45 **Sala Perla**

Scientific Session 2
Diffuse liver disease (Liver 2)

SS 2.01
Liver iron concentration quantification by MRI: are recommended protocols accurate enough for clinical practice?
J.M. Alústiza[1], A. Castiella[2], J.I. Emparanza[1], E.M. Zapata,[2], A.B. Costero[3], M.I. Díez[3]; [1]San Sebastián/ES, [2]Mendaro/ES, [3]Alcala de Henares/ES

Purpose: To assess the quantification of liver iron concentration (LIC) by MRI using the Rennes University (URennes) algorithm.
Material and Methods: In 1999-2006 the LIC calculated with URennes model in 171 patients was compared to the LIC values obtained by liver biopsy.
Results: According to the biopsy, 107 patients had no overload (<37 µmol Fe/g), 38 had moderate overload (37-79 µmol Fe/g), and 26 had hemochromatosis (>79 µmol Fe/g). There is a correlation between the LIC estimated with MRI and the measurement obtained with a biopsy (r = 0.86). MRI correctly classified 105 patients in the various levels of LIC. Diagnostic accuracy is 61.4%, with a tendency to overestimate: 43% of patients with no overload were diagnosed as overloaded, and 44.7% of patients with moderate overload were diagnosed as having high overload. The sensitivity of the URennes method for high overload is 92.3%, and the specificity for absence of overload is 57.0%. The MRI estimated values >170 µmol Fe/g revealed a PPV for hemochromatosis of 100% (n = 18); concentrations <60 µmol Fe/g had a NPV of 100% for hemochromatosis (n = 101). The 44 patients with intermediate values remain in uncertainty.
Conclusion: The assessment of LIC with URennes is useful in 74.3% of the patients included in to rule or to identify patients with high iron overload. The method has a tendency to overestimate overload, which limits its diagnostic performance.

SS 2.02
Diffusion-weighted imaging for quantification of hepatic iron deposition in patients with thalassemia major: comparison with multi-echo T2*-weighted imaging
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Purpose: Multi-echo MRI GRE sequence has been fully established in clinical practice for liver iron overload assessment in severe conditions like hemochromatosis and thalassemia major. Diffusion weighted imaging (DWI) is very sensitive to susceptivity effects from iron deposits. Purpose of the study is to determine the diagnostic performance of DWI for hepatic iron quantification in patients with thalassemia major.
Material and Methods: 53 patients with thalassemia major and 20 healthy volunteers underwent liver MRI with 1.5T scanner. Liver T2* was assessed with a multi-echo GRE sequence. ADC values were measured in the same hepatic region with EPI-DWI sequence with 2 different b-values (600 and 1000). Subjects were classified, according to liver T2*, into 4 groups: (I)no iron overload, (II)borderline, (III)slight, and (IV)moderate/severe overload. ADC values were compared in the groups with ANOVA with Dunnett's adjustment.
Results: All volunteers resulted in iron burden group I; amongst the patients, 9 were in group I, 24 in group II, 8 in group III, and 12 in group IV. In both DWI acquisitions it was impossible to differentiate the group I from II and the group III from IV because of overlapping of ADC values. Conversely, there was no overlap between ADC values after grouping I-II groups and III-IV groups.
Conclusion: DWI with b = 600 and b = 1000 had excellent performance for differentiating subjects with absent or borderline iron overload from subjects with slight to severe iron overload.

SS 2.03
Liver vessel cancellation artifact on in-phase and out-of-phase MRI imaging: a sign of ultra-high liver fat content
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Purpose: To describe a new MRI sign on in-phase and out-of-phase gradient-echo sequences related to ultra-high liver fat content (UHLFC) (>90%) by qualitative histology, the liver-vessel cancellation artifact.
Material and Methods: Institutional review board approval was obtained for this retrospective HIPAA compliant study with waived informed consent. Patients with liver steatosis were searched on MRI (n = 195) and pathology (n = 116) databases between January 1, 2008 and June 20, 2010. Two readers blindly reviewed all MR images for the presence of the liver-vessel cancellation sign. Cross-reference of patients with biopsy-proven steatosis and MRI within one month was performed (n = 54, 25 males, 29 females; mean age: 41.0 ± 18.9), with a population of 6 patients with UHLFC (1 male, 5 females, 15.5 ± 11.2). Performance diagnostic tests, including sensitivity and specificity were performed.
Results: Liver vessel cancellation sign was present in all patients with UHLFC but in none of the remaining patients. Calculated sensitivity and specificity for the detection of UHLFC with this sign were 100% (95% CI: 69.1-100%) and 100% (95% CI: 98.4-100%), respectively.
Conclusion: The presence of phase cancellation artifact around intra-hepatic vessels is a feature of UHLFC.

SS 2.04
The influence of lipid droplets on MRI diffusion parameters: results in phantoms and patients with liver steatosis
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Purpose: To assess if lipid droplets in lipid-based phantoms and patients with liver steatosis influence the diffusion parameters measured with diffusion-weighted MR imaging (DWI).
Material and Methods: Lipid-based phantoms with different concentrations of fat, and thirty-three patients with or without liver steatosis were evaluated with DWI. All patients had previous liver biopsy. Multi-b, free-breathing DWI images were obtained at 1.5T with a spin-echo EPI sequence (TR/TE = 305/56 ms, 3 transverse slices, 4mm slice thickness, b = 0, 10, 20, 30, 40, 50, 75, 100, 150, 300 and 500 s/mm^2, scan duration of 3 min 30s). Measurements of perfusion fraction (DCfast), pure diffusion fraction (DCslow), pure diffusion coefficient (ADCslow) and conventional ADC (ADCconv) were blindly performed by one observer for each DWI acquisition.
Results: In the phantom evaluation, we observed a strong correlation between ADCconv and the lipid fraction ($p < 0.0001$, $r = -0.972$). Patients with steatosis had significantly lower ADCslow than non-steatotic patients (with steatosis: ADCslow 0.959×10^{-3} mm^2/s; without steatosis: 1.101×10^{-3} mm^2/s; $p = 0.024$).
Conclusion: Lipid droplets restrict the apparent diffusion in lipid-based phantoms and in patients with liver steatosis.

SS 2.05
Fat-fibrosis correlation with acoustic radiation force impulse: are larger patients prone to high variability in elastography readings?
M. Jagtiani Sangwaiya, D. Sherman, P. Bassett, P. Shorvon; London/UK

Purpose: Experience with ultrasound elastography to date has indicated that obesity limits the usefulness of the technique. The aim of this study was to determine if patients with larger amounts of subcutaneous fat on ultrasound (and thus, large body habitus) are more prone to variable elastography scores with the more recent introduction of acoustic radiation force impulse (ARFI) ultrasonography.
Material and Methods: Sixty-four consecutive patients scanned for chronic liver disease from January 2010 through July 2010 by ARFI (24 females:40 males, mean age 49 years, age range 22-81 years) were identified retrospectively. For each patient, the age, gender, mean ARFI fibrosis score and standard deviation and subcutaneous fat depth were recorded. Statistical correlation tests were performed to assess correlation (if any) between the variability of reading with the depth of the patient's subcutaneous fat and also the depth of measurement.
Results: Correlation between the mean ARFI score and subcutaneous fat is 0.001. The r value for correlation between the standard deviation of ARFI score and subcutaneous fat was 0.13, while the r value for correlation of depth of measurement and standard deviation of ARFI was 0.1. However, the depth of measurement and subcutaneous fat depth were correlated by a r value of 0.55.
Conclusion: No correlation was identified between the variation of elastography score (standard deviation) and the subcutaneous fat depth while measuring liver stiffness by ARFI.

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SS 2.06

Cross-validation of MR elastography and ultrasound transient elastography in liver stiffness measurement

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Purpose: To evaluate individual differences in liver stiffness measurement using both magnetic resonance elastography (MRE) and ultrasound transient elastography (UTE) in patients with chronic liver disease.

Material and Methods: This study included 80 patients with chronic liver disease who underwent both UTE and MRE. MRE and UTE were performed using a pneumatic driver (60 Hz) and an ultrasound probe with a vibrator (50 Hz), respectively. Liver stiffness data measured using the 2 techniques (μ_{UTE} and μ_{MRE}) were compared with respect to shear modulus. The patients were subdivided into 4 quartiles on the basis of average of the μ_{UTE} and μ_{MRE} values for each patient.

Results: The analysis of the 4 quartile groups revealed that μ_{UTE} was significantly higher than μ_{MRE} in the 2 most stiff liver groups: μ_{UTE} vs. μ_{MRE}, 7.5 (1.2) vs. 6.0 (0.72) kPa for the group with $[\mu_{UTE} + \mu_{MRE}]/2$ of 5.6–8.0 kPa; 15.1(4.2) vs. 6.7 (1.4) kPa for the group with >8.0 kPa. However, in the least stiff liver group (i.e., the group with $[\mu_{UTE} + \mu_{MRE}]/2 < 3.2$ kPa), μ_{UTE} was significantly lower than μ_{MRE}.

Conclusion: The shear modulus measured by UTE and MRE are not equivalent, especially in patients with stiff livers.

SS 2.07

Elastography immediately prior to biopsy: comparison of acoustic radiation force impulse scores with histology

M. Jagtiani Sangwaiya, D. Sherman, P. Bassett, P. Shorvon; London/UK

Purpose: Studies comparing elastography with liver biopsy often use data not acquired at the same time or from the same liver site. The aim of this study was to compare acoustic radiation force impulse (ARFI) scores in patients with chronic liver disease and concomitantly acquired biopsy specimen scores from the same liver position.

Material and Methods: As part of an ongoing study, patients (n=32; F:M 11:21) who underwent ultrasound-guided liver biopsy for chronic liver diseases, performed by a consultant radiologist with a specialist interest in liver imaging, were assessed. All patients underwent ARFI scoring immediately prior to biopsy in the same anatomical region. All histopathologic reports were queried for pathological scoring of the acquired specimen. Any correlation between ultrasound and pathology scores was evaluated.

Results: Data for 24 (F:M 8:16, mean age 47 ± 12 years) patients were available at the time of submission of this abstract. The mean elastography score was 2 ± 0.8. Mean depth of readings was 3.7 ± 0.75 cm and the mean subcutaneous fat depth was 1.9 ± 0.55 cm. The r value for correlation between pathology (ISHAK) and ARFI score was 0.37.

Conclusion: A weak correlation between the pathology and ARFI scores was calculated. Ultrasound may be used as an adjunct to histopathology and serum investigations. Histopathology as a gold standard should be used with caution. A larger study is required to compare ARFI results with same sitting biopsy results.

SS 2.08

Are T2*, MR elastography and 31P MR spectra surrogate markers for liver fibrosis staging in hepatitis C infection?

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Purpose: To assess whether hepatic T2* measurements, MR elastography stiffness and 31P spectra correlate with fibrosis stage determined on histopathological analysis of liver biopsy samples and can therefore be used as non-invasive methods for liver fibrosis staging.

Material and Methods: Twenty-six patients underwent an MRI examination (including multi-echo gradient echo, MR elastography and 31P MR spectroscopy sequences) and liver biopsy on the same day. An experienced liver pathologist provided fibrosis staging using the Ishak fibrosis score (0–6). The T2* measurements of the liver, MR elastography stiffness data and the 31P spectra were plotted versus the ISHAK fibrosis stage in scatter plots from which r^2 values were calculated.

Results: Histopathological analysis of the biopsy samples showed the following results: ISHAK stage 0: 3 patients, stage 1: 3 patients, stage 2: 8 patients, stage 3: 7 patients, stage 4: 2 patients, stage 5: 2 patients and stage 6: 1 patient. We found a good correlation between MR elastography stiffness and fibrosis stage (r^2: 0.67); no apparent correlation was found between the T2* (r^2: 0.04) or 31P spectra (PME/PDE ratio) ($r^2 < 0.001$) and the fibrosis stage.

Conclusion: Our results show that liver stiffness measured by MR elastography is the most promising non-invasive marker of liver fibrosis in patients with hepatitis C infection.

SS 2.09

Pattern analysis of spontaneous volume changes of well-compensated cirrhotic liver: CT volumetry evaluation with laboratory correlations

M.J. Park, Y. Kim, H. Kim, S.J. Lee, H.K. Lim; Seoul/KR

Purpose: To elucidate the pattern of spontaneous parenchymal volume changes of well-compensated cirrhotic livers using CT volumetry and to evaluate which liver function test significantly reflects such changes.

Material and Methods: Twenty patients (M:F = 16:4, mean age 54.1) with Child-Pugh class A, biopsy-confirmed liver cirrhosis who underwent long-term MDCT follow-up (>4 years and >3 times/year) were retrospectively enrolled. We performed 340 CT volumetric measurements of hepatic parenchyma (excluding IVC and hepatic vessels >5mm) using semi-automatic segmentation method and analyzed their patterns. We also investigated correlations between volume changes and liver function tests (within 3 days of CT) by performing the analysis using mixed model to consider random effects between subjects.

Results: CT follow-up period was 59.7 ± 5.0 (49.7-68.1) months with 3.7 ± 0.6 (1.6-5.3) months intervals. Hepatic parenchymal volume measured from all CTs was 1208.0 ± 213.0 mL. All livers showed undulating patterns of volume change (cycle 13.2 ± 4.6 months; maximum amplitude 240.5 ± 94.7mL [19.9 ± 7.2% of mean volume]). At the end of evaluation period, liver volume decreased in 40% (8/20, -61.2 ± 55.3 mL from baseline), however increased in 60% (12/20, 145.2 ± 125.5 mL). Among liver function tests, only serum total bilirubin ($p = 0.003$) revealed to be inversely correlated with liver volume changes.

Conclusion: Volume of well-compensated cirrhotic liver undulates with a cycle of approximately one year. Liver volume does not always decrease over a long-term follow-up. Among liver function tests, only serum total bilirubin reflected such undulating volume changes significantly.

SS 2.10

MR imaging in patients with extrahepatic biliary atresia and Kasai hepatoportoenterostomy: a prospective cohort study

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Purpose: Extrahepatic biliary atresia is characterized by complete fibrotic obstruction of the extrahepatic bile ducts. Kasai hepatoportoenterostomy (HPE) is the initial treatment of choice. The long-term morbidity of patients without liver transplantation is yet unknown. The aim of our study was to evaluate the extend of hepatic changes using MR imaging.

Material and Methods: Between 1977 and 1986, HPE was performed in 71 children nationwide, of which 28 patients were alive in 2006. Sixteen patients (22.5%) did not undergo liver transplantation. These patients were contacted for participation, and 8 patients (5 females, 3 males) consented. Clinical analysis including serum blood samples and dynamic contrast-enhanced MR imaging were performed.

Results: Mean age was 21.8 years (20-24 years). All patients had elevated liver enzymes. MRI demonstrated extensive macronodular liver cirrhosis in all patients, with severe portal hypertension in 7 patients. Intrahepatic bile duct dilation was noted in 4 patients. In one patient a large focal lesion (10.2 cm) was detected, with imaging characteristics consistent with HCC. This patient was successfully treated by liver transplantation.

Conclusion: MR imaging is the imaging modality of choice in the evaluation of patients with Kasai hepatoportoenterostomy, since the spectrum of hepatic changes consists of extensive cirrhotic changes including portal hypertension, intrahepatic bile duct dilation and hepatocarcinogenesis.

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11:15 -12:45 **Sala Laguna**

Scientific Session 3

Rectal cancer: characterization and treatment response (Tube 1)

SS 3.01

Can we identify the peritoneal reflection at rectal MRI?

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Purpose: To assess the ability of readers to identify the PR, an important landmark in treatment decisions, on rectal MRI.

Material and Methods: This retrospective, IRB approved, two-center study included 207 randomly chosen patients with rectal cancer undergoing pelvic MRI. Two experienced GI radiologists independently analyzed sagittal and axial T2 weighted MR images to identify the anterior PR and its distance from the anorectal junction (ARJ) on a five-point confidence scale. Tumor sizes and distances from the ARJ and the PR were also recorded.

Results: Two-hundred seven MRI were analyzed. The PR was confidently seen in between 75 and 83% cases. The mean distance to the PR from the ARJ was 68.3 mm (Reader 1) and 66.7 mm (Reader 2, intra-class correlation coefficient [ICC] = 0.833). Mean tumor length was 55.0 mm (Reader 1) and 53.1 mm (Reader 2, ICC = 0.868). Readers 1 and 2 agreed more on tumor distance from the PR (k = 0.706), than on the distance of tumor from the ARJ (k= 0.424).

Conclusion: The peritoneal reflection was identified by 2 experienced GI radiologists in the majority of rectal MRI. Greater agreement was found in the relationship between tumors and the PR than in their distance above the anorectal junction, likely reflecting intrinsic anatomic variation between patients.

SS 3.02

Reproducibility of dynamic contrast-enhanced magnetic resonance imaging (MRI) and dynamic contrast-enhanced computed tomography (CT) of primary rectal cancer

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Purpose: Dynamic contrast-enhanced (DCE)-MRI and DCE-CT may both assess tumor angiogenesis. No direct comparison of reproducibility has been undertaken to date. The aim was to evaluate their reproducibility in primary rectal cancer.

Material and Methods: Following ethical approval, 12 patients underwent DCE-MRI and vDCE-CT to derive K^{trans}, v_e, and $AUGC_{60}$ (DCE-MRI); and BF, BV and FE (vDCE-CT). Imaging was repeated within 48 hours, and analysed by two readers. Reproducibility was assessed using Bland-Altman statistics.

Results: DCE-MRI: K^{trans} mean difference, 95% limits of agreement, and wCV for repeat studies were 0.0066, -8.47 to 9.25, and 11.7 (Reader One); 0.0115, -9.3 to 10.3, and 13.0 (Reader Two). v_e mean difference, 95% limits of agreement, and wCV were 0.16, ï,±10.4 and 12.9 (Reader One); and -0.04, ï,±9.1 and 11.4 (Reader Two). $AUGC_{60}$ mean difference, 95% limits of agreement, and wCV were -0.58, -9.2 to 10.2 and 12.9 (Reader One); and -0.28, -10.1 to 11.2, and 14.2 (Reader Two). DCE-CT BF: mean difference, 95% limits of agreement, and wCV for repeat studies were 1.48, -6.57 to 7.04, and 8.5 (Reader One); 4.27, ï,±9.3, and 11.1 (Reader Two). BV mean difference, 95% limits of agreement, and wCV were -1.74, ï,±15.6, and 18.6 (Reader One); -1.29, ï,±21.0, and 25.2 (Reader Two). FE mean difference, 95% limits of agreement, and wCV were 5.36, -15.7 to 18.6, and 22.6 (Reader One); 6.49, -17.8 to ,and 21.6 (Reader Two).

Conclusion: Reproducibility was similar for both modalities.

SS 3.03

Diffusion-weighted magnetic resonance imaging in rectal cancer: apparent diffusion coefficient as a potential non-invasive marker of tumor aggressiveness

L. Curvo-Semedo[1], D.M.J. Lambregts[2], M. Maas[2], T. Thywissen[2], R.G. Riedl[2], G. Beets[2], F. Caseiro-Alves[1], R.G.H. Beets-Tan[2]; [1]Coimbra/PT, [2]Maastricht/NL

Purpose: To assess the usefulness of diffusion-weighted imaging (DWI) as a potential non-invasive marker of aggressiveness in rectal cancer, by analyzing the relationship between the apparent diffusion coefficient (ADC) values of tumors and several prognostic clinical and histological parameters.

Material and Methods: Fifty rectal cancer patients underwent primary staging MRI including DWI (b0, 500, 1000). All received surgery with histological analysis of the surgical specimen. Oval-shaped ROIs were placed over the tumor ADC map to obtain mean pre-treatment ADC values. Correlation between ADC values and CEA levels and tumor-to-fascia distance at primary staging was investigated. Differences between the mean tumor ADCs of the following pre-treatment groups were tested: CEA <5mg/mL vs. ≥5mg/mL and cT1-2 vs. cT3-4; cN0 vs. cN+; CRM-free vs. CRM-invaded (as determined on primary staging MRI). Differences in tumor ADCs of the following histological subgroups were also investigated: lymphovascular invasion (LVI) absent vs. LVI present; differentiation grade (DG).

Results: Pearson coefficient (r) was -0.191 (p = 0.208) and 0.374 (p = 0.019) for the correlation between pre-treatment ADC values and CEA levels and tumor-to-fascia distance, respectively. Mean tumor ADCs were significantly different between cN0 vs. cN+ (p = 0.011), CRM-free vs. CRM-invaded (p = 0.013) and DG (p = 0.025).

Conclusion: A profile of higher tumoral aggressiveness was associated with lower ADC values. Significant correlations were found between ADC and CRM status, tumor-to-fascia distance, N-stage and histological differentiation grade. ADC has the potential to become a non-invasive marker of rectal cancer aggressiveness.

SS 3.04

Changes in tumor oxygenation in primary rectal cancer using intrinsic susceptibility weighted-MRI

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Purpose: Intrinsic susceptibility weighted (ISW)-MRI informs on the hypoxic blood volume and may be used to assess tumor oxygenation alterations induced by treatment. The aim was to assess changes in R2* with chemoradiation in rectal cancer.

Material and Methods: Following IRB approval, 10 prospective patients with rectal cancer underwent multiecho ISW-MRI at 1.5-tesla (Avanto, Siemens) before and after chemoradiation: TR 100ms, TE 4.76 to 61.93ms. NEX2, FOV260, matrix256, 6 slices, SW 5mm. R2* values were derived by ROI analysis using proprietary software (ICR, London, UK). Signal changes on ISW-MR images were used to calculate intrinsic T2* relaxivity. R2* values were calculated on a pixel-by-pixel basis from a straight line fitted to a plot of signal intensity against TE using a least squares approach; the gradient is -R2*. Voxels with either negative or zero values were excluded. R2* values were compared using t-test; significance at 5%.

Results: Mean (SD) tumor R2* was 26.17 (5.36) sec-1 before and 23.37 (3.31) sec-1 immediately after chemoradiation, a mean reduction of 12.6% (p = 0.07), indicating a reduction in hypoxic blood volume with treatment, unlike the increases seen with chemotherapy. In 4 patients there was a 25% or greater reduction in R2*. 1 patient had a 15% increase in R2*, not related to artefact.

Conclusion: ISW-MRI demonstrates a decrease in R2* with chemoradiation. This may reflect improvement in tumor oxygenation and/or oedema following treatment.

SS 3.05

Dynamic contrast-enhanced mr evaluation of rectal cancer before, during and after neoadjuvant treatment

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Purpose: To identify the effects of chemoradiation therapy on tumour vascularization performing dynamic contrast-enhanced magnetic resonance (D-CE-MR).

Material and Methods: We enrolled 18 patients (pts) with locally advanced rectal cancer. For each patient D-CE-MR was obtained before, during and after the neoadjuvant treatment by 1.5 T system. Computer-aided quantitative analysis was performed by a system developed in MATLAB for the contrast enhancement analysis. Basing on MR findings pts were divided into two groups: pts who underwent downstaging (responders), and pts who did not undergo downstaging (non-responders).

Results: The analysis of numerical values of the local peak intensity (LPI) provided by the software according to the area under curve (AUC) showed the same statistical significant difference before, during and after treatment in healthy and pathological tissue. An increase of LPI was observed during treatment as compared to the pre-treatment phase, for healthy and for pathological tissue; on opposite, LPI in both healthy and pathological tissue showed a post-treatment decrease as compared to pre-treatment and during treatment LPI. The responders group showed 48% increase of LPI with respect to LPI before treatment; on opposite, the non-responders group showed 18% decrease of LPI compared to LPI before treatment.

Conclusion: Tumor response more likely occurs in pts who report higher LPI values on D-CE-MR analysis during treatment with respect to pre-treatment.

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SS 3.06

Clinical impact of imaging for restaging rectal cancer after preoperative chemoradiation

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Purpose: To determine the accuracy of different imaging techniques in predicting local staging and the circumferential resection margin (CRM) status of rectal cancers (RC) after preoperative chemoradiotherapy (CRT).

Material and Methods: We prospectively assessed 132 patients with locally advanced mid-to-low RC using CT, MRI and endorectal ultrasound (ERUS). 93 patients were studied with both MRI and ERUS. Post-CRT local staging and infiltration of CRM were compared with histopathology.

Results: The overall concordance rate between CT (n = 98) and histopathology findings was 33%. Because of these disappointing results, this part of the study was discontinued. Unfortunately, the accuracy of T staging was low also using MRI (35%) and ERUS (33%). Grouping mural stage into ypT≤3 and ypT4 categories imaging showed high specificity and negative predictive value (NPV); particularly MRI achieved 92% specificity and 95% NPV. The accuracy of N staging was 67% and 65% for ERUS and MRI, respectively; the corresponding NPV were 75% and 78%. The specificity and NPV for the CRM involvement were 80% and 96%, respectively, for MRI.

Conclusion: Current imaging techniques are unreliable for RC restaging purposes after CRT, but are useful in predicting T≤ 3 RC and RC with negative nodes and CRM. These findings may be of clinical relevance for planning less invasive surgery.

SS 3.07

Accuracy of gadofosveset-enhanced 3D T1W MRI for T-stage prediction after chemoradiation for rectal cancer

M. Maas, G. Beets, D.M.J. Lambregts, U. Lalji, R.G.H. Beets-Tan; Maastricht/NL

Purpose: Accurate selection of a rectal tumour confined to the bowel wall after CRT (ypT1-2) could select patients for local excision without compromising the risk for local recurrence. Goal of this study was to evaluate diagnostic performance at gadofosveset-enhanced T1W-MRI for selecting ypT1-2 tumours compared to T2W-MRI.

Material and Methods: 50 patients with locally advanced rectal cancer underwent 2DT2W-FSE-MRI (in 3 planes) and axial gadofosveset-enhanced 3DT1W-GRE-MRI before and 6-8 weeks after CRT. All patients underwent surgery after the 2nd MRI. An abdominal radiologist predicted yT-stage at T2W-MRI and at ce-T1W-MRI (after a 2-week interval). After another 2-week interval the T2W and ce-T1W images were scored simultaneously. With the ce-T1W-images multiplanar reformatting was used. Patient order was randomised between every reading. Likelihood of yT1-2 was scored using a confidence level score (0 = definitely outgrowing wall to 4 = definitely confined to wall). Histology was gold standard. ROC-analyses were performed to compare diagnostic performance.

Results: Area under the ROC-curve (AUC) was 0.68 (0.53-0.83) at T2W, 0.70 (0.55-0.85) at ce-T1W and 0.75 (0.61-0.90) at T2W+ce-T1W images. Corresponding sensitivity and specificity are: 61% and 62% for T2W, 82% and 57% for T1W and 86% and 52% for ce-T1+T2W.

Conclusion: The addition of gadofosveset-enhanced 3DT1W GRE imaging improved radiologist's performance for selecting tumors limited to the bowel wall after CRT. Strikingly, ce-T1W images only already achieve similar accuracy as T2W alone. Enhancement with gadofosveset might help to more accurately select tumours confined to the rectal wall after CRT.

SS 3.08

Response of rectal cancer to preoperative chemoradiation therapy: a comparison between MR volumetry assessed on T2-weighted and diffusion-weighted images

L. Curvo-Semedo[1], D.M.J. Lambregts[2], M. Maas[2], R. Mehsen[2], G. Lammering[2], G. Beets[2], F. Caseiro-Alves[1], R.G.H. Beets-Tan[2]; [1]Coimbra/PT, [2]Maastricht/NL

Purpose: To assess whether volume measurements on diffusion-weighted images (DWI) are accurate for the assessment of complete response (CR) after chemoradiation treatment (CRT) in patients with locally advanced rectal cancer (LARC) and to compare them with conventional T2-weighted (T2W) MR volumetry (MRV).

Material and Methods: Fifty patients with LARC underwent pre- and post-CRT MRI. Histology (ypT0) was the standard reference. Free-hand ROIs were used to calculate pre-CRT tumor volume, post-CRT tumor volume and tumor volume reduction rate (Δ volume) on both datasets (T2W and b1000 DWI). ROC curve analysis evaluated their accuracy in detecting CR and differences were analyzed by comparing areas under the ROC curves (AUC). The intraclass correlation coefficient (ICC) between measurements on T2W and DWI was assessed on pre- and post-CRT images.

Results: AUCs for identification of CR based on pre-volume, post-volume and volume were 0.54, 0.68 and 0.79 for T2W versus 0.64, 0.91 and 0.91 for DWI, respectively. Diagnostic performance for post-CRT volume was significantly better for DWI (p = 0.03) than for T2W. The ICC between tumor volume on T2W and DWI was 0.98 and 0.32 (pre- and post-CRT, respectively).

Conclusion: MR volumetry based on high b-value DWI, specifically the volume reduction measurements (Δ volume) after CRT and volume measurements on post-CRT DWI, is very accurate and superior to those performed on T2W for identification of a complete response after CRT for locally advanced rectal cancer.

SS 3.09

Apparent diffusion coefficient for assessment of post-treatment tumor response in locally advanced rectal cancer 8 weeks after chemoradiotherapy

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Purpose: To evaluate apparent diffusion coefficient (ADC) as a marker of response to neoadjuvant chemoradiotherapy (CRT) in patients with rectal cancer.

Material and Methods: Twenty-eight patients with non-mucinous rectal adenocarcinoma treated with CRT and surgery were enrolled. All patients underwent pre and 8-week after CRT 3.0T conventional MRI plus DWI (six b values from 0 to 1000 s/mm^2). Pre- and post-CRT ADC values were compared. Pathologic reports (Mandard's classification) served as reference standard. Patients with tumor regression grade (TRG) of I or II were considered as responders, whereas patients with TRG of III, IV, or V as non-responders.

Results: After CRT, the mean ADC significantly increased in all patients, irrespective of tumor response (P = 0.001). Before CRT, the mean ADC of responders was lower than those of non-responders (P = 0.33). After CRT, the mean ADC of responders was significantly higher than those of non-responders (P = 0.003). The mean %ADC increase in responders (77.2) was significantly greater than that of non-responders (36.0) (P = 0.05). The best post-CRT mean %ADC increase cut off to differentiate responders from non-responders with ROC curve analysis was 29.5%. Negative correlation was observed between mean %ADC increase rate and TRG after CRT (rho = -0.69; P = 0.0063).

Conclusion: 8-week post-CRT ADC can reliably assess tumor response. The mean %ADC increase rate seems to be a reliable tool to differentiate responders from non-responders.

SS 3.10

Assessment of texture changes in primary rectal cancer following neoadjuvant chemoradiation

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Purpose: CT texture provides information on tumor heterogeneity. The aim was to assess the changes in tumor texture following chemoradiation in rectal cancer.

Material and Methods: Following IRB approval, 14 prospective patients (10 males, 4 females, mean age 67.1 years) with rectal cancer underwent contrast-enhanced CT (dual source CT, Siemens Definition). Texture parameters (entropy (irregularity) and uniformity (distribution of gray level)) were determined at mid rectal tumor level using proprietary software (TexRAD, University of Sussex). Filter levels (unfiltered, 1.0, (fine) 1.5, 1.8 (medium) , 2.0 and 2.5 (coarse texture) were applied and normalized to define features at different spatial scales. Mean (SD) for entropy and uniformity was recorded. Texture changes were compared using t-test; statistical significance at 5%.

Results: 12 of 14 patients had a post-treatment CT. Baseline mean (SD) of entropy and uniformity were 1.02 (0.74), 1.27 (0.39), 1.38 (0.37), and 1.81 (0.77); and 1.17 (0.25), 0.87 (0.10), 0.82 (0.09), and 0.73 (0.06), respectively, at the following filter ratios: 1.0/1.5, 1.0/1.8, 1.0/2.0, and 1.0/2.5. Following chemoradiation, mean entropy and uniformity changed by +1.97, -1.17, -0.34, +4.04%; and +2.29, -2.58, -4.03 and -9,77%, respectively, at same filter ratios. This was statistically lower for uniformity at 1.0/2.5 filter ratio (p = 0.0088) but not for entropy.

Conclusion: CT uniformity but not entropy decreases following chemoradiation.

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11:15 -12:45 **Sala Feste**

Scientific Session 4

Upper GI-tract imaging (Tube 2)

SS 4.01

Role of MR-fluoroscopy with high-speed kinetic sequences in multiple swallowing disorders of oro-esophageal tract and gastro-esophageal junction

I. Sansoni, R. Alloni, C.L. Piccolo, C.A. Mallio, I. Di Giampietro, R. DelVescovo, R. Coppola, B. Beomonte Zobel; Rome/IT

Purpose: To evaluate the capability of high-speed kinetic MR sequences in defining upper and lower swallowing disorders.

Material and Methods: 33 patients (10 M, 23 F) with various oro-esophageal and gastrooesophageal disorders underwent MR examination on 1.5 Tesla magnet equipped with high performing gradients. Anatomical BH GRE unspoiled T1-w and HASTE T2-w sequences were acquired on multiple planes in order to define the anatomic details (f.e. Nissen fundoplication position above or below diaphragmatic plane). We evaluated visualization of oesophageal bolus transit, bolus transit-time, peristalsis, gastrooesophageal junction patency and competency during oral administration of contrasted yogurt.

Results: MR-fluoroscopy provided useful information regarding bolus propulsion from oesophagus to stomach. MR-fluoroscopy imaged swallowing abnormalities in 31/33 patients: 3 upper motility disorder, 8 achalasia, 1 megaoesophagus, 2 para-esophageal Hjatal Hernia, 7 gastro-esophageal reflux (2 of those with sliding Hiatal Hernia), 12 after Nissen-fundoplication, 1 after gastrectomy. MR findings well correlated with other different instrumental examination findings.

Conclusion: High-speed kinetic MR-fluoroscopy is a useful and complementary tool for evaluating oro-esophageal deglutition process and gastro-esophageal junction alterations. In symptomatic subjects after Nissen fundoplication, it can detect antomic and motility alterations, providing additional information useful in diagnostic work-up. MR-fluoroscopy is radiation-free able to evidence swallowing disorder, with no time of observation limit characteristic of tools employing ionizing radiations. It is simple, non-invasive, rapid and well-tolerated for diagnosing GE reflux or motility disorders, but deserves further investigations.

SS 4.02

Agreement of ultrasound with endoscopy for evaluation of upper GI pathology

A. Mishra, E.F. Ehtuish; Tripoli/LY

Purpose: Ultrasound is a promising, non-invasive, readily available imaging technique for evaluation of hollow viscera like stomach. Agreement of ultrasound vs. the current 'gold standard' - endoscopy – has not been evaluated for assessing gastroduodenitis yet.

Material and Methods: 460 patients with epigastric pain underwent ultrasound and endoscopy. Both operators were blinded to the respective findings. The findings were tabulated in a standard format. Stomach was adequately distended with oral water prior to ultrasound. Gastric antral wall >5 mm was assumed thickened which was evaluated for symmetry as circumferential/asymmetric and focal/diffuse distribution. Gastric body and fundus were not assessed on ultrasound. The results were compared to assess agreement coefficient between two modalities. All ultrasound and endoscopy examinations were performed by same personnel.

Results: Diffuse circumferential gastric antral wall thickening was seen in 78.2%(n = 360). Focal symmetric thickening was seen in antrum (18.4%) and pylorus (16%). Focal asymmetric thickening was seen in 2.8% patients which were biopsied during endoscopy. Duodenal wall thickening was seen in 58.4% (n = 269) patients. Non-neoplastic pathology (gastritis/ulcer/fibrosis) was diagnosed in 71.3% (n = 328) on endoscopy and duodenitis in 54.6% (n = 251). 3 patients were proven gastric cancer after biopsy. The sensitivity, specificity, PPV and NPV for ultrasound were 92.1%, 76.5%, 91.1% and 78.8%, respectively.

Conclusion: Ultrasound and endoscopy show excellent agreement for evaluation of gastric/duodenal wall thickening indicating upper GI pathology provided the viscus is adequately distended, albeit a steep learning curve for ultrasound.

SS 4.03

The role of computed tomography with volumetric analysis in secondary treatment planning after gastric bypass surgery

T. Baumann, G. Pache, E. Kotter, S. Küsters, W.K. Karcz, M. Langer; Freiburg/DE

Purpose: Bariatric surgery is a rapidly growing field. Secondary surgical procedures, however, are sometimes necessary to achieve sufficient weight-loss. It was the purpose of this study to evaluate the role of computed tomography (CT) in surgical treatment planning.

Material and Methods: Forty-two patients after Roux-en-Y gastric bypass (RnYGB) were considered for secondary surgery due to insufficient weight-loss (n = 21, group 1) or late complications (n = 21, group 2). These patients underwent abdominal CT after application of oral contrast and an antiperistaltic agent. Thin-slice datasets were evaluated for pouch volume, area of the gastroenterostomy, and volume of the proximal Roux-limb. A multidisciplinary team (MDT) decided on further surgical treatment.

Results: With 67.7ml compared to 32.2ml and 5.7cm^2 compared to 2.9cm^2 pouch volume and the area of the gastroenterostomy were significantly higher in group 1, respectively ($p < 0.05$). Eighteen patients from group 1 were subjected to secondary surgery. In 5 patients gastric restriction was fortified by banded RnYGB; 10 patients received malabsorptive secondary procedures. Banded RnYGB patients exhibited larger pouches (148.6ml vs. 52.3ml; $p = 0.006$) but normal dimensions of the Roux-limb, whereas malabsorption was commonly introduced in patients who showed a combined dilation of the gastroenterostomy and the Roux-limb.

Conclusion: Pouch dilation and widening of the gastroenterostomy are common findings in cases of insufficient weight-loss after RnYGB. Extreme pouch dilation combined with normal dimensions of the Roux-limb might support an MDT decision for further restrictive treatment options.

SS 4.04

320-row CT virtual gastroscopy: differential diagnosis between benign and malignant ulcers

M. Moschetta, A.A. Stabile Ianora, F. Cazzato, V. Lorusso, A. Scardapane, G. Angelelli; Bari/IT

Purpose: This study aims to assess the diagnostic accuracy of virtual gastroscopy obtained by 320-row CT examination in differentiating benign from malignant gastric ulcers.

Material and Methods: 29 patients (18 M, 11 F, mean age 58.4) with endoscopic and histological diagnosis of gastric ulcer underwent CT examination. A hypotonizing drug was administered and gastric walls were distended by air in order to perform virtual endoscopy. Basing on morphological features, gastric ulcers were subdivided into benign or malignant forms by two blinded radiologists. Interobserver agreement was evaluated using Cohen's kappa (k) test. CT results were then compared with endoscopic and histological findings, having the latest as the reference standard.

Results: 21 out of 29 patients (72%) were affected by malignant ulcers, while in the remaining 8 cases diagnosis of benign gastric ulcer was made. Virtual gastroscopy shown diagnostic accuracy, sensitivity and specificity values of 93%, 90% and 100%, respectively, in differentiating benign from malignant ulcers. Almost perfect agreement between the two readers was found (k = 0.86).

Conclusion: CT virtual gastroscopy improves the identification of gastric ulcers and allows to differentiate benign from malignant forms.

SS 4.05

Diagnostic performance for gastric cancer detection of three different reconstruction techniques using MDCT compared with 2D axial CT

J.H. Kim, H.W. Eun, S.S. Hong, J.K. Han, B.I. Choi; Seoul/KR

Purpose: To assess diagnostic performance for gastric cancer detection of three different reconstruction techniques compared with 2D axial CT.

Material and Methods: During 7 months, we performed CT of 104 patients with gastric cancer (EGC = 63) and control group (n = 35). Two radiologists retrospectively and independently interpreted the axial CT and three different reconstruction techniques; multiplanar reformation(MPR), transparent image(TI), and virtual gastroscopy(VG). They graded the presence or absence of gastric cancer and, if present, assess its location. Diagnostic performances were compared using the area under the ROC curve (Az) in gastric caner and EGC. Sensitivity and specificity were also calculated. The statistics was used to determine interobserver agreement.

Results: The diagnostic performances for gastric cancer detection were as follows: 2D-axial (Az = 0.858); MPR (Az = 0.879); TI (Az = 0.873); VG (Az = 0.928). VR was better in performance than 2D axial CT ($p = 0.016$). The sensitivity and specificity were as follows: 76.7% and 82.9% in 2D-axial; 79.6% and 85.7% in MPR; 91.3% and 80% in TI; 95.1% and 74.3% in VG. The interobserver agreement showed substantial (= 0.67-0.75). In EGC, the diagnostic performances for detection were as follows: 2D-axial (Az = 0.777); MPR (Az = 0.811); TI (Az = 0.825); VG (Az = 0.896). VR was better in performance than 2D axial CT ($p = 0.006$) and MRP ($p = 0.038$). The sensitivity and specificity were as follows: 62.9% and 82.9% in 2D-axial; 67.7% and 85.7% in MPR; 85.5% and 80% in TI; 91.9% and 74.3% in VG.

Conclusion: Among three different reconstruction techniques, virtual gastroscopy accurately detects gastric cancer, especially useful for EGC, compared with 2D axial CT.

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SS 4.06

Clinical application of dynamic 320-row multidetector computed tomography for identifying preoperative staging of gastric cancer

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Purpose: To evaluate accuracy of the novel dynamic scanning technique using 320-detector-row CT to determine the preoperative staging of gastric cancer.
Material and Methods: 49 patients with gastric cancer were included. MDCT was performed on 320-detector-row scanner (AquilionONE,Toshiba) with 16-cm width detector and the possibility of volume scanning (obtaining images of whole stomach in the dynamic mode). After native scanning 18 volumes at 3-4 seconds interval (total 53sec) with administration of 90ml Omnipaque 350mgI/m were performed with slice thickness 0.5mm, 100kV, 250mA. Postprocessing included multiplanar reformation and construction of dynamic video. All patients underwent surgery.
Results: The sensitivity (SE) of MDCT in detecting gastric cancer was 96%, specificity(SP) 100%. Accuracy in determining the T-stage was on average 63% (14-77% for T1-T4stage). In 2 cases T1-tumor was not been detected. The gastric wall thickness is closely correlated with depth of invasion ($r = 0.54$, $p = 0.0001$). The SE of MDCT in detecting metastatic lymph nodes was 96%, SP91%. Accuracy for N-staging was 78%. The highest accuracy was detected for contrast-enhancement nodes (area under ROC-curve (AUC) 0.92, SE91%, SP91%), and size over 12mm (AUC0.82, SE63%, SP86%). In 5 patients tumor invaded the surrounding organs, which was accurately determined by MDCT.
Conclusion: MDCT-dynamic study provides a good opportunity to preoperative staging of gastric cancer.

SS 4.07

The value of gastric adenocarcinoma length by MDCT and MRI and correlation with clinical staging

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Purpose: Tumoral length is considered an important prognostic factor in gastric adenocarcinoma (GA) and MDCT and less commonly MRI have been used to stage the disease. The purpose of this study is to compare gastric cancer length (GCL) by MDCT and MRI, with the gold standard of pathologic evaluation and to clinical staging (CS) of GA.
Material and Methods: Sixty pathologic specimens of operated GA were reviewed between October 2008 and November 2010. To compare GCL by MDCT and MRI, a T-student test with data of 32 patients was performed. The comparison of GCL by pathology with MDCT and MRI was done with the Bland-Altman Test (21 and 30 patients, respectively). Finally, GCL by pathology was compared to the CS by histograms.
Results: Student's t test with a p-value of 0.705 excluded a statistical evidence of disparity between GCL by MDCT or MRI. With the Bland-Altman test the bias for GCL by MRI and MDCT vs pathology were - 4 mm and - 7mm, with limits of agreement of ±27 mm and ±18 mm, respectively. The histograms revealed that GCL larger than 5 and 8 cm corresponded, respectively, to a minimum CS of 2 and 3; GCL smaller than 2 cm had a CS inferior to 2.
Conclusion: GCL by MRI and MDCT are not statistically different and both are useful tools in the measurement and CS of GA.

SS 4.08

What you need to know in clinical use of contrast-enhanced PET/CT for GIST evaluation and follow-up

E. Biscaldi, D. Comandini, M. Iacozzi, A. Piccardo, G.A. Rollandi; Genova/IT

Purpose: To evaluate the effectiveness of contrast-enhanced (CE)-PET/CT (MultidetectorCT, 16 rows) in GIST management, after 6 years of a retrospective experience with a group of patients in follow-up at our oncologic centre.
Material and Methods: We studied 33 patients (aged 44-81, mean 64), affected by GIST. In 14 a MultidetectorCT (MDCT, 16 rows) study discovered the pathology at the beginning, in 19 a pretherapy CE-PET/CT was performed, in all patients the CE-PET/CT was used in follow-up after imatinib, sunitinib and in the absence of a targeted therapy. 22 patients were operated, at the onset and/or after relapses. 7 died after three years. The MDCT study alone was used in follow-up, every two negative PET/CTs. We compared MDCT and CE-PET/CT sensibility and specificity in detection of peritoneal relapses, of response during therapies (5 years), in liver metastases identification and monitoring. We evaluated when the CE-PET/CT modified the therapy of the patients, compared to MDCT alone.
Results: The overall sensibility of MDCT in relapse detection was 78%, the specificity 85%; for CE-PET/CT 85% and 94%; specificity in identification of liver metastasis modifications was higher (95vs83%) for CE-PET/CT. In 12 patients the CE-PET/CT never determined therapy changes, while it modified the therapy in 21 patients considering 49 examinations in 36 months. MDCT modified therapy in 14 cases only.
Conclusion: The CE-PET/CT is a reliable examination in GIST evaluation and follow-up. It improves the peritoneal lesions detection, their characterization during therapy and it allows an effective evaluation of the liver parenchyma. The CE-PET/CT is more effective than MDCT alone in GIST monitoring during the follow-up.

SS 4.09

Comparison of the new Choi CT response patterns to the RECIST criteria with CT and MR in pts affected by GIST during molecular targeted therapy

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Purpose: Correlate new tumor response criteria (Choi criteria) to Recist in patients with GIST undergoing imatinib mesylate therapy (peculiar response with no decrease in size) These criteria have been demonstrated to correlate with patients' outcomes better than Recist criteria.
Material and Methods: 37 pts with advanced GIST underwent therapy with imatinib mesylate. All pts performed CT (16 slice) and MR (1,5T system) examinations at baseline and then at 2, 4, 6, 8, 10 and 12 months during the treatment. The radiological patterns that we used were: 1) changes in tumor size (according to RECIST criteria). 2) Tissue characteristics and changes in vascularization (according to Choi Criteria). MR/CT pattern in responsive patients, according to RECIST criteria, was tumor decrease in size. MR/CT pattern in responsive patients, according to the new Choi criteria, was the descrease of vascularization >15% on contrast enhanced evaluation.
Results: CT and MR show the same results. On morphologic evaluation, using dimensional criterion, 18/37 pts had a RECIST "partial response" , 9/37 pts had a RECIST "stable disease" and 10/37 pts had a RECIST "progression disease". On vascular evaluation 24/37 pts had "partial response pattern, 7/37 had "stable disease" pattern and 6/37 had "progression disease" pattern.
Conclusion: In GIST, new response assessment criteria proposed by H. Choi, incorporating not only tumor size but also changes in tumor density and vascularization following contrast enhancement, were shown to predict prognosis better than RECIST.

SS 4.10

Tumour response and clinical outcome in metastatic GI stromal tumour under sunitinib therapy: comparison of RECIST, Choi and volumetric criteria

N. Schramm, M. Schlemmer, C. Becker, M.F. Reiser, F. Berger; Munich/DE

Purpose: Purpose of the study was the comparison of RECIST, Choi and volumetric radiological response in GIST-patients under 2nd-line-sunitinib-therapy with correlation to disease-specific survival (DSS).
Material and Methods: 20 patients with baseline-CT of the abdomen under imatinib obtained follow-up-CTs 3 months and 1 year after change to sunitinib. Therapy response was evaluated according to RECIST, Choi and volumetric criteria (PR: decrease ≥40%, PD: increase ≥33%). The response categories, respectively, were: partial response (PR), stable disease (SD) and progressive disease (PD). Response according to the different assessment systems was correlated to the DSS of the patients.
Results: The mean DSS (in months) of the response groups 3 months after therapy change was: RECIST: PR (0/20); SD (17/20): 29.2 (months); PD (3/20) 11.6 Choi: PR (10/20) 27.9; SD (8/20) 26.4; PD (2/20) 13.5. Volumetry: PR (4/20) 29.7; SD (11/20) 28.4; PD(5/20) 17.2. Reponse groups after 1 year of sunitinib showed the following mean DSS: RECIST: PR (3/20) 33; SD (9/20) 28.2; PD (8/20) 20.3. Choi: PR (10/20) 21.3; SD (4/20) 39.6; PD(6/20) 23.9. Volumetry: PR (6/20) 27.0; SD (5/20) 35.9; PD (9/20) 19.3. Patients classified as PR after 1 year according to Choi and volumetry had a shorter DSS than patients classified as SD.
Conclusion: In our GIST-patient collective Choi and volumetric criteria could detect responders with prolonged survival time under sunitinib only in the early follow-up but not in the later course of disease. These results have to be verified in larger patient cohorts.

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11:15 -12:45 **Sala Mosaici 1**

Scientific Session 5
CTC 1 - protocol & reporting

SS 5.01
Dose optimization in CT colonography
G. Boehm, W. Schimetta, M. Gschwendtner; Linz/AT

Purpose: CT colonography is a modern imaging technique for colon assessment. To keep the radiation exposure as low as possible, low dose protocols are used for optimization.
Material and Methods: In our retrospective analysis 700 patients were included who received a CT colonography (CTC) for evaluation of colon polyps or tumors. All examinations were performed according to the same low dose protocol (120 kV, 80mA, 16x1 mm, 0.5 sec. rotation time, supine and prone position). The dose length product (DLP) of each patient was documented. For comparison, the DLP of 100 patients who received an abdominal CT in routine diagnosis was used. The study parameters were equivalent to a normal dose protocol using a CT automatic exposure control. For comparison, the maximum value for abdominal CT in the Austrian Radiation Protection Ordinance has been invoked.
Results: The DLP was determined with the average of 339.8 (285-380)mGy.cm in CTC and 548.9 (198-1277)mGy.cm in the abdominal CT. The DLP-values in CTC (two series) were significantly lower ($p < 0.001$) compared to abdominal CT. The highest collected DLP of CTC reached only 32% of the maximum DLP value (1200 mGy.cm) for abdominal CT in medical radiation protection regulations.
Conclusion: Despite recording two series in CTC, the radiation exposure is significantly lower than for a routine abdomen CT and does not reach the maximum value of DLP for abdominal CT in medical radiation protection regulations by far.

SS 5.02
Optimisation of CT colonography dose protocols: a District General Hospital experience
M. Jagtiani Sangwaiya, A. Marcus, J. Edwards, J. Lovell, M. Train, J. Berger; London/UK

Purpose: To assess radiation administered to patients undergoing CT colonography at Barnet General Hospital. Subsequent re-evaluation of dose achieved.
Material and Methods: Patients undergoing CTC in 01/2010 were identified. The dose parameters (CTDI, CT dose index and DLP, dose length product) were documented; note was also made when the dose sheet was not sent to PACS. Conservative reduction in the dose was attempted, keeping in mind local scanner limitations. The CT protocol was changed to include the dose sheet on PACS as a mandatory step of scanning. Patients scanned from 09/2010 were evaluated.
Results: In 01/2010, 50 consecutive patients (F:M 33:17; mean age 70) were assessed. The CTDI (supine) was 14.8 ± 2.1; corresponding DLP 690 ± 129. The CTDI (prone) was 7.8 ± 0 and DLP 372 ± 36. No dose sheet was sent to PACS in 14 patients. Corresponding measurements in 09/2010, 50 consecutive patients (F:M 28:19; mean age 72) were assessed. The CTDI(S) was 11.4 ± 3.2; DLP was 516 ± 158. Also, the CTDI and DLP(P) were 4.8 ± 1.7 and 222 ± 81, respectively. All dose sheets were archived in PACS. Overall dose reduction from a CTDI vol of 11.3 ± 4.9; DLP of 531 ± 224 to CTDI vol of 8.1 ± 1.1; DLP of 369 ± 53 was achieved.
Conclusion: Optimisation of CT dose up to 30% can be safely achieved in a District General Hospital setup. Changes in the Departmental protocol can improve compliance with the IRR99. Precautions must be taken to minimise dose in CT colonography.

SS 5.03
CT colonography with computer-aided detection (CAD) using a first reader paradigm: effect on reader performance
L. Correale[1], G. Iussich[2], F. Iafrate[3], A. Laghi[4], E. Neri[5], F. Cerri[5], L. Morra[1], A. Bert[1], C. Senore[1], N. Segnan[1], D. Regge[2]; [1]Torino/IT, [2]Candiolo/IT, [3]Rome/IT, [4]Latina/IT, [5]Pisa/IT

Purpose: To assess the diagnostic performance and reporting time of CAD as a first reader.
Material and Methods: 155 colonoscopy CTC exams were interpreted by 3 experienced radiologists twice, 6 weeks apart, using both unassisted reading and CAD as a first reader. Reading paradigms were randomized on a per-case basis. Performance was compared to an annotated reference standard created by 2 experienced radiologists unblinded to colonoscopy. Per-patient sensitivity (SE), specificity (SP), reporting time and diagnostic confidence without and with CAD were compared using paired exact and Student's t tests, respectively. For both reading strategies, areas under the curves (AUCs) were calculated.
Results: 57 of 155 cases (37%) were positive for a total of 89 lesions ≥6mm, and 10 masses. CAD stand-alone detected 91% (81/89) (71 polyps and all masses). Per-patient CAD SE was 91.2% (52/57). On average unassisted readers identified 74% (95%CI: 66-80%) of patients with at least one lesion ≥6mm while CAD-FR SE was 76% (95%CI:69-83%; p = .5). All masses were identified with both paradigms; 37 polyps correctly prompted by CAD were dismissed by at least one reader. SP was 94% (95% CI: 91-97%) and 92% (95%CI: 88-95%) without and with CAD-FR, respectively (p = .3). No differences were reported also between AUCs (p > .05). CAD-FR reporting time was significantly shorter than the unassisted read (p = .0001).
Conclusion: Diagnostic performances of CAD-FR are not different from those of unassisted interpretation. However, with the former reading times are reduced.

SS 5.04
Observer variability: comparing a computer aided detection in a first reader paradigm to unassisted read
G. Iussich[1], L. Correale[2], F. Iafrate[3], A. Laghi[4], E. Neri[5], F. Cerri[5], S. Del Santo[2], A. Bert[2], C. Senore[2], N. Segnan[2], D. Regge[1]; [1]Candiolo/IT, [2]Torino/IT, [3]Rome/IT, [4]Latina/IT, [5]Pisa/IT

Purpose: To compare observer variability of CAD as a first reader (FR) versus unassisted reading.
Material and Methods: The database contained 155 CT colonography studies, with a total of 89 ≥ 6 mm lesions. The reference standard was built by 2 unblinded radiologists. Three experienced radiologists read the datasets, randomized between CAD-FR and unassisted reading. Datasets were reread with the opposite paradigm after 6 weeks. For both reading strategies, readers recorded lesions and classified patients according to the CRADS criteria. Data were analyzed with Fleiss-kappa-statistic to characterize the agreement among the 3 radiologists and the accuracy of the study readers' diagnoses was assessed against the reference standard. Accuracy was defined as the percent of the reference standard CRADS classifications correctly identified by readers.
Results: Average intra-observer agreement within 4 diagnostic categories (C1-C4) was good (k = 0.67 [95% CI: 0.60-0.74]). Inter-observer agreement was substantial for both unassisted and CAD-assisted reading (k = 0.67 [95%CI: 0.60-0.73] vs k = 0.62 [95%CI: 0.55-0.68]). The accuracy of the CRADS classification with respect to the reference standard was quite high for both reading strategies (k = 0.67 vs k = 0.63). However, in both reading conditions, the level of agreement between readers and reference standard in identifying C2 cases was low (k = 0.42 vs k = 0.35).
Conclusion: There was good agreement between unassisted read and CAD-assisted reading. However, our results suggest that the description of patients with 6-9 mm polyps does not yield reproducible results, independently from the used reading paradigm.

SS 5.05
CT colonography for nonpolypoid colorectal lesions: CAD-assisted versus unassisted reading by radiologists with different level of experience
M. Ciolina[1], P. Baldassari[1], A. Pichi[1], M. Iannitti[1], A. Stagnitti[1], F. Iafrate[1], A. Laghi[2]; [1]Rome/IT, [2]Latina/IT

Purpose: To determine sensitivity of CT colonography interpreted by four readers with different levels of experience with and without applying CAD software for flat lesions.
Material and Methods: A database of 94 patients was interpreted by four readers with different levels of experience. 50 patients (control group) and 44 patients had 47 flat lesions. Data were first interpreted on a dedicated workstation. After 1 month interval same datasets were randomly interpreted using a CAD software in a second reading paradigm. Sensitivities and specificities with and without CAD software were assessed. Mean reading time and number of CAD false-positive findings were evaluated.
Results: Sensitivities of human readers for nonpolypoid lesion without CAD was, respectively, 51% and 57% for novice readers, 65% for intermediate reader, 74% for expert reader. Using CAD as second reader sensitivities were, respectively, 51%, 72%, 75% and 84% for novices, intermediate and expert readers. CAD sensitivity for nonpolypoid lesion was 89%. Specificities were, respectively, 90% and 91% for novices, 94% and 96% for intermediate and expert reader. FP were 6. Mean reading time was 9 min and 10 min for novice readers, 8 for intermediate and 6 for expert.
Conclusion: CTC after applying CAD software showed a promising high sensitivity for flat lesions. The use of CAD software as second reader seemed to improve sensitivity of readers with different levels of experience.

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SS 5.06

Learning and training in virtual colonscopy: difficulty and facility in recognizing findings by expert and unexpert examiners

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Purpose: To choice the best method reporting the cancer findings in virtual colonscopy (CCT), we compared two different models of learning and training through the conventional findings of barium enema and without their previous experience.

Material and Methods: We compared the accuracy in reporting made by an expert radiologist (A) who has experience with barium enema studies and the results obtained by a beginning radiologist (B), as resident, in recognizing the same findings in the same cases. Both results were also compared with CAD of the system (PEV-Leonardo, Siemens).

Results: The A results are more accurate in recognizing the protruding and flat cancers compared with B readers (sensitivity 90% vs 68%). The CAD system is useful for flat lesions, which easily could be missed by A observer and more easily by B reader. Usually the CAD is highly sensitive and it could be useful, in particular way with the less prominent lesions.

Conclusion: The great experience derived by barium enema is not much improving the accuracy in reading by the expert reader (A) because it increases also the FP results. Therefore, in the other hand, it is more useful for the unexperienced reader (B). A previous experience with traditional study is not recommended for young radiologist, even a learning of cancer findings with the barium enema studies appears less useful. More aid could be achieved by A and B readers using CAD system.

SS 5.07

CT colonography: comparison of visual search patterns in experienced and novice readers

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Purpose: Diagnostic accuracy can vary between observers due to differences in ability to detect and characterise lesions. Eye tracking technology has been used to explore visual search during plain radiographic interpretation but not complex 3D tasks. We compared search strategies of novice and experienced readers interpreting CT colonography.

Material and Methods: Endoscopically validated CTC datasets, containing 8 lesions reported by experienced readers in a prior study were selected (mean polyp size = 10mm; range 5-25mm). Video clips (mean = 26s) were interpreted by faculty members (n = 10) or participants (n = 19) during 3 CTC workshops. Case order and polyp appearance time were randomised. Visual search was recorded using a Tobii X150 eye tracker and observers indicated potential polyps with a mouse click.

Results: Visual search patterns were recorded satisfactorily. Of 5 true positive lesions, novices indicated a median of 3 lesions (range 1 to 5) and experienced readers indicated a median of 4 lesions (range 2 to 5), giving good accuracy calibration data for the development of new eyetracking metrics. Both novices and experts identified true positive lesions at a median of 3.3 seconds after the lesion was first visible, although times varied by lesion.

Conclusion: Visual tracking during 3D interpretation is technically feasible. Experienced readers on average identified more lesions, although both novices and experts took on average similar times to indicate polyps. Further studies will assess the effect of training on visual search pattern.

SS 5.08

Effect of training on different experienced readers with and without the assistance of a CAR software when a primary 3D flythrough approach is used

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Purpose: To investigate the learning process of two inexperienced readers when a primary 3D flythrough approach is used with and without the assistance of a CAR software.

Material and Methods: Two readers evaluated 50 patients with 100 endoscopically proved polyps (ranging from 3 mm to 40 mm) and different colonic preparations (fluid tagging and full cathartic preparation) with and without the assistance of a CAR softaware. Datasets analysis was performed during 10 sessions (5 assisted and 5 unassisted). Per-polyp sensitivity, learning curve for both approaches, mean reporting time and false positive were evaluated for each approach.

Results: Both readers increased progressively per-polyp sensitivity, respectively, from 75% and 61% for 3D analysis to 86% and 74% for primary 3D+CAR analysis with a significant difference ($p = 0.001$ and $p = 0.01$). No significant differences were found between the learning curve of the assisted and unassisted sessions. Less experienced readers were faster when assisted by CAR but no significant differences were found on mean reading time for all readers ($p = 0.5/0.07$). Both readers decrease false positive when assisted.

Conclusion: Our study demonstrated that the learning process of less experienced readers was not influenced by the assistance of the CAR software.

SS 5.09

Systematic review: the effect of manipulating clinical context on studies of diagnostic test accuracy

D. Boone[1], S. Halligan[1], S. Mallett[2], S.A. Taylor[1], D. Altman[2]; [1]London/UK, [2]Oxford/UK

Purpose: We performed a systematic review of diagnostic accuracy imaging studies investigating the effect of, (A) blinding observers to population information and, (B) reporting intensity and recall bias.

Material and Methods: We searched the biomedical literature during March 2010 using 3 discrete strategies. Inclusion criteria: imaging studies that quantified the effect on diagnosis of modifying the context of observers' interpretations, in terms of varying disease prevalence, blinding to population characteristics, reporting intensity, and recall bias.

Results: 11247 abstracts were reviewed, 201 full texts examined, and 12 included in our systematic review. There were 5 to 9520 patients and 2 to 129 observers per study. Interpretation rate varied from 5 per day to 3208 over 18 months. 9 studies investigated clinical review bias of population level information. Only 3 studies investigated prevalence, 2 of which investigated maximum enrichment well below levels often used by researchers. We identified no research specifically directed at observer knowledge of prevalence or that specifically addressed the duration of washout. Available research found no evidence of recall bias on study results.

Conclusion: Potential sources of bias central to design imaging diagnostic test accuracy studies are poorly researched and there is little evidence to guide study design. Research is needed urgently to investigate the impact of potential sources of bias on imaging studies, particularly observers' knowledge of prevalence and the effects of recall bias, especially in screening contexts.

SS 5.10

Chronic diverticulitis versus colorectal cancer: findings on CT colonography

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Purpose: In CT colonography chronic diverticulitis (CD) can mimic colorectal cancer (CRC) masses. In order to distinguish these two entities several findings were analysed.

Material and Methods: 371 symptomatic patients consecutively underwent CT colonography between June 2008 and November 2010. All patients with pathologic confirmation of CD (10) and CRC (28) on surgical specimens were included. The images were analysed by a consensus of two reviewers. Length of the mass, diverticula included in the mass, growth pattern, luminal narrowing, presence of perilesional lymph nodes and mesenteric fat stranding were evaluated.

Results: There was a significant difference in median length of the mass between CD and CRC, 98 and 49 mm, respectively ($p < 0.001$). Diverticula included in the mass were visible in all patients with CD, but in none of the patients with CRC ($p < 0.001$). A curved growth pattern of the mass was noted in all but one patient with CD versus three out of 28 patients with CRC ($p < 0.001$). There were no significant differences between the groups with respect to median luminal narrowing (84 vs 83%, $p = 0.3$), presence of perilesional lymph nodes ($p = 0.3$) and presence of perilesional mesenteric fat stranding ($p = 0.3$).

Conclusion: To differentiate CD and CRC masses, the length of the mass, inclusion of diverticula and growth pattern are important discriminating factors.

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11:15 -12:45 **Mangano**

Scientific Session 6
Acute abdominal conditions

SS 6.01
Quantification of adipose tissue on abdominal CT: a new biomarker for the severity of acute pancreatitis? Preliminary results
A. Furlan, G. Papachristou, B. Park, K.T. Bae; Pittsburgh, PA/US

Purpose: To quantify abdominal fat volumes on CT images of patients with acute pancreatitis (AP), and to correlate them with patient's BMI and severity of disease.
Material and Methods: Study cohort included 26 patients (16M, 10F; mean age, 54 years – BMI: 19-40kg/m2; mean, 26kg/m2) with AP and available MDCT scan. Abdominal fat was segmented and measured from unenhanced CT images using semi-automated segmentation program. Abdominal total adipose tissue (TAT) was quantified from diaphragm dome to pelvis and further divided into visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT). Severity of pancreatitis was defined as development of multi-system organ failure (OF). Pancreatic necrosis was determined from contrast-enhanced MDCT. Correlation between BMI, SAT, VAT, and TAT was assessed using Pearson's coefficient (r). Association between the mean values of fat measurement and development of pancreatic necrosis and OF was assessed with Student's t-test.
Results: BMI strongly correlated with TAT ($r = .767$, $p < .001$), VAT ($r = .662$, $p < .001$) and SAT ($r = .654$, $p < .001$). 8/26 (31%) patients had pancreatic necrosis: mean BMI and TAT in patients with pancreatic necrosis (30.3 ± 5kg/m2, and 14.6 ± 5.2L) were significantly larger than those without necrosis (25.2 ± 5.4kg/m2, and 9.7 ±4.7L). 9/26 (35%) patients developed OF; mean VAT was higher in patients with OF than without (5.9 ± 3.5L vs.4.4 ± 2.4L).
Conclusion: High BMI and TAT were associated with increased pancreatic necrosis. VAT tended to increase in patients with OF.

SS 6.02
Severe acute pancreatitis requiring drainage therapy: findings on computed tomography as predictor of patient outcome
P. Heiss, T. Bruennler, B. Salzberger, C. Stroszczynski, O.W. Hamer; Regensburg/DE

Purpose: To evaluate whether morphologic features on computed tomography (CT) correlate with outcome of patients with severe acute pancreatitis.
Material and Methods: 80 patients with severe acute pancreatitis requiring percutaneous drainage therapy were retrospectively analyzed. Twelve CT features beyond the CT severity index (CTSI) were studied. Endpoints for patient outcome were patient death, length of hospital and ICU stay. The twelve features and the CTSI score were correlated with mortality using Kaplan-Meier estimator and correlated with length of hospital and ICU stay using Chi-square test. A p-value of ≤0.05 was considered statistically significant.
Results: Two CT features exhibited a significant correlation with mortality: (1) the number of parts of pancreas (head/corpus/tail) that exhibited areas of necrosis and (2) the presence of distant fluid collections (posterior pararenal space and/or paracolic gutter). Mortality was 42% (21 of 50 patients) and 20% (6 of 30 patients) if two/all three parts or none/one part of the pancreas exhibited necrosis, respectively. Mortality was 46% (18 of 39 patients) and 22% (9 of 41 patients) if distant fluid collections were present or absent, respectively. Based on these two features, we propose a new simple CT score to stratify patient risk. All other imaging features including the CTSI showed no significant correlation with patient outcome.
Conclusion: We identified that two morphologic features on CT might be helpful to predict prognosis of patients suffering from severe acute pancreatitis.

SS 6.03
Role of 64-scan CT in the detection of pancreatic fistula after pancreatoduodenectomy
M.C. Gibertini, A. Pecchi, M. De Santis, G. Della Casa, F. Di Benedetto, P. Torricelli; Modena/IT

Purpose: To evaluate the role of 64-scan CT in the detection of pancreatic fistula (PF) after pancreatoduodenectomy.
Material and Methods: Between September 2004 and September 2009, 63 patients (37 males, 26 females, mean age 64.5 years), underwent pancreatoduodenectomy. During postoperative period, 25/63 patients with abdominal pain, fever, leucocytosis and output through operatively placed drains with amylase content greater than three times the normal serum value were evaluated with 64-scan CT before and after intravenous contrast medium administration in precontrastographic, arterial and venous phases.
Results: In 18 cases (72%), CT depicted peripancreatic and perianastomotic fluid collections with air bubbles (9, one patient with mild amylase drainage content was septic for hepatic abscess) and homogeneously hypodense (8). Diagnostic confirmation was obtained with US percutaneous drainage (13), and relaparotomy (5). In 6 cases (28%), CT was negative for abdominal fluid collections. In one patient with severe and prolonged amylase drainage output, CT did not show abnormalities. Sensibility, specificity, accuracy , positive , negative predictive value for CT were 95%, 88%,93% 95% and 88%, respectively.
Conclusion: 64-scan CT is an accurate technique to evaluate patients underwent pancreatoduodenectomy with clinical suspicion of PF, as it depicts the extension of abdominal fluid collections and defines the possible treatment. Output through surgical drains with amylase content greater than three times the normal serum value, in addition to CT evidence of peripancreatic and perianastomotic fluid collections enables to diagnose PF.

SS 6.04
At war with the clinicians. Should we still perform erect abdominal radiographs just because the clinicians request them?
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Purpose: According to various international radiological references and guidelines, erect abdominal radiographs are not part of routine abdominal imaging, but in most cases have been replaced by supine X rays. However, clinicians still ask for them, especially for the assessment of bowel obstruction and pneumoperitoneum. We examine if this practice is warranted.
Material and Methods: We retrospectively review abdominal radiographs requested by clinicians from 334 patients and performed for the detection of obstruction, pneumoperitoneum, appendicitis, abdominal pain, cholecystistis, nausea/vomiting, pancreatitis, Crohn's disease, haematemesis and calculi. We examine the patients' position as requested by the clinician (erect or supine). We compare abnormal findings in the two positions.
Results: In 220/334 patients (65.9%) abdominal radiographs were performed in the erect position. Of these, 34 (15.5%) were abnormal. Supine radiographs were performed in 114/334 patients (34.1%). Of these 45 were abnormal (39.5%). Supine radiographs revealed abnormal findings in more cases in comparison to erect ($p < 0.0001$-Fischer's exact test).
Conclusion: Erect abdominal radiographs do not reveal pathology more often than supine. They are also more difficult to perform in obese and debilitated patients. Recent medical literature and guidelines do not include them in routine imaging assessment. Except for very few indications, they should be abandoned.

SS 6.05
Sensitivity and specificity in identifying cocaine drug mules by computed tomography, plain radiograph and Lodox
P.M. Flach, S. Ross, G. Hatch, U. Preiss, T. Ruder, M.J. Thali, M.A. Patak; Bern/CH

Purpose: To retrospectively evaluate the specificity and sensitivity of multi-detector computed tomography (MDCT), digital radiography (DR) and low-dose linear slit digital radiography (LSDR, Lodox) in the detection of incorporated cocaine containers.
Material and Methods: 50 patients suspected of having incorporated cocaine drug containers (45m, 5f, 16-45yrs) were included in the study. All underwent radiological imaging: MDCT n = 27, CR n = 50, LSDR n = 12. A total of 89 exams were performed. Radiological findings were compared with the written record of evidence recovered from the feces of each detained suspect in the hospital-affiliated custody ward. Image analysis was performed prior to knowledge of the gold standard: cocaine packs from feces. Sensitivity and specificity for drug concealment were calculated for each modality.
Results: There were 43 drug mules. Seven patients did not incorporate any drug containers. In the 27 MDCT exams, 18 were true positive (TP), 8 true negative (TN), 1 false positive (FP) and no false negative (FN). For CT, sensitivity was 100%, specificity 88%, positive predictive value (PPV) 95% and negative predictive value (NPV) 100%, respectively. In 50 DR exams, 21 were TP, 14 TN, 6 FP and 9 FN showing a sensitivity of 70%, specificity 93%, PPV 77% and NPV 60%, respectively. LSDR (total number of 12) showed 6 TP, 3 TN, 2 FP and 1 FN with a sensitivity of 85%, specificity 60%, PPV/NPV 75%, respectively.
Conclusion: The detection of incorporated cocaine drug packs should be performed by MDCT, rather than by DR or LSDR, in order to provide 100% sensitivity. In the future for radiation protection, low-dose protocols need to be implemented for imaging drug mules while still providing accurate diagnostic outcome.

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SS 6.06

MRI features associated with acute appendicitis (pilot study)

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Purpose: To identify MRI features associated with appendicitis.
Material and Methods: Radiological signs expected to be associated with acute appendicitis were recorded by sixteen readers (9 radiologists, 7 residents) in 82 abdominal MRI scans of patients with suspected appendicitis. Previously, the readers were trained to appraise MRI examinations for appendicitis with 20 scans, receiving direct feedback. An expert panel assigned acute appendicitis as final diagnosis in 36 of 82 patients based on histopathology and follow-up. Associations between imaging features and acute appendicitis were evaluated with logistic regression analysis.
Results: We evaluated 1291 MRI readings. Seven evaluated MRI features were associated with acute appendicitis in multivariable analysis: thickened appendix (>6mm), peri-appendiceal fat infiltration, peri-appendiceal fluid, appendicolith, restricted diffusion of the appendiceal wall, the appendiceal lumen and of focal fluid collections. The probability of appendicitis was at least 89% if two of these MRI features were present, 91% if three MRI features were present. The combination of peri-appendiceal fat infiltration and presence of an appendicolith on MRI had the highest probability of appendicitis (99%, 95% CI 94-100%). In the absence of any of these features appendicitis was present in 7% (95% CI 5-10%) of patients.
Conclusion: Presence of a thickened appendix (>6mm), peri-appendiceal fat infiltration, peri-appendiceal fluid, appendicolith, restricted diffusion of the appendiceal wall, the appendiceal lumen and focal fluid collections on MRI are associated with acute appendicitis.

SS 6.07

Does additional diffusion weighted imaging improve the detection of acute appendicitis in MRI?

M. Leeuwenburgh[1], M. Thieme[2], B. Wiarda[2], S. Bipat[1], P.M. Bossuyt[1], M. Boermeester[1], J. Stoker[1]; [1]Amsterdam/NL, [2]Alkmaar/NL

Purpose: To evaluate if additional diffusion weighted imaging (DWI) increases the detection of acute appendicitis in MRI.
Material and Methods: Sixteen readers (9 radiologists, 7 residents) examined 82 abdominal MRI scans of patients with suspected appendicitis. Previously, these readers were trained to appraise diffusion weighted images for appendicitis with 20 scans, receiving direct feedback. Presence of appendicitis was first recorded after viewing T2 weighted images (coronal and axial HASTE with and without fat saturation) and secondly after viewing diffusion weighted images (coronal and axial). An expert panel assigned acute appendicitis as final diagnosis in 36 of 82 patients based on histopathology and follow-up. Mean sensitivity and specificity were calculated for the first and second diagnoses.
Results: We evaluated 1291 MRI readings. Mean sensitivity of the readers increased from 83% (95%CI 80-86%) to 88% (95%CI 85-91%, $p < 0.001$) after viewing the additional DWI, whereas specificity decreased from 91 (95%CI 88-93%) to 87 (95%CI 84-89%). Readers' accuracy did not improve significantly between the first and the last set of 20 scans. The addition of DWI reduced the percentage of inconclusive findings from 24% (95%CI 22-26%) to 11% (95%CI 9-12%). Readers assigned the correct diagnosis in 157 out of 309 inconclusive scans after viewing DWI. The additional DWI was indicated as helpful in 64% of all examinations.
Conclusion: Addition of DWI increased sensitivity for acute appendicitis in MRI significantly and reduced the percentage of inconclusive results.

SS 6.08

The quantitative analysis of the enhancement of the bowel wall with contrast-enhanced ultrasound in the evaluation of activity degree in patients with inflammatory bowel diseases correlated to the histopathologic features

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Purpose: In order to demonstrate the accuracy of the semi-quantitative analysis of the enhancement of the bowel wall after CEUS in patients with inflammatory bowel disease (IBD), as objective evaluation, the results were related to an objective "quantitative" histopathologic analysis of same bowel wall: the count of vessels after haematoxylin and eosin stain and CD34, considered a quantifiable marker of inflammation.
Material and Methods: 33 patients with IBD were studied blindly and consecutively with CEUS just after colonoscopy with biopsy. The routine histological exam was completed by the count of the vessels in 10 optical fields with high magnification (40x) after haematoxylin and eosin stain and CD34. The data considered were the features usually considered in the study of these diseases: type of IBD, presence or absence of symptoms, therapy, CPR value, endoscopic, histological and ultrasound disease degree. We added the count of vessels and the enhancement quantitative evaluation (PEAK%, TTPs, RBV, RBF, MTTs) (Qontrast, e-AMID/BRACCO). Statistical analysis was performed with T-test study.
Results: 21/33 patients (Group 1) resulted affected by active disease at the endoscopic, histological and US/CEUS study; and 12/33 patients (Group 0) showed quiescent disease. The count of vessels at the histopathologic examination demonstrated a significant different range between the two groups: from 265 to 396 (mean 349) vessels in Group 1 and from 136 to227 (mean 148) in the Group 0. All the results were statistically significant respect to the number of vessels, in particular a strictly correlation was demonstrated between quantitative evaluation and vessels within the bowel wall. The statistical analysis permits to demonstrate a cutoff value of Peak%. TTPs, and RBF in order to distinguish active or non-active disease.
Conclusion: The study demonstrates high accuracy of this quantitative analysis of the enhancement to evaluate the activity degree of the IBD disease.

SS 6.09

Superior mesenteric artery embolism: imaging markers of bowel necrosis using MDCT angiography

A. Huete, C. Besa, P. Bächler; Santiago/CL

Purpose: To retrospectively correlate superior mesenteric embolism (SME) morphology and patterns of abnormal bowel wall (aBW) with bowel necrosis (BN), using MDCT angiography.
Material and Methods: 31-patients were diagnosed with SME (2001-2010; age: 45-94yo). Biphasic MDCT angiography was performed. Images were reviewed using advanced vessel analysis software. Distance of SME from ostium and presence of occlusive clot were recorded. Patterns of aBW included: thin-wall without arterial and venous enhancement (wAV), thin-wall without arterial enhancement (wA), "target"-thickening (wT), homogenous-thickening (wH) and hyperEnhancement (wE). Ileus was defined as small-bowel diameter >2.5cm. Medical records were reviewed for surgical correlation and patient outcome.
Results: Twenty-patients underwent surgery. BN was found in thirteen (42%). Mortality was 29%, all with BN. SME-distance from ostium was not correlated with neither BN nor mortality. Occlusive clot was associated with BN ($p < 0.05$) but not with mortality. Normal bowel was seen in 9 patients, with no BN or mortality in this group. BN and mortality were strongly associated with wAV (76.9% vs. 15.0%, $p < 0.001$, and 88.9% vs. 13.9% $p < 0.001$, respectively) and ileus (93.3% vs. 22.2%, $p < 0.001$, and 100% vs. 31.8%, $p < 0.01$). wAV had 77% (95% CI: 46%-94%) sensitivity, 94% (71%-100%) specificity, 91% PPV, 85% NPV, and 13.8 +Likelihood-ratio for diagnosing BN. Ileus reported 92% (62%-100%) sensitivity, 78% (52%-93%) specificity, 75% PPV, 93% NPV, and 4.2 +Likelihood-ratio to identify BN in patients with SME.
Conclusion: MDCT angiography optimally depicts markers of BN in SME. Ileus and wAV pattern both correlate strongly with BN and mortality.

SS 6.10

Diagnosis of intestinal traumatic lesions: contribution of CT

E. Danse, T. Van Drogenbroeck; Brussels/BE

Purpose: To evaluate the role of MDCT in the diagnosis of bowel traumatic lesions, and to identify CT signs contributive for the optimal treatment option.
Material and Methods: Retrospective analysis of our database and selection of patients with a final diagnosis of bowel trauma. 11 cases were identified in whom the following CT signs were noted: focal bowel wall changes (disruption, thickening, modified enhancement), pneumoperitoneum, iodine extravasation in the mesenteric folds, infiltration or haematoma into the mesentery, free fluid, abdominal wall changes. We compared the CT findings with surgery or the clinical evolution.
Results: 10 cases were operated with a favorable outcome. Surgery was required for bowel rupture (complete in 8 and superficial in 2). The non-operative patient had a duodenal haematoma. Free fluid was noted in 10 , infiltration of the mesentery in 8, focal wall thickening in 8, focal disruption of the gut in 8, intraperitoneal gas in 7, reduced enhancement of the gut in 5, haematoma into the meso in 5, abdominal wall changes in 5, bowel pneumatosis in 2 and extravascular iodine contrast in the mesentery in 1.
Conclusion: The most frequent CT signs of bowel trauma include focal disruption of the bowel wall, extradigestive gas and focal reduced enhancement of the gut. A larger series are need to identify the best CT sign helping for the choice for an optimal treatment.

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11:15 -12:45 **Sala Perla**

Scientific Session 7

Hepatobiliary MR contrast agents (Liver 3)

SS 7.01

Characterization of incidental liver mass: comparison of multidetector CT versus gadoxetate disodium-enhanced MR imaging

Y.E. Chung, M. Kim, Y.E. Kim, M. Park, J. Choi, S. Baek, W. Chung, J.S. Lim, K.W. Kim; Seoul/KR

Purpose: To retrospectively compare the accuracy of contrast-enhanced multidetector-CT (MDCT) and gadoxetate-disodium-enhanced MRI (EOB-MRI) for characterization of incidental liver masses.

Material and Methods: 127 incidental liver masses (94 benign and 33 malignant: hemangioma, 24 lesions; focal nodular hyperplasias [FNH] 27; eosinophilic abscess, 15; focal fat deposition, 3; angiomyolipoma, 3; schwannoma, 1; hepatocellular carcinoma, 24; cholangiocarcinoma, 6; inflammatory pseudotumor, 2; and embryonal sarcoma, 1) found in 80 (M:F = 45:35) patients without primary extrahepatic malignancy or chronic liver disease were included. All patients underwent EOB-MRI and MDCT. Two radiologists reviewed EOB-MRI and MDCT independently. Area under the ROC (Az) values were calculated to compare the diagnostic performance for differentiation of benign and malignant (B/M) lesions. The accuracy for the differentiation of B/M lesions and for the specific diagnosis of diseases were also compared.

Results: The accuracy for the differentiation of B/M lesions was significantly higher with EOB-MRI (94.5%) than with MDCT (74.0%) for reader 2 (R2, $P < 0.001$), but was comparable for reader 1 (R1, EOB-MRI: 97.6%; MDCT: 92.9%; $P = 0.050$). Az values for differentiation of B/M lesions with MDCT (R1, 0.963; R2, 0.988) and EOB-MRI (R1, 0.977; R2, 0.975) were comparable (R1, $P = 0.621$ and R2, $P = 0.504$). For the diagnosis of FNH, accuracy was significantly higher with EOB-MRI (R1, 96.3%; R2, 77.8%) than with MDCT (R1, 66.7%; R2, 22.2%). Diagnosis rates of the remaining diseases were comparable between EOB-MRI and MDCT for both readers.

Conclusion: For characterization of incidental liver masses, EOB-MRI may provide higher accuracy than MDCT for the differentiation of B/M lesions. Specific diagnosis of focal nodular hyperplasia can be significantly improved with EOB-MRI than with MDCT.

SS 7.02

Gadolinium-ethoxybenzyl-diethylene triamine penta-acetic acid-enhanced magnetic resonance imaging of the liver: timing of T1 and T2-weighted sequences

N. Hersey[1], R. Musson[2], A. Blakeborough[2]; [1]Derbyshire/UK, [2]Sheffield/UK

Purpose: To compare the signal intensity and relative enhancement of liver parenchyma at set time intervals following injection of gadolinium-ethoxybenzyl-diethylene triamine penta-acetic acid (Gd-EOB-DTPA) in both T1 and T2-weighted breathhold sequences.

Material and Methods: We performed a retrospective analysis of all patients at our institution during an 18-month period undergoing gadolinium-ethoxybenzyl-diethylene triamine penta-acetic acid (Gd-EOB-DTPA)-enhanced liver MR imaging. All patients with repeat imaging or abnormal liver function tests were excluded. Each patient underwent T1- and T2-weighted breathhold sequences at 3, 6, 10 and 20 minutes post-injection of Gd-EOB-DTPA, as well as pre-contrast imaging. Signal-to-noise ratio was determined for each patient at each time interval and relative enhancement calculated.

Results: 101 patients were eligible for the study with a mean age of 51 years. The relative enhancement increased incrementally at each time interval on the T1-weighted imaging, with a 64% mean increase by 20 minutes. Between 10 and 20 minutes post-contrast, the relative enhancement increased by 20%. There was negative relative enhancement of the liver parenchyma on all post-contrast T2-weighted sequences with a mean reduction of 13.5%.

Conclusion: Only a modest negative relative enhancement of liver parenchyma was observed following Gd-EOB-DTPA administration on T2-weighted imaging. Liver enhancement on T1-weighted imaging increases incrementally up to 20 minutes. In contrast, timing of post-contrast T2-weighted imaging is less critical.

SS 7.03

Improved focal liver lesion detection on gadoxetic acid disodium-enhanced hepatocyte phase MRI with increasing the flip angle protocol

H. Haradome, K. Al Manea, T. Bonaventure, L. Grazioli; Brescia/IT

Purpose: To determine whether hepatocyte phase gadoxetic acid disodium (EOB)-enhanced MRI using a high flip angle (FA) improves focal liver lesion (FLL) detection compared to using a standard low FA.

Material and Methods: Sixty-two consecutive patients with 159 FLLs underwent EOB-enhanced MRI during the hepatocyte phase at 5, 10, 15, and 20 minutes, with both low (10°) and high (30°) FAs. Two blinded radiologists independently and randomly reviewed the two image sets using a four-point rating scale. Receiver operating characteristic (ROC) analysis was performed, and sensitivities and specificities were calculated. Lesion-to-liver contrast ratio (LLC) on all hepatocyte phase images was measured.

Results: The area under the ROC curve for the detection of all FLLs at 5 and 10 minutes with high FA was significantly higher than that with low FA, for both readers ($P < 0.01$). The sensitivities with high FA for small (≤10mm) malignant FLLs were significantly higher than those with low FA, at all time points, for both readers ($P < 0.05$). LLCs with high FA were significantly higher than those with low FA at all time points ($P < 0.001$).

Conclusion: Hepatocyte phase EOB-enhanced MRI with high FA can significantly increase LLC and improve the detection of FLLs, particularly small malignant lesions.

SS 7.04

Characteristics of hepatocellular adenomas in Gd-EOB-enhanced MRI

C. Grieser, I.G. Steffen, C.M. Perez Fernandez, L. Stelter, D. Schnapauff, J.H. Rothe, B. Hamm, T. Denecke; Berlin/DE

Purpose: To retrospectively evaluate MRI characteristics with hepato-specified contrast media (Gd-EOB-DTPA) of histopathologically confirmed hepatocellular adenomas (HCA).

Material and Methods: Thirteen patients who underwent liver MRI (1.5 T) and subsequently histologically proven HCA were retrospectively included. The examination protocol contained: T1-in-and opposed-phase; T2-w, and fs T1w sequences before and after Gd-EOB-DTPA application (arterial (ap), portal venous (pv), venous (vp), and hepatobiliary phase (hbp; 20 minutes delay)). Standard of reference was surgical exploration (n = 11) or diagnostic puncture (n = 2). Two blinded radiologists analyzed the MR images in consensus (criteria: size; shape; texture; fat; haemorrhage and intensity of HCA and liver). Furthermore, relative dynamic signal intensity (SI) values in comparison to the pre-contrast SI-values were recorded (liver, muscle, and HCA).

Results: In total, 31 HCA were evaluated. All HCA showed a strong contrast uptake in the ap (56.8 (±58.9)%; $p < 0.001$); 13 HCA showed "wash out" in the vp and all adenomas presented a relative contrast uptake in the hbp (51.4 (±40.8)%; $p < 0.001$). Visually, 5 HCA were iso-/hyperintens compared to the surrounding liver parenchyma in the fs T1w images of the hbp; all of these were found in only 2 patients with prominent fatty livers.

Conclusion: All HCA showed a significant contrast uptake in the hbp, however significantly less than the surrounding liver parenchyma. In case of distinctive hepatic steatosis, a hyperintensity of HCA on fs T1w images can be seen in the hbp.

SS 7.05

Gadolinium-EOB-DTPA-enhanced MRI in differentiating focal nodular hyperplasia from hepatocellular adenoma

M. Bieze, J.W. van den Esschert, C. Yung Nio, R.B. Reitsma, T.M. van Gulik, S.S.K.S. Phoa; Amsterdam/NL

Purpose: We assessed the accuracy of Gadolinium-EOB-DTPA compared to conventional gadolinium-enhanced MRI in differentiating FNH from HCA, with histological outcome as standard of reference.

Material and Methods: In this prospective study, 55 consecutive patients suspected of FNH or HCA underwent a gadolinium-EOB-DTPA MRI of the liver. Conventional series included dynamic contrast-enhanced T1-weighted FS series, T1 in/out of phase, T2, and diffusion, followed by delayed hepatobiliary phase. The two imaging studies were stored separately and evaluated by two blinded abdominal radiologists. Diagnosis on conventional imaging was based on lesion characteristics (bleeding, central scar, shape) and enhancement pattern. In addition, diagnosis based on the hepatobiliary phase was regarded diagnostic for FNH if accumulation of contrast was seen and diagnostic for HCA without accumulation. Imaging results were compared to histological outcome as standard of reference (SOR) and obtained by biopsy or resection.

Results: SOR revealed HCA 23 and FNH 32. The conventional MRI showed a sensitivity of 52.2% for HCA with a positive predictive value (PPV) of 92.3% and for FNH of 56.3% (PPV 94.7%). The hepatobiliary phase showed a sensitivity for HCA of 95.7% (PPV 92.7%) and for FNH of 93.8% (PPV 96.8%). Features with significant predictive value for diagnosis included bleeding for HCA ($p = 0.040$) and a central scar for FNH ($p = 0.001$).

Conclusion: The hepatobiliary phase of the Gd-EOB-DTPA contrast significantly increases the sensitivity of MRI in differentiating FNH from HCA.

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SS 7.06

The value of gadoxetic acid–DTPA-enhanced MR imaging in the differential diagnosis of hepatocellular adenoma and focal nodular hyperplasia

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Purpose: To evaluate the utility of gadoxetic acid (Gd-EOB-DTPA)-enhanced MRI in the differential diagnosis of hepatocellular adenoma (HCA), and focal nodular hyperplasia (FNH).

Material and Methods: Seventy-five patients with pathologically proven 71 nodules (28 FNHs and all 43 HCAs) and 40 FNHs diagnosed using typical imaging reference and follow-up studies were enrolled in this study. For quantitative analysis, contrast enhancement ratio (CER), lesion-to-liver contrast (LLC), and signal intensity (SI) ratio of each tumor on dynamic and hepatobiliary phase images were calculated. Two readers retrospectively and in consensus reviewed all images in terms of signal intensity features of each tumor on pre-contrast, dynamic and hepatobiliary phase images.

Results: The mean CER of FNHs on arterial phase was significantly higher than that of HCAs ($p < 0.01$). During hepatobiliary phases, mean LLC of FNHs showed minimal positive value and that of HCAs demonstrated strong negative value. The areas under the receiver operating characteristic of hepatobiliary phase SI ratio for differentiation of the two tumors was 0.97, with sensitivity of 100% and a specificity of 90% when using an optimal cutoff value of less than 0.87. Among 6 FNHs showing atypical hypointense during hepatobiliary phases, the 4 FNHs had a large central scar, the one contained rich fat component, and the remaining one had abundant radiated fibrous septa.

Conclusion: Gd-EOB-DTPA-enhanced MRI facilitates accurate differentiation of FNH from HCA with potential ability of avoiding invasive biopsy.

SS 7.07

Detection of liver metastases using gadoxetate disodium-enhanced MR imaging: comparison of dynamic, 10-min, and 20-min delayed phase images

H.T. Jeong, M. Kim, M. Park, J. Choi, J.S. Choi, K.S. Kim, G.H. Choi, S. Shin; Seoul/KR

Purpose: To assess the incremental value of hepatobiliary phase images in gadoxetate disodium-enhanced magnetic resonance (MR) imaging, and to compare diagnostic accuracy and lesion conspicuity on 10-min and 20-min delayed images for the preoperative detection of hepatic metastases.

Material and Methods: Forty-six patients with 107 metastases who underwent surgery after MR imaging were evaluated. Four observers interpreted three sets of images: dynamic set, precontrast T1-, T2-weighted and dynamic images; 10-min set, dynamic set with 10-min delayed; 20-min set, 10-min set with 20-min delayed. Diagnostic accuracy, sensitivity and positive predictive values were compared with subgroup analysis according to size and prior chemotherapy. Liver-to-lesion signal difference ratio (SDR) was also compared.

Results: Mean Az values and sensitivities were significantly higher for 10-min and 20-min sets than dynamic, with no significant difference between 10-min and 20-min. For small (≤1cm) metastases and chemotherapy, sensitivities were significantly higher with 10-min and 20-min set than dynamic. The SDR was significantly higher on 10-min and 20-min images than precontrast and dynamic, with significantly higher on 20-min than 10-min.

Conclusion: Regardless of size or chemotherapy, detection of hepatic metastases was significantly improved by the addition of hepatobiliary phase images with no significant differences between 10-min and 20-min delayed images.

SS 7.08

Colorectal metastases detectability on hepatospecific phase of Gd-EOB-DTPA-enhanced MRI: can we save up 10 minutes in MR examination time?

F. Sabatino, A. Filippone, R. Cianci, V. Bianco, A. Tartaro, A.R. Cotroneo; Chieti/IT

Purpose: To compare the conspicuity of colorectal hepatic metastases on hepatospecific phase MR images obtained 10 and 20 minutes after injection of Gd-EOB-DTPA.

Material and Methods: Fifty-four patients with non-cirrhotic liver and hystologically proved colorectal metastases were selected among patients who underwent Gd-EOB-DTPA-enhanced MR imaging. MR examinations were carried out at 1.5 T before and 25s, 70s, 180s, 10min, and 20min after Gd-EOB-DTPA administration. Two readers of different experience independently evaluated lesion detectability according to a four-point confidence scale in two separate reading sessions including: A) unenhanced, dynamic and 10 min hepatospecific phase images; B) unenhanced, dynamic and 20-min hepatospecific phase images. The diagnostic accuracy (Az values), sensitivity, and confidence score of each reader for each reading session were statistically evaluated.

Results: For both readers, the Az values were higher when dealing with the 20-min hepatospecific phase images, but differences were not significant. The sensitivity values were higher in session B (92.12 vs 94.78 for reader 1 and 95.65 vs 96.52 for reader 2), without significant differences. On the other hand, when considering the detectability of lesions ≤1cm, the less experienced reader's confidence was significantly higher when assessing the 20-min hepatospecific phase images ($p = 0.001$).

Conclusion: When dealing with the detection of colorectal metastases in non-cirrhotic liver we can save up 10 min of examination time for Gd-EOB-DTPA-enhanced MR imaging.

SS 7.09

Diffusion-weighted MR imaging of the liver after administration of different gadolinium contrast agents: is it still reliable?

S. Kinner, L. Umutlu, S. Blex, G. Antoch, T.C. Lauenstein; Essen/DE

Purpose: Diffusion-weighted imaging (DWI) is an emerging technique for abdominal MRI. DWI is usually performed before intravenous contrast injection. However, it may be necessary or time-saving to acquire DWI data after gadolinium administration. We aimed to compare DWI before and after the administration of different gadolinium compounds.

Material and Methods: 15 patients with known HCC underwent liver MRI at 1.5T (Magnetom Avanto, Siemens) including DWI on day 1 before and after administration of gadobutrol (Gadovist®) and on day 2 after administration of EOB-gadolinium-DTPA (Primovist®). Signal to noise ratios (SNR) and contrast to noise ratios (CNR) of HCC lesions and liver parenchyma were determined for all acquired DWI data sets. Furthermore, ADC values were calculated and compared using a Wilcoxon test. A p-value <0.05 indicated statistical significance.

Results: There were no statistically significant differences regarding SNR pre-contrast (mean: 43.3), after gadobutrol (43.2) or after EOB-gadolinium-DTPA (46.5). Similarly, significant differences were found neither for CNR (average values: 34.7 vs. 32.1 vs. 35.7) nor for ADC values (1.5 vs. 1.4 vs. 1.5 x 10^{-3}).

Conclusion: There is no significant difference regarding DWI of HCC before and after intravenous injection of a liver-specific agent (EOB-gadolinium-DTPA; Primovist®) as well as a highly concentrated compound (gadobutrol; Gadovist®). Hence, it is feasible to run DWI after gadolinium either as an alternative for unsuccessful pre-contrast DWI or as a gap filler to spare time in EOB-gadolinium-DTPA imaging.

SS 7.10

Does diffusion weighted imaging add diagnostic confidence in characterizing focal lesions if included in contrast-enhanced magnetic resonance imaging (MRI) of the liver?

R. Girometti, M. Del Pin, S. Pullini, L. Cereser, C. Zuiani, M. Bazzocchi; Udine/IT

Purpose: To investigate whether DWI improves the diagnostic confidence in focal lesions characterization when added to contrast-enhanced liver MRI.

Material and Methods: One experienced abdominal radiologist, blinded to clinical information, reviewed thirty-six focal liver lesions (11 benign, 25 malignant) in 23 patients who underwent MRI on a 1.5T magnet. Pre- and post-i.v. Gd-BOPTA sequences were reviewed without (set 1) and with single-shot echo-planar DW images and apparent diffusion coefficient (ADC) maps (b = 50, 400, 800 sec/mm^2) (set 2) in separate sessions. The reader recorded on a 1-5 score: (i) the confidence in lesion diagnosis (malignant/benign nature and type), for both sets; (ii) the impact of ADC vs. signal intensity (DWI images/ADC map) in achieving the diagnosis, for set 2.

Results: No significant difference ($p > 0.01$; Wilcoxon test) was found between the confidence scores of sets 1 and 2, both for lesions nature (mean:4.25 ± 0.8 vs. 4.11 ± 0.7, respectively) and type (4.11 ± 0.97 vs. 4.02 ± 084). Reader attributed significantly greater impact to signal intensity than ADC in achieving the diagnosis both for lesions nature and type (scores of 4.08 ± 1.15 vs. 3.2 ± 1.42 and 3.9 ± .1.13 vs. 2.9 ± 1.39, respectively) ($p < 0.01$; Wilcoxon test). Accuracy in characterizing lesions nature was similar without or with DWI (83.3%).

Conclusion: Expert reader relied on DWI signal intensity to characterize focal liver lesions. Nonetheless, DWI adds neither diagnostic confidence nor accuracy to contrast-enhanced MRI. Work-in-progress results will show whether DWI is more useful for less-experienced readers.

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11:15 -12:45 **Sala Laguna**

Scientific Session 8

Rectal cancer and pelvic floor (Tube 3)

SS 8.01

Restaging nodal status after chemoradiation for locally advanced rectal cancer: predictive factors for ypN0-status

M. Maas, D.M.J. Lambregts, M. Berkhof, G. Beets, R.G.H. Beets-Tan; Maastricht/NL

Purpose: Restaging N-stage after chemoradiation (CRT) is more accurate than N-stage prediction at primary staging of rectal cancer. Aim was to identify predictive factors which can help a radiologist in predicting yN-stage.
Material and Methods: 39 patients with locally advanced rectal cancer underwent MR imaging before and after CRT. All visible nodes in the mesorectum were measured and recorded before and 6-8 weeks after CRT on 3DT1W-GRE-sequence with 1mm^3 voxel size. Baseline characteristics were collected and compared between patients with and without nodal involvement at pathology. With regression analyses predictive factors for nodal involvement were identified. ROC curves were constructed for a predictive model based on the regression analyses.
Results: 913 nodes were identified, of which 392 (43%) disappeared after CRT. Patients with ypN+ had larger nodes than ypN0-patients: mean 6.3 vs 3.6mm before CRT and 4.5 vs 2.3mm after CRT, respectively (both $p < 0.0001$). Regression analyses identified pre- and post-CRT size, T-downstaging and primary CRM involvement as predictive factors for ypN0. In lesion-based analyses AUCs for the regression-based model, pre-CRT size and post-CRT size were 0.83, 0.78 and 0.78, respectively. On a patient-basis they were 0.84, 0.73 and 0.75, respectively.
Conclusion: Nodal size (both pre- and post-CRT), T-downstaging and CRM involvement at primary staging are predictors of ypN0-stage. With this knowledge and by use of these criteria a radiologist could select yN0-patients with higher sensitivity than when size is used as a single criterion.

SS 8.02

Does correlation between dynamic contrast-enhanced MRI and perfusion CT in rectal cancer change after neoadjuvant chemoradiation therapy?

G. Petralia, S. Viotti, P. Summers, L. Bonello, M. Pasin, R. Di Filippi, M. Bellomi; Milan/IT

Purpose: To compare the findings of dynamic contrast-enhanced (DCE) MRI and perfusion CT (pCT) in rectal cancer before and after neoadjuvant chemoradiation therapy (NACRT).
Material and Methods: Patients with locally advanced rectal cancer underwent DCE-MRI and pCT before and after NACRT. DCE-MRI was performed at 1.5T using a dynamic T1-weighted sequence after contrast administration (0.2mL/kg, 3.5mL/s). pCT was performed with a 16-slice MDCT after contrast administration (40mL, 4mL/s). Using dedicated software packages (MRIWorkbench and CT Perfusion 3), a radiologist defined regions of interest on tumour for each modality, which were applied to the corresponding functional maps to extract quantitative parameters: Ktrans, Kep, Ve and IAUC60 for DCE-MRI; blood flow (BF), blood volume (BV), mean transit time (MTT) and permeability-surface (PS) for pCT. Correlations between quantitative parameters were calculated.
Results: Up to date, 13 patients underwent both DCE-MRI and pCT before NACRT, whilst 10 after NACRT. Pre-therapy values showed moderate correlation between Kep and BV ($R = 0.64$), and a trend to correlation between Ktrans and BV ($R = 0.56$) and between Ve and PS ($R = 0.55$). Post-therapy values showed moderate correlation between Ktrans and PS ($R = 0.63$), Kep and PS ($R = 0.61$) and IAUC and PS ($R = 0.61$).
Conclusion: DCE-MRI estimates of capillary permeability (Ktrans and Kep) correlated with pCT parameters estimating blood volume before NACRT and capillary permeability after NACRT. Ktrans and Kep may therefore exhibit different sensitivity to the vascular status of rectal cancer if measured before or after NACRT, possibly relating to the changes in the balance between flow and permeability limited conditions.

SS 8.03

Magnetic resonance volumetry in rectal cancer patients after preoperative chemoradiotherapy: impact of the volume reduction ratio on disease-free survival and on the prediction of histopathologic complete response

S. Nougaret, M. Pierredon Foulongne, P. Rouanet, J.M. Bruel, B.P. Gallix; Montpellier/FR

Purpose: The aim of this study was to determine the relationship between rectal cancer volume changes assessed by magnetic resonance (MR) volumetry, histopathologic tumor response and disease-free survival (DFS) in patients undergoing preoperative chemoradiation therapy (CRT).
Material and Methods: 58 patients who underwent preoperative CRT followed by radical surgery were enrolled in the study. The tumor volume before and after CRT was measured by a semi-automated software by two radiologists. The tumor volume reduction ratio, shown by MR volumetry, was compared with the histopathologic response and the DFS.
Results: Concordance correlation coefficient (ICC) between the two radiologist was 0.87 (0.76-0.93) for volumetry. The concordance correlation was 0.69 (0.64-0.73) for both T staging. The mean tumor volume was 56cm3 +/- 7 in tumoral regression grade (TRG) 1-2 whereas the mean tumor volume in patient who showed TRG3-4 was 83 cm3+/-8. Patients with a volume reduction ratio of more 75% were associated with a higher DFS at 2 year ($P = 0.0001$).
Conclusion: Our study demonstrates that cancer volumetry is a reliable marker for rectal cancer prognosis. In contrary to traditional parameters (CRM, Downstagin), MRI volumetry might be easier to measure, faster to perform and predicts as well as other methods survival prognosis.

SS 8.04

Does the number of lymph nodes harvested at pathology in rectal cancer depend on the surgeon and pathologist only?

M. Maas, R.G.H. Beets-Tan, D.M.J. Lambregts, M. Berkhof, G. Beets; Maastricht/NL

Purpose: Prognosis of rectal cancer patients depends on the number of harvested nodes. Harvest depends on quality of surgery&pathology and patient factors. Aim was to evaluate with MRI whether there are differences in number&size of mesorectal lymph nodes (MRL) between patients with and without rectal cancer, which could influence nodal harvest.
Material and Methods: Size and number of MRL in 71 rectal cancer patients and in 30 controls were measured on 3DT1W-MRI with 1mm^3 voxel size. Control patients had disease not affecting MRL. These measurements were compared between rectal cancer patients and controls and in subgroups of rectal cancer patients with and without positive nodes at pathology.
Results: Mean 16 ± 9 MRL were found per control vs. 21 ± 12 MRL per rectal cancer patient ($p = 0.019$). Mean node size for controls was 1.6 ± 0.8mm vs. 2.8 ± 1.5mm for rectal cancer patients ($p < 0.0001$). Number and size of MRL did not differ between the pN+ and pN0 rectal cancer patients: 21 ± 10 nodes/patient (pN+) vs. 22 ± 13 nodes/patient (pN0) ($p = 0.61$). Size was 3.2 ± 1.8 (pN+) vs. 2.5 ± 1.3 (pN0), $p = 0.07$. Number and size of rectal cancer patients with pN0 were significantly higher than in controls: $p = 0.026$ (number) and $p = 0.001$ (size).
Conclusion: Number and size of MRL are significantly higher in rectal cancer patients than in controls. This supports the literature that there might be an immune response to rectal cancer, leading to an increased number and size of nodes. Further research to evaluate the relationship between number and size of nodes at MRI and this immune response and prognosis is indicated.

SS 8.05

Gadofosveset-enhanced MRI for nodal staging in rectal cancer: predictive criteria

D.M.J. Lambregts, M. Maas, I.J.G. Rutten, W.H. Backes, R.G. Riedl, F.C.H. Bakers, V.C. Cappendijk, G. Beets, R.G.H. Beets-Tan; Maastricht/NL

Purpose: Recently we showed that MRI using a new lymph-node contrast agent (gadofosveset) can significantly improve accuracy for nodal staging in rectal cancer -- to a level that can be sufficient for clinical decision making. Aim of this study was to determine the most accurate predictive imaging criteria for lymph node assessment using gadofosveset-MRI.
Material and Methods: 33 patients underwent a 3D T1-weighted GRE sequence (1 mm isotropic voxels), both before and after administration of gadofosveset-contrast. For each node the signal intensity (SI) was measured on pre- and post-contrast MRI. Furthermore, the nodal border characteristics ("relief effect") were scored. Finally, nodes were scored (using a 5-point confidence score) by an MR-rectum expert, based on visual evaluation of SI and nodal relief. Nodes were drawn on an anatomical template for lesion-by-lesion histologic validation.
Results: 289 nodes (55 malignant) were analysed. On pre-contrast MRI, SI did not differ between benign and malignant nodes. On gadofosveset-MRI, SI was significantly higher in the benign nodes ($p<0.0001$), which resulted in an area under the ROC-curve (AUC) of 0.74. The combination of SI and nodal relief rendered an AUC of 0.88. When analysed visually, AUC for discrimination of metastatic nodes was 0.92.
Conclusion: Only benign nodes show uptake of gadofosveset-contrast. The best criteria are nodal signal intensity and a nodal relief. When analysed visually, these criteria provide high accuracy for discrimination of metastatic nodes.

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SS 8.06

Standardized intensity ratio: a robust, effective and reproducible DCE-MRI semi-quantitative index to monitor LARC before and after preoperative combined radio and chemo-therapy

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Purpose: The aim was to investigate the relationship among standalone morphological MRI (mMRI), combined morphological and qualitative DCE-MRI (qMRI) and standalone DCE-MRI pattern analysis (paMRI) in tumor response evaluation, to obtain a reliable and reproducible assessment of preoperative radio-chemo therapy (pCRT) in locally advanced colorectal cancer (LARC).
Material and Methods: 30 patients, LARC affected, were enrolled in this perspective study. All patients underwent dynamic contrast-enhanced MRI examination with a 1.5T scanner before and after pCRT. After total surgical mesorectal excision (TME), pathological TNM (pTNM) was obtained. mMRI and qMRI evaluation were performed by two blinded expert radiologists. DCE-paMRI was based on multiple ROIs and 14 TIC shape descriptors were computed for each selected ROI. Paired sample tests, Hotelling trace criterion (HTC) and ROC analysis were applied.
Results: mMRI sensibility (SEN), specificity (SPE) were, respectively, 54,2% and 66,7%; qMRI SEN and SPE were 66,7%, 87,5%. WII*WIS+AUCWO match, obtained through HTC analysis provided the best statistically significant gain in paMRI. Cut-off value of 199,98% divided pT3 group (non-responders) by pT2 and pT0-pT1 group (responders) with SEN of 91.7% and SPE of 100%.
Conclusion: Being WII*WIS+AUCWO based on piecewise linearly fitted normalized TICs, it allows a reproducible comparisons between current or retrospective studies. This term, named standardized intensity ratio (SIR) gained best values of SEN and SPE, leading to an objective and easy differentiation between responders and non-responders, by means of a defined cutoff, resulting in a reliable index for a fast clinical employment.

SS 8.07

Selection of patients with rectal cancer for local excision with lymph node specific contrast-enhanced MRI

M. Maas[1], D.M.J. Lambregts[1], J.W. Leijtens[2], S.M. Engelen[1], S.D. Ayodeji[1], R.M. van Dam[1], G. Beets[1], R.G.H. Beets-Tan[1]; [1]Maastricht/NL, [2]Roermond/NL

Purpose: T1-2 rectal cancer brings about 5-20% risk for N+disease, which cannot be accurately evaluated with standard imaging. To minimise the risk for local recurrence (LR), total mesorectal excision (TME) is performed in these patients. Accurate prediction of N0-status could make local excision (LE) feasible. Aim is to evaluate whether contrast-enhanced (CE)-MRI is useful in selecting patients with N0-status for LE.
Material and Methods: 38 patients who underwent LE for rectal cancer were included and underwent T2W and T1W-CE-MRI with ultrasmall superparamagnetic particles of iron-oxide (USPIO; n = 26) or gadofosveset (n = 12) to evaluate N-stage and residual tumour. An expert radiologist evaluated the images. In case of N0-status, patients underwent follow-up with regular visits, endoscopy and/or MRI. Patients with N+status underwent TME (+/-neoadjuvant therapy).
Results: CE-MRI indicated N0-status in 35/38 patients, who underwent follow-up. 3 patients had suspected N+status, of which 2 had surgery, which confirmed N+status in one patient, but refuted N+status in the other (false-positive). The third patient underwent chemoradiation which sterilised the nodes. These 3 patients are disease-free and alive. Median follow-up for all patients is 31 (0-65) months. Three luminal and one nodal LR were found in the follow-up group. All recurrences were curatively treated. 2-year disease-free survival is 94%.
Conclusion: CE-MRI is useful for selecting N0-patients for LE. The low LR-rate and resectability of the local recurrences suggest that CE-MRI can be important in safely selecting T1-2N0 tumours for LE, leading to lower treatment-related morbidity.

SS 8.08

Neoadjuvant chemotherapy evaluation by 3D MRI volumetry in rectal cancer followed by chemoradiotherapy and total mesorectal excision: a pilot study

S. Nougaret, P. Rouanet, M. Pierredon Foulongne, J.M. Bruel, B.P. Gallix; Montpellier/FR

Purpose: 17 consecutive patients who underwent neoadjuvant chemotherapy (CX) before chemoradiotherapy (CRT) and surgery were enrolled in the study. Tumor volume regression (TVR) was studied at the first MRI, after CX and after CRT. TVR was compared with histological results to assess the chemotherapy response. Histological results were classified into two groups: good response: TRG 3 or TRG 4 and bad response: TRG 1 or 2.
Material and Methods: 17 consecutive patients who underwent neoadjuvant chemotherapy (CX) before chemoradiotherapy(CRT) and surgery were enrolled in the study. Tumor Volume Regression (TVR) was studied at the first MRI, after CX and after CRT. TVR was compared with histological results to assess the chemotherapy response. Histological results were classified in two groups: good response: TRG 3 or TRG 4 and bad response: TRG 1 or 2.
Results: After neoadjuvant CX, regarding the tumor volume regression, 5 patients had a favourable response (volume regression of over 75%), 9 unfavourable response (volume regression less than 75%). These results were consistent with histologic findings (p = 0.003).Moreover, there was a positive relationship between the tumor volume, as measured in the postoperative specimen, and the post-treatment tumor volume after neoadjuvant CX as determined by MR Volumetry (r2 = 0.93).
Conclusion: Our pilot study shows that MRI volumetry after CX could predict histological response and could be an help for the clinician to distinguish good and bad responders in order to propose an individual adapted treatment to prevent both drawback treatment effects and recurrence.

SS 8.09

Diagnostic usefulness of proctographic and cine-defecographic investigation in patients with chronic constipation

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Purpose: Current study was designed to assess the diagnostic usefulness of radiologic investigation in patients with obstructed defecation caused by pelvic outlet obstruction. Moreover, the clinical usefulness of combined studies using the proctographic and cine-defecographic images were highlighted.
Material and Methods: 555 patients with chronic constipation visited our clinic and anorectal physiologic studies were performed. Studies included proctography and cine-defecography (n = 553), anal manometry (n = 237), anal EMG/PNTML (n = 133), and colonic transit time study (n = 85), Age matched control data (n = 33) in anal manometry and sex matched control data (n = 20) were selected from volunteers.
Results: Patients were categorized as rectocele (Group I: n = 337; sensitivity; 98%, specificity; 94%, accuracy; 96%, false positive rate; 6%, false negative rate; 2%, kappa;0.925), nonrelaxing puborectalis syndrome(Group II: n = 164; 86%, 90%, 88%, 10%, 14%, respectively, kappa; 0.738). rectoanal intussusception (Group III: n = 45; 100%, 97%, 97%, 3%, 0%, respectively, kappa;0.826). significant sigmoidocele (Group IV: n = 9; 97%, 97%, 3%, 0%, respectively, kappa;0.488). As compared with combined study (proctography plus cine-defecography), the proctogram showed decreased diagnostic rates in the evaluation of rectocele ($p < 0.05$), nonrelaxing puborectalis ($p < 0.01$), and rectoanal intussusception ($p < 0.05$). Moreover, the proctogram also showed increased false positive rate in the evaluation of rectocele ($p < 0.01$), nonrelaxing puborectalis ($p < 0.01$), and rectoanal intussusception ($p < 0.05$).
Conclusion: Current data suggested that proctography showed a tendency to overdiagnosis. Therefore, the combined study of proctography with cinedefecography should be taken as a diagnostic tools for patients with obstructed defecation. This helps the clinical decision making.

SS 8.10

Dynamic pelvic floor MRI performed with a balloon catheter and rectal air filling: comparison with conventional defecography in the evaluation of functional pelvic floor disorders

F. Maccioni, N. Al Ansari, F. Mazzamurro, M. Martinelli, I. Staltari, M. Marini; Rome/IT

Purpose: Purpose of this study was to compare dynamic pelvic floor MRI (DPF-MRI) with conventional defecografy in a group of patients affected by pelvic floor disorders.
Material and Methods: 36 consecutive patients (33 females) aged between 25 and 75 years (mean age 57) with pelvic floor dysfunction underwent physical examination and evacuation proctography before DPF-MRI. The two examinations were compared with regard to the following parameters: ano-rectal angle, ARJ descent, rectocele, invagination, diskinesia, other findings.
Results: Significant correlation was found between ano-rectal angles (ARAs) at straining (r: 0.38, ($p < 0.02$), at rest (r: 0.440, $p < 0.07$) and in contraction (r: 0.389 ($p < 0.19$); a stronger correlation (r: 0.612, $p < 0.0001$) was found between MRI and conventional defecography, with 75%sensitivity and 66.7% specificity. Agreement between the two examinations was obtained in 29/32 cases of dyskinesia and 26/36 cases of rectal invagination, with 86 and 72% of MRI accuracy, respectively . No significant correlation was found for cystoceles and enteroceles, being MRI superior to conventional defecography.
Conclusion: Standard measurements of anorectal configuration at evacuation proctography and dynamic MR imaging showed a significant correlation. A good correlation was found both for the presence and staging of rectoceles, as well as with the assessment of invagination. Other findings, extremely important for surgical planning, such as cystocele and enterocele, could be detected by MRI only.

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11:15 -12:45 **Sala Feste**

Scientific Session 9

Pancreas - solid and cystic lesions

SS 9.01

MR imaging versus positron emission tomography-CT for evaluation of pancreatic lesions

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Purpose: To retrospectively determine the diagnostic accuracy of magnetic resonance imaging (MRI) and combined positron emission tomography/computed tomography (PET-CT) in the differential diagnosis of benign and malignant pancreatic lesions.

Material and Methods: Twenty-seven patients (15 women/12 men, mean age 56.5) with MR imaging and PET-CT studies performed to differentiate benign and malignant pancreatic lesions were identified between October 2008 and October 2010. Both MR and PET-CT datasets were retrospectively and blindly evaluated by two independent readers (4 readers total) with different experience degrees, using a five-point visual score system. The results were correlated with final diagnosis obtained by histopathology.

Results: 18 patients had malignant diseases and 9 patients had benign diseases. Depending on the observer, sensitivity, specificity, positive predictive value and negative predictive values of MRI were 88-94%, 50-80%, 75-89% and 71-89%, respectively. Sensitivities, specificities, positive predictive values and negative predictive values of PET-CT were 71-79%, 56%, 71-73% and 56-63%, respectively. The diagnostic accuracy of MR for the differential diagnosis of pancreatic lesions was 74-89%, compared with 65-70% for PET-CT. The Cohen kappa coefficient was 0.47 at MR and 0.60 at PET-CT.

Conclusion: MRI achieved higher sensitivity and specificity in the differential diagnosis of pancreatic lesions; however, the inter-observer agreement was relatively poor.

SS 9.02

Accuracy of CEUS in the characterization of focal pancreatic lesions

M. D'Onofrio, A. Gallotti, F. Principe, R. Malagò, E. Martone, R. Pozzi Mucelli; Verona/IT

Purpose: To describe the typical CEUS pattern and to evaluate the diagnostic accuracy of CEUS in the characterization of pancreatic lesions.

Material and Methods: All CEUS examinations of focal pancreatic masses performed during a period of five years were reviewed. Inclusion criteria were: focal pancreatic mass pathologically proved, visible at ultrasound (US) and studied with CEUS. All lesions were then evaluated for enhancement pattern. Sensitivity, specificity, positive and negative predictive values with 95%CIs were calculated to define diagnostic accuracy of CEUS with respect to pathology. Agreement was evaluated by means of k statistics.

Results: 876 pancreatic lesions were included. At CEUS the lesions were divided into solid (82%) and cystic (18%) masses and classified into six and eight categories, respectively. There were among the solid lesions, ductal adenocarcinomas were characterized with an accuracy of 85.8%. Among the cystic lesions, cystic tumors were diagnosed with an accuracy of 97.5%. Inter-observer agreement was slightly higher for solid (k = 0.78) than cystic (k = 0.62) lesions. In none of the centers side effects were reported.

Conclusion: CEUS is accurate in the characterization of pancreatic lesions. CEUS should be considered as a complementary imaging method for pancreatic lesions characterization. CEUS study after US detection of an incidental focal pancreatic lesion will therefore improve the diagnostic accuracy.

SS 9.03

MDCT vs CEUS in the preoperative staging of pancreatic adenocarcinoma

G.A. Zamboni, M.C. Ambrosetti, F. Lombardo, M. D'Onofrio, R. Pozzi Mucelli; Verona/IT

Purpose: To compare MDCT and CEUS in the preoperative staging of pancreatic adenocarcinoma.

Material and Methods: MDCT and CEUS examinations performed in a two year period were prospectively compared with surgical notes and pathology reports from 111 patients with pancreatic carcinoma. Imaging findings were compared with surgical reports or patient follow-up. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for resectability were calculated for the two modalities.

Results: 53 patients underwent resection, while 58 underwent palliative procedures because judged unresectable. According to MDCT angiographic criteria, 57 patients were resectable and 54 unresectable: the clinical interpretation of CT angiographic scans in all 111 patients had 83% sensitivity in the detection of resectability, 78% specificity, 77% PPV and 83% NPV. According to CEUS criteria, 58 patients were resectable and 53 unresectable: the clinical interpretation of CEUS findings in all 111 patients had 85% sensitivity in the detection of resectability, 78% specificity, 78% PPV and 85% NPV. When at least one modality confirmed resectability, sensitivity, specificity, PPV and NPV were, respectively, 89%, 76%, 77% and 88%.

Conclusion: MDCT angiography and CEUS are effective tools for the preoperative staging of pancreatic adenocarcinoma, and in an experienced setting provide similar results in terms of accuracy.

SS 9.04

CT perfusion can predict ductal adenocarcinoma pathological grading

M. D'Onofrio, A. Gallotti, A. Ventriglia, R. Pozzi Mucelli; Verona/IT

Purpose: The aim of this study is to analyze the correlation between the enhancement pattern of pancreatic adenocarcinoma at perfusion CT and its pathologic grading.

Material and Methods: From December 2009 to June 2010, 22 patients with pancreatic adenocarcinoma were included in this study. They had unresectable carcinoma, no presence of metastases at the imaging and they had not previously undergone chemotherapy or palliative care. All pancreatic lesions were first evaluated by perfusion CT. Blood volume (BV), perfusion (P), time to peak (TTP) and peak of enhancement (PEI) values were obtained. All pancreatic lesions then received needle biopsy.

Results: 22 pancreatic lesions, average diameter of 4.58 cm, were studied. The lesions were pathologically classified into low-grade 8/22 (36.4%) and high-grade carcinomas 14/22 (63.6%). Comparing the median of the perfusion parameters of the low-grade lesions with the perfusion parameters of the high-grade lesions, the PEI was significantly different using Mann-Whitney U test ($p < 0.05$). The accuracy to identify the high-grade lesion was 84.1% with a positive predictive value of 95% for PEI < 20 HU and 68.2% with 100% for PEI < 15 HU.

Conclusion: PEI, among the perfusion CT parameters, seems to be accurate in the identification of the high-grade pancreatic ductal adenocarcinoma.

SS 9.05

18F-FDG PET/CT in pancreatic carcinoma: diagnosis and staging

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Purpose: To evaluate the reliability of ^{18}F-FDG PET/CT in the preoperative evaluation of pancreatic masses and in the assessment of the resectability of pancreatic cancer.

Material and Methods: 106 patients with suspected or diagnosed pancreatic carcinomas underwent contrast-enhanced multislice ^{18}F-FDG PET/CT. Malignancy was confirmed in 72 patients (prevalence 0.679).

Results: ^{18}F-FDG PET/CT correctly diagnosed pancreatic carcinoma in 61 patients, 11 false negative (FN), 5 false positive (FP), 29 true negative (TN): sensitivity_0.847 (95% CI 0.764-0.930), specificity_0.853 (95% CI 0.734-0.972), PPV_0.924, NPV_0.725, LR+ 5.761, LR- 0.179. Lymph node (N) and distant metastases (M) staging was evaluated in the subgroup of 67 patients which underwent surgical exploration (42 carcinomas – prevalence_0.626). Histologically confirmed lymph node involvement (prevalence_0.239) was detected using ^{18}F-FDG PET/CT in 8 patients, 8_FN, 4_FP, 47_TN: sensitivity_0.500 (95% CI 0.255-0.745), specificity_0.922 (95% CI 0.848-0.995), PPV_0.667, NPV_0.855, LR+ 6.375, LR- 0.543. ^{18}F-FDG PET/CT revealed distant metastases (prevalence_0.328) in 12 patients, 10_FN, 1_FP, 44_TN: sensitivity_0.545 (95% CI 0.337-0.754), specificity_0.978 (95% CI 0.935-1.021), PPV_0.923, NPV_0.815, LR+ 24.545, LR- 0.465. According to ^{18}F-FDG PET/CT, 19 patients with pancreatic carcinoma were judged to have non-operable disease.

Conclusion: Contrast-enhanced multislice ^{18}F-FDG PET/CT appears to be an attractive staging tool for pancreatic cancer, although the N and M staging sensitivity values are lower than levels of specificity. It could help to omit a non-indicated surgery in patients with advanced disease. This study was supported by IGA MZCR (NT11023-3/2010).

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SS 9.06

Non-functioning neuroendocrine tumors of the pancreas: MRI appearance and correlation with biological behavior

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Purpose: To describe MRI features of non-functioning neuroendocrine tumors (NF-NETs) of the pancreas, compared to histopathology and assess capability of MRI in predicting their biological behavior.

Material and Methods: In the period January 2003–July 2010, 130 patients affected by NF-NET were observed at our Institution. Inclusion criteria: surgical resection and histopathological examination of NF-NET, ≥1 preoperative MR/MRCP examinations. Our study encompassed 45 patients. At histopathology: 16 NF-NET were adenomas, 10 borderline neoplasm and 19 carcinomas. For each lesion we evaluated, maximum diameter, margins, presence of vascular encasement, local spread, presence of metastasis, signal intensity on T1- and T2-weighted images and vascularization.

Results: Evaluated MRI parameters showed an overall excellent concordance with pathologic findings (k = 0.88). Adenomas presented mean maximum diameter of 13mm, borderline lesions 32mm and carcinomas 65mm. 6,3% of adenomas showed irregular margins, 33.3% of borderline lesions and 63.2% of carcinomas. Vascular encasement was appreciable in 57.9% of carcinomas, 0% of borderline lesions and 6.3% of adenomas. Local spread was present in 52.6% of carcinomas, in 11.1% borderline lesions and in 0% adenomas. 21.1% of patients affected by carcinoma presented metastases, and none of the other groups.

Conclusion: Carcinomas show a significantly larger diameter than adenomas and borderline lesions ($p = 0.001$). Irregular margins, vascular encasement, local spread and presence of metastasis are significantly ($p < 0.05$) associated with malignant behavior. No significant differences were found in signal intensity and vascularization between different graded lesions.

SS 9.07

Non-functioning pancreatic endocrine tumors: preoperative assessment by means of contrast-enhanced MDCT and contrast-enhanced MRI

G. Foti, N. Faccioli, G. Malleo, G. Zamboni, R. Manfredi, R. Pozzi Mucelli; Verona/IT

Purpose: To compare contrast-enhanced MDCT and contrast-enhanced MRI capabilities in the preoperative assessment of non-functioning pancreatic endocrine tumors (NPET).

Material and Methods: In a 4-year period, 32 consecutive patients with pathologically proven NPET (17 males, 15 females, mean age 49 years, range 25-64), preoperatively studied with MDCT and MRI, were evaluated. Both MDCT and MRI protocols included pre-contrast (unhenanced CT and T1-w and T2-w MRI) and post-contrast scans (arterial-pancreatic, 45 sec; portal, 80 sec; late venous, 120 sec). Student't test was used to compare enhancement patterns (hyper versus iso-hypovascularity with respect to normal pancreas), main pancreatic duct (MPD) involvement (upstream dilation vs normal MPD), vessels involvement (absent or operable versus inoperable), and liver metastases (presence versus absence). A value of $p < 0.05$ was considered significant.

Results: Lesion hypervascularity was depicted in 24/32 (75.0%) MDCT and 25/32 (78.1%) MRI exams ($p = 0.1$). MPD involvement was present in 13/32 (34.3%) MRI and 12/32 (37.5%) MDCT exams ($p = 0.1$). Vessel involvement was correctly evaluated in 30/32 (93.7%) cases at MDCT and 27/32 (84.3%) cases at MRI ($p = 0.025$). Liver metastases were correctly identified in 11/32 (34.3%) cases both at MDCT and MRI ($p = 0.45$).

Conclusion: MDCT and MRI presented similar overall accuracy for preoperative assessment of NPET. However, MDCT may be slightly superior to MRI in the evaluation of vessel involvement because of its higher spatial resolution.

SS 9.08

Gastroenteropancreatic neuroendocrine tumors: standardizing therapy monitoring with Ga-68-DOTATOC PET/CT, using the example of somatostatin receptor radionuclide therapy

W. Luboldt, K. Zoephel, B. Wiedemann; Munich/DE

Purpose: To standardize therapy monitoring of hepatic metastases from gastroenteropancreatic neuroendocrine tumors (GEP-NETs), during the course of somatostatin receptor radionuclide therapy (SRRT).

Material and Methods: In 21 consecutive patients with non-resectable hepatic metastases of GEP-NETs chromogranin A (CgA) and Ga-68-DOTATOC PET/CT were compared before and after the last SRRT. On Ga-68-DOTATOC PET/CT, the maximum standard-uptake values (SUV_{max}) of normal liver and hepatic metastases were calculated. In addition, hepatic metastases volumes (volume-of-interest (VOI)) were measured using four cut-offs to separate normal liver tissue from metastases (cut-off: SUV_{max} of the normal liver plus 10% ($VOI_{liver+10\%}$), 20% ($VOI_{liver+20\%}$) 30% ($VOI_{liver+30\%}$) and SUV = 10 (VOI_{10SUV})).

Results: The SUV_{max} of the normal liver was below 10 (7.2 ± 1.3) in all patients and without significant changes. Overall therapy changes per patient [mean (95% confidence interval (CI))] were statistically significant ($p < 0.01$); for: ΔCgA = -43 (-69…-17)%, ΔSUV_{max} = -22 (-29…-14)%, ΔVOI_{10SUV} = -53 (-68…-38)% and less significant ($p < 0.05$) for: $\Delta VOI_{liver+10\%}$ = -29 (-55…-3)%, $\Delta VOI_{liver+20\%}$ = -32 (-62…-2)% and $\Delta VOI_{liver+30\%}$ = -37 (-66…-8)%. Correlations were found only between: ΔCgA and ΔVOI_{10SUV} ($r = 0.595$; $p < 0.01$), ΔSUV_{max} and ΔVOI_{10SUV} (0.629, $p < 0.01$), and between SUV_{max} and ΔSUV_{max} ($r = -0.446$; $p < 0.05$).

Conclusion: Ga-68-DOTATOC PET/CT allows volumentric therapy monitoring via a SUV-based cut-off separating hepatic metastases from normal liver tissue (10 SUV recommended).

SS 9.09

Small cystic lesions of the pancreas: incidence and size changes in a large series population

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Purpose: To evaluate the incidence and size changes of small pancreatic cysts in a large series population.

Material and Methods: We reviewed the reports of MR of abdomen in the period March 2005-March 2010. Reports positive for cystic lesions of the pancreas were selected and images reviewed.

Results: We evaluated 4463 patients: 394 (8.8%) patients have been selected with at least one cystic lesion of the pancreas <4 cm. 174 were males (44,2%), 220 females (55.8%). 140 patients had a single lesion, with a mean diameter at diagnosis of 15 mm: 54 patients <10 mm, 57 with 10-20 mm, 21 with 20-30 mm and 22 >30 mm. 86 patients were followed up at 6, 12, 24 or 36 months. 254 patients had a multifocal lesion with a mean diameter at diagnosis of 16 mm: 95 patients <10 mm, 106 with 10-20, 31 with 20-30 mm and 22 >30 mm. 173 patients were followed up at 6, 12, 24 or 36 months. No differences in age and sex was evident between monofocal and multifocal lesions. The lesions did not show significant diameter increase at follow-up up to 36 months, either for single lesion or multifocal.

Conclusion: Small cystic lesions of the pancreas are not infrequent in daily practice. Follow-up is a safe procedure as there is no significant variation in size of the lesions. Time interval for follow up can be lengthened.

SS 9.10

Diagnostic performance of MR imaging for pancreatic cysts: focusing on communication with main duct and differential diagnosis of malignant pancreatic cysts

J.H. Kim, H.W. Eun, S.S. Hong, J.K. Han, B.I. Choi; Seoul/KR

Purpose: To assess diagnostic ability of MRI for pancreatic cyst communication with main duct and differential diagnosis of malignant versus benign pancreatic cysts.

Material and Methods: During 5 years, we performed MRCP and contrast-enhanced MRI in 65 patients with pancreatic cysts who underwent ERCP or surgery. Among them, 36 consecutive patients confirmed communication with main duct and 29 patients confirmed non-communication. Among them, 51 patients were pathologically proven. Pancreatic cysts include IPMN (n = 26), pseudocyst (n = 6), serous cystadenoma (n = 1), retention cyst (n = 1) in communication group and IPMN (n = 6), pseudocyst (n = 4), mucinous cystadenoma (n = 1), serous cystadenoma (n = 2), SPT (n = 1), islet cell tumor (n = 1), undifferentiated carcinoma (n = 1), retention cyst (n = 1) in non-communication group. Two radiologists retrospectively and independently graded the cyst communication with main duct and malignancy using five-point scale. They also measured size of cyst and main duct. Diagnostic performances were analyzed using the area under the receiver operating characteristic curve. Sensitivity and specificity were also calculated. Mann–Whitney U test was used. The statistics was used to determine interobserver agreement.

Results: Area under the ROC curve for MR diagnostic performance of cyst communication with main duct was 0.931 and using the cut-off points as 3, sensitivity was 91.4% and specificity was 89.7%. Interobserver agreement was excellent (= 0.81). Area under the ROC curve for MR diagnostic performance of differentiate malignant from benign pancreatic cysts was 0.902 and using the cut-off points as 3, sensitivity was 94.3% and specificity was 75.0%. Interobserver agreement was excellent (= 0.82). The mean size of malignant and benign cysts (3.98cm + 2.74: 3.17cm + 1.26, $p = 0.327$) and main duct (5.20mm + 3.22: 4.39mm + 4.12, $p = 0.227$) showed no statistically difference between malignant and benign pancreatic cysts.

Conclusion: MRI accurately assess pancreatic cyst communication with main duct and very useful for differential diagnosis of malignant versus benign pancreatic cysts.

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11:15 -12:45 **Sala Mosaici 1**

Scientific Session 10

CTC 2 - bowel preparation & screening

SS 10.01

Bowel preparation for CT colonography with reduced volume polyethylene glycol-based preparation and low-osmolar non-ionic iodinated contrast agent

D.A. Tiferes, C.A. Matsumoto; São Paulo/BR

Purpose: To evaluate the efficacy of CT colonography bowel preparation using primarily a reduced PEG–based preparation (1.5 L) and low-osmolar non-ionic iodinated contrast agent.

Material and Methods: 312 consecutive patients undergoing CT colonography were evaluated. Bowel preparation consisted primarily of a reduced volume PEG-based preparation (1.5 L) and a 50 mL dose of low-osmolar non-ionic iodinated contrast agent (iobitridol) for fecal and fluid tagging. Liquid diet and low-dose bisacodyl (10 mg) were also used. Two radiologists prospectively scored the colon for the amount of residual stool and fluid using a 4-point scale and classified tagging of residual fluid and stool as adequate or inadequate.

Results: Stool-free segment or only minimal particles (<5mm) was seen in 90.4% of colonic segments. Residual fluid occupying less than 50% of lumen was seen in 94.2% of segments. Tagging of residual fluid and stool was considered adequate in 95.8% and 88.0% of the cases, respectively. No immediate complications related to the bowel preparation were seen.

Conclusion: The use of reduced volume PEG–based preparation and low-osmolar non-ionic iodinated contrast agent resulted in adequate bowel preparation for CT colonography in the vast majority of patients.

SS 10.02

CT colonography with iodinated enema fluid tagging: feasibility and preliminary results

E. Neri, L. Faggioni, E. Picano, P. Vagli, F. Cerri, R. Scandiffio, C. Bartolozzi; Pisa/IT

Purpose: To evaluate the feasibility and effectiveness of fluid tagging in CT colonography (CTC) by rectal introduction of iodinated contrast material (CM).

Material and Methods: Thirty-six patients (male:female = 12:24, age 57-81 years, mean 66 years) underwent CTC for colorectal cancer screening using a low radiation dose protocol. Prior to CTC, patients received a three-day low residue diet plus a low dose of Macrogol after each meal, beginning 3 days before CTC. Immediately before CTC, all patients received an enema consisting of 100mL diatrizoate dimeglumine diluted in 300mL of warm tap water, followed by automatic insufflation of 2.5-3.5L of carbon dioxide. Between rectal CM and insufflation, patients were asked to repeatedly turn themselves on the CT table to ensure homogeneous opacification of the colon. Intraluminal CT density was measured inside the cecum/ascending colon, transverse, descending colon, and in the sigmoid colon/rectum. The time required for CM enema administration and insufflation was measured, and patients' satisfaction was recorded using a four-point score (1 = low, 2 = moderate, 3 = high, 4 = very high).

Results: Overall colonic enhancement was 726 ± 597 HU, with no significant difference among the various colonic segments (p = 0.3705). The time needed for the entire rectal tagging procedure was 13.4 ± 3.2 minutes. Overall patients' tolerance after CTC was graded 3.78 ± 1.16. Neither complications nor adverse events occurred during and after the procedure.

Conclusion: CTC with iodinated enema allows good and homogeneous enhancement of the colonic lumen and is well tolerated.

SS 10.03

CT colonography bowel preparation: influence of a laxative agent on a fluid tagging preparation

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Purpose: To compare two different bowel preparations in terms of patient acceptance and image quality.

Material and Methods: Seventy five consecutive patients were prospectively randomised in two groups. Both groups followed a low residue diet for two days before the examination. Both preparations were based on fluid tagging, using a iodinate contrast medium (gastromiro). Group 1 received 180 ml of fluid tagging agent the day before the study. Group 2 received 100 ml of fluid tagging agent and 500 ml of a laxative agent (Lovol-esse) the day before the study. Patient acceptance was evaluated using a visual assessment scale. Quality of bowel preparation was evaluated using quantitative (tagged fluid density and number of untagged residue per segment) and qualitative (tagging homogeneity per segment on a 4-point scale).

Results: Bowel preparation was complete in all patients. No statistical significant differences for tagged fluid density, number of residue and tagging homogeneity between the two groups were founded. A significant higher patient acceptance was founded in group 2 (P = 0.02).

Conclusion: The preparation based on the combination of a laxative and a fluid tagging agents was better accepted. Adding a laxative agent to a fluid tagging preparation did not improved image quality but was associated with an higher patient acceptance. Moreover, if a laxative agent is added to a fluid tagging bowel preparation the amount of iodine can be reduced.

SS 10.04

CT colonography: development and validation of a novel registration algorithm to align prone and supine scans

D. Boone, H. Roth, S. Halligan, J. McClelland, T. Hampshire, S.A. Taylor, M. Hu, D. Hawkes; London/UK

Purpose: Despite colonic cleansing prior to CT colonography, prone and supine acquisitions remain necessary to differentiate pathology from luminal content. Observers must therefore match endoluminal locations between prone and supine studies, a process that is complicated by considerable colorectal deformation between acquisitions. We developed and validated a novel algorithm that establishes endoluminal spatial correspondence between prone and supine CT acquisitions.

Material and Methods: Ethical approval was obtained to use anonymised CT colonography data from 24 patients randomised into 12 development (13 polyps) and 12 validation sets (13 polyps). A radiologist (experience > 500 validated datasets), indicated the polyp volumes in both prone and supine CTC scans using separate multiplanar reformats. These polyps were masked from the algorithm to avoid biasing registration and used as reference points for validation. To perform registration, a triangulated mesh of the endoluminal colonic surface was first extracted from segmented colonic data. Surface parameterisation was then achieved using the Ricci flow method followed by non-rigid 2D B-spline registration to recover the deformations.

Results: Using the development set, 8 of the 13 polyps were registered successfully (62%) with a mean error of 6.6mm +- 4.8. In the validation set, 10 of the 13 polyps were registered successfully (77%) with a mean error of 6.7mm +- 4.6.

Conclusion: This novel algorithm allows accurate registration of prone and supine datasets and may ultimately simplify the interpretative task in CT colonography.

SS 10.05

Patient acceptability of CT colonography compared with double contrast barium enema: results from a multicentre randomized controlled trial

S. Halligan, C. von Wagner, S. Smith, A. Ghanouni, S.A. Taylor, J. Wardle, W. Atkin and the SIGGAR INVESTIGATORS; London/UK

Purpose: To determine the acceptability of barium enema (BE) or CT colonography (CTC) via a randomized controlled trial for patients being investigated for symptoms of colorectal cancer.

Material and Methods: After ethical approval, 921 consenting patients with symptoms of colorectal cancer who had been randomly assigned and completed either BE (N = 606) or CTC (N = 315) received a questionnaire to assess experience including bowel preparation, the primary randomized procedure and post-test complications. An adapted version of a previously validated patient acceptability scale rated overall satisfaction (10-70), worry (6-42) and discomfort (13-91). Higher scores indicated more positive experiences. Non-parametric methods assesed differences between the randomized procedures and patient characteristics.

Results: Patients undergoing BE were significantly less satisfied (median 61, interquartile range [IQR] 54-67 vs. median 64, IQR 56-69; p = 0.003) and experienced more physical discomfort (median 64, IQR 52-75 vs. median 68.5, IQR 57-79; p < 0.001) than those undergoing CTC. Post-test, BE patients were significantly more likely to experience 'abdominal pain/cramps' (68% vs. 57%; p = 0.007), 'soreness' (57% vs. 37%; p < 0.001), 'nausea/vomiting' (16% vs. 8%; p = 0.009), 'soiling' (31% vs. 23%; p = 0.034), and 'wind' (92% vs. 84%; p = 0.001) and in the case of 'wind' to also rate its intensity as severe (27% vs 15%; p < 0.001).

Conclusion: CTC is associated with modest albeit significant and consistent improvements to patient acceptability, both during, and immediately after, the diagnostic episode. These data support calls for CTC to replace BE.

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SS 10.06

Informed decision-making in colorectal cancer screening using colonoscopy or CT-colonography: a randomized controlled trial

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Purpose: To evaluate and compare the level of informed choice for colonoscopy and CT-colonography CRC screening in a RCT.

Material and Methods: 8,844 Dutch citizens (50-74yrs) were randomly invited for CRC screening: 5,924 to colonoscopy; 2,920 to CTC. Invitees received an information leaflet. All invitees received a questionnaire containing measures of knowledge and attitude; participants <4 weeks before the examination, non-participants 4 weeks after the invitation. Knowledge about CRC screening among colonoscopy and CTC invitees was measured by 11 and 14 statements, deemed sufficient if >50% was answered correctly. Attitudes towards screening were measured by four seven-point Likert-scales, ≥15 points indicating a positive attitude.

Results: Knowledge and attitude items were completed by 79% (980/1236) colonoscopy participants, 16% (725/4688) non-participants; 81% (762/935) of CTC participants and 11% (224/1985) non-participants. Of all responding colonoscopy and CTC participants, 977 (99.7%) and 755 (99%) had adequate knowledge, of which 933 (95%) and 728 (96%) had a positive attitude. Of all responding non-participants 700 (97%) and 212 (95%) had adequate knowledge, of which 184 (26%) and 35 (25%) had a negative attitude. Overall, 65% of colonoscopy and 77% of CTC responders made an informed decision (p = 0.001).

Conclusion: A majority of CRC screening invitees made an informed decision about participation. However, this concerned significantly more CTC invitees, suggesting additional barriers to participation in colonoscopy invitees.

SS 10.07

Individuals' time invested in participating in colorectal cancer screening with colonoscopy or CT-colonography

M.C. de Haan[1], L. van Dam[2], T.R. de Wijkerslooth[1], E. Stoop[2], P.M. Bossuyt[1], P. Fockens[1], M. Thomeer[2], E.J. Kuipers[2], M.E. van Leerdam[2], M. van Ballegooijen[2], J. Stoker[1], E. Dekker[1], E.W. Steyerberg[2]; [1]Amsterdam/NL, [2]Rotterdam/NL

Purpose: Measure the amount of time individuals spend in population-based CRC screening by colonoscopy or CT-colonography.

Material and Methods: 8,844 average-risk participants aged 50-74 were randomly invited for CRC screening by colonoscopy (n = 5,924) or CTC (n = 2,920). Colonoscopy was performed with 2L Moviprep and 2L clear fluid, CTC with 3 x 50mL Telebrix. Between February and May 2010 consecutive participants (eligible when able to read the Dutch language) were asked to participate in a diary study. Time intervals were recorded and are reported as median and interquartile range (IQR).

Results: 538 of 600 eligible subjects consented: 68% (240/355) of colonoscopy and 69% (127/183) of CTC participants completed the diary. For colonoscopy and CTC, median intervals between starting the preparation and leaving home for the examination were 17hrs (IQR15-18) and 19hrs (IQR18-20) (p < 0.001); between leaving home and arriving back home 4.3hrs (IQR3.5-5.0) and 2.5hrs (IQR2.1-3.0) (p < 0.001); between leaving home and returning to routine activities 6.0hrs (IQR4.0-17) and 3.2hrs (IQR2.3-6.2) (p < 0.001), between leaving home and feeling completely back to normal 13hrs (IQR5.1-22) and 24hrs (IQR6.9-48) (p < 0.001), between starting the preparation and feeling back to normal 35hrs (IQR22-39) and 43hrs (IQR26-67) (p < 0.001).

Conclusion: The time spent in the examination itself and before going back to routine activities was significantly shorter for CTC than for colonoscopy. Despite using limited bowel preparation, time needed to feel back to normal was longer for CTC participants.

SS 10.08

Computer-aided detection in CT colonography (CTC): which CAD paradigm is best in a screening population?

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Purpose: To prospectively compare the diagnostic performance and time efficiency of primary and second reader CAD paradigms.

Material and Methods: Individuals participating to a CRC screening program and with a positive FOBT test were recruited for same-day CTC and colonoscopy. Two experienced radiologists independently analyzed the CTC studies following randomization, using CAD as a first (CAD1) or as a second reader (CAD2); levels of confidence were assigned to positive findings. Reporting time, per-patient sensitivity for patients with adenomas or cancer ≥6 mm, specificity, 95% confidence intervals, and areas under ROC curves (AUC) were calculated for both reading paradigms. CC and histology were reference standards.

Results: Seventeen of the 199 enrolled individuals (8.5%) were excluded for: refusal to perform CC (3), unavailable histological data (4), protocol violation (3) and non-diagnostic image quality (7). The remaining 182 individuals included 93 patients (51%) with at least one adenoma ≥6mm. Sensitivity with CAD2 and CAD1 was 86% (80/93) (77-92%) and 89% (83/93) (81-95%), respectively (P = 0.5). There was no difference in specificity between CAD2 and CAD1 [89.9% (80/89) (81-95%) versus 91% (81/89) (83-96%)]. The mean AUCs for CAD2 and CAD1 were similar (P = 0.09). CAD1 reading took 2 minutes less than CAD2 (6m versus 8m, P = 0.01).

Conclusion: CAD1 is more time efficient and has a similar diagnostic performance to CAD2 and should be considered for future mass screening programs, where cost-effectiveness may represent a key issue.

SS 10.09

A randomized controlled trial comparing participation and diagnostic yield in colonoscopy and CT-colonography for population-based colorectal cancer screening

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Purpose: To compare participation rate and diagnostic yield of colonoscopy and CT-colonography screening in a RCT trial.

Material and Methods: 8,844 Dutch citizens aged 50-74 were 2:1 randomized to colonoscopy or CTC. Participation rate was defined as number of invitees undergoing the examination divided by the total number of invitees. Colonoscopy was positive when advanced neoplasia was detected; CTC when a lesion >5mm was found. Individuals with ≥1 lesions 6-9mm were offered surveillance CTC and colonoscopy was offered for lesions ≥10mm. Diagnostic yield was calculated as number of advanced neoplasia per 100 invitees.

Results: 1,236 of 5.924 colonoscopy invitees participated (21%) compared to 935 of 2,920 CTC invitees (32%) (p < 0.001). Yield colonoscopy participants: 91/1236 (7%) had ≥1 advanced adenomas, 7 (0.6%) had a carcinoma. Yield CTC participants: 75/935 (8%) were offered surveillance, 70/935 (7%) were offered colonoscopy of which 44/935 (5%) had ≥1 advanced adenomas, 5 (0.5%) had a carcinoma. The diagnostic yield of advanced neoplasia was 8.4 per 100 participants for colonoscopy versus 5.2 for CTC (p < 0.001); relative to the number of invitees, these numbers were 1.7 per 100 invitees in both arms (p = 0.909).

Conclusion: This randomized population-based CRC-screening trial demonstrated superior participation for CTC compared to colonoscopy, but colonoscopy identified significantly more advanced neoplasia. The diagnostic yield for advanced neoplasia per 100 invitees was comparable for both strategies.

SS 10.10

The influence of a radiographers-radiologist model on population screening with CT colonography for colo-rectal cancer

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Purpose: To assess the reduction of costs in screening for colo-rectal cancer (CRC) with CT colonography (CTC) interpreted by a team of radiographers supervised by one radiologist.

Material and Methods: In this model, CRC screening was performed by a team of eight radiographers and one experienced CTC-radiologist. The radiographers were educated in CTC based on the interpretation of 75 training cases. In this model each radiographer interpreted two cases per hour. The positive cases were submitted to the radiologist, who monitored the radiographer's marks using an average reading time of 5 minutes per case. This model was compared with interpretation of CTC by the radiologist only. The time with the radiographers-radiologist model versus the radiologist only model was calculated for a population of 100,000 patients eligible for CRC screening.

Results: Screening a cohort of 100,000 patients per year needed 9, 8 and 7 radiographers-radiologist teams versus 19 radiologists at a ppv of 30%, 50% and 70%, respectively. A radiologist time reduction of 54%, 59% and 64% with a reduction of 10, 11 and 12 radiologist full-time equivalents at a ppv of 30%, 50%, and 70%, respectively, was achieved. The team interpreted 49, 55 and 62 CTC per day at a ppv of 30%, 50% and 70% respectively.

Conclusion: Population-based CRC screening with CTC interpreted by a team of educated radiographers under radiologist supervision is time efficient and reduces radiologist man power.

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11:15 -12:45 **Mangano**

Scientific Session 11

Liver intervention and transplantation

SS 11.01

Percutaneous microwave ablation of the liver at 2.45 GHz: ablation zone volume achieved

P.A. Patel, M.B. Johnson, C.N. Hacking, B. Stedman, D.J. Breen; Southampton/UK

Purpose: There is little published data on ablation zone volume (AZvol) achieved in human liver following microwave ablation (MWA) at 2.45 GHz. We have analysed performance of percutaneous liver MWA at 2.45 GHz by correlation of AZvol against ablation time, total energy delivered and number of treatment stations.
Material and Methods: 12 liver tumors (HCC (5), metastases (7)) in 11 patients were treated by percutaneous MWA. Ablation times, total energy delivered and number of ablation stations were recorded prospectively. Post-procedural late arterial and venous phase CT was performed between 6 and 49 days post-treatment. AZvol was calculated using drawn regions of interest and Siemens volume software.
Results: Mean total MWA time was 376 seconds (standard deviation (SD) +/- 188.9). Mean total energy delivered was 77.9 kJ (SD +/-33.9). MWA was performed at 1 station (n = 9), 2 (n = 2) and 4 stations (n = 1). Mean AZvol achieved was 41.4 cc (SD +/-14.6). Pearson's product correlation (r) between both MWA time and total energy delivered and AZvol were not significant (r = -0.265 and 0.330, respectively). There was significant positive correlation between number of ablation stations and AZvol achieved ($r = 0.662$, $p < 0.02$).
Conclusion: Early clinical liver MWA experience suggests that number of treatment stations significantly correlates with AZvol achieved. Increasing MWA time and total energy delivered shows poor correlation with AZvol. These results indicate that probe repositioning is a significant factor in achieving larger microwave liver ablation volumes.

SS 11.02

Multipolar radiofrequency ablation for the treatment of HCC using no touch technique

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Purpose: The aim of this pilot study was to assess the effectiveness of extranodular no touch multipolar radiofrequency ablation of hepatocellular carcinoma (HCC).
Material and Methods: 109 patients with cirrhosis (Child-Pugh A/B: 91/18) and one or two (86/23) HCC (median size: 25mm (10-45mm)) were treated with no touch multipolar radiofrequency ablation technique, consisting of simultaneous activation of two to four bipolar coaxial electrodes inserted just outside the tumors.
Results: A complete ablation was obtained in 108 patients (99%) after one (n = 102) or 2 (n = 6) sessions. The mean number of electrodes used per tumor ablation was 3 (4 electrodes was used in 3 patients). More than one application was necessary in 5 cases, 20 to 330kJ were delivered per session (mean: 106kJ), during 10min to 55 minutes (mean: 27min). Two deaths occurred within three months after the procedure: one patient died of ascites infection 2 months after the procedure, the other death was not related to complication of cirrhosis (pneumonia). One patient experienced jaundice and another pleural effusion requiring drainage. After a median follow-up of 12.8 months, one local and 27 distant recurrence occurred. At the end point, 15 patients dead and 5 patients were transplanted. The 2-year survival and recurrence rates were 80% and 35%, respectively.
Conclusion: Multipolar radiofrequency ablation of HCC using no touch technique is a very effective method in terms of local tumor control.

SS 11.03

Hepatocellular carcinoma (HCC) in cirrhosis: long-term results of percutaneous radiofrequency ablation of both the nodule and the portal venous tumor thrombus

A. Giorgio, G. de Stefano; Naples/IT

Purpose: To report 5-year survival of percutaneous radiofrequency ablation (RFA) of both medium-sized HCC with portal venous tumor thrombus (PVTT) in cirrhotic patients.
Material and Methods: From January 2005 and January 2010, 672 had HCC and PVTT; 57 of the 672 had a single HCC with main portal vein tumor thrombus (MPVTT). Thirty-five patients with 35 HCC 3.7-5 cm in diameter extending into the main portal trunk underwent percutaneous RFA. Twenty-two matched patients with 22 HCC 3.6-5 cm in diameter extending into the main portal trunk refused RFA (control group). RFA was performed first on the MPVTT and then on the HCC nodule. Efficacy of RFA was defined as complete necrosis of HCC (enhanced CT one month after procedure) and complete recanalization of the MPV.
Results: Complete necrosis of the HCC with complete recanalization of MPV was achieved in 67% of cases. No patient died. The cumulative survival rates were 63, 41, 30, 20 and 20% at 1, 2, 3, 4, and 5 years, respectively, in the treated group, while in the untreated patients, survival was 0% at 1 year ($p < 0.0001$).
Conclusion: RFA of both medium-sized HCCs with MPVTT significantly prolongs long-term survival of cirrhotic patients compared with no treatment. The procedure is safe, with low rate of complications and should be considered as a new and effective tool in the treatment of this subset of advanced HCC.

SS 11.04

Combined radiofrequency ablation and drug-eluting beads TACE for large hepatocellular carcinoma

E. Bozzi, F. Turini, I. Bargellini, S. Mazzeo, R. Cioni, R. Lencioni, C. Bartolozzi; Pisa/IT

Purpose: To prospectively evaluate the efficacy of combined radiofrequency ablation (RFA) and doxorubicin-eluting beads transarterial chemoembolization (DEB-TACE) in a series of patients with single hepatocellular carcinoma (HCC) larger than 3 cm.
Material and Methods: From September 2005 to January 2010, 34 patients (26 males, mean age 70 ± 7.7 years) with unresectable HCC, larger than 3 cm in maximum diameter (mean size 43.3 ± 15 mm, range 33-80 mm) underwent RFA followed by DEB-TACE, that was performed the day after RFA. Safety and tumor response (according to amended RECIST criteria) were analyzed.
Results: No major complications were observed. Mean follow-up was 18 ± 15 months (range 1-51 months). At 1-month imaging follow-up, complete tumor response (CR) was obtained in 26 target lesions (76.5%); at 6 months, CR rate was 64.7% (22/34 target lesions). On follow-up, local tumor progression was observed in 20 (58.8%) patients with a median expected time of 14 months, whereas the median expected time for tumor recurrence in the non-target liver was 18 months. Radiological disease progression was observed in 8 (23.5%) patients with a mean expected time of 29 months.
Conclusion: In patients with unresectable HCC larger than 3 cm, the combination of RFA and DEB-TACE is safe and results in a high rate of sustained complete tumor response.

SS 11.05

Portal vein-thrombosis and arterioportal-shunts: effects on local tumor response after chemoembolization of unresectable hepatocellular carcinoma

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Purpose: To evaluate the effect of portal vein thrombosis (PVT) and arterioportal shunts (APS) on the local tumor response in advanced cases of unresectable hepatocellular carcinoma (HCC) treated by transarterial chemoembolization.
Material and Methods: A retrospective study included 39 patients with unresectable HCC, who were treated with repetitive transarterial chemoembolization (TACE) between March 2006 and October 2009. The effect of PVT (19 out of 39 patients), the presence of APS (7 out of 39), the underlying liver pathology, Child-Pugh score, initial tumor volume, number of tumors and tumor margin definition on imaging were correlated with the local tumor response after TACE. The local tumor response was evaluated according to the response evaluation criteria in solid tumors (RECIST) and MRI volumetric measurements.
Results: The local tumor response according to RECIST criteria was partial response in one patient (2.6%), stable disease in 34 patients (87.1%), and progressive disease in 4 patients (10.2%). The MR volumetric measurements showed that the PVT, APS, underlying liver pathology and tumor margin definition were statistically significant prognostic factors on the local tumor response ($p = 0.018$, $p = 0.008$, $p = 0.034$ and $p = 0.001$), respectively. The overall 6, 12 and 18 months survival rates were 79.5%, 37.5% and 21%, respectively.
Conclusion: TACE may be exploited safely for palliative tumor control in patients with advanced unresectable HCC; however, tumor response is significantly affected by the presence or absence of PVT and APS.

SS 11.06

Early-stage HCC patients clinically excluded from liver transplantation: survival after transarterial chemoembolization

I. Bargellini, E. Bozzi, R. Sacco, A. Cicorelli, F. Turini, R. Cioni, C. Bartolozzi; Pisa/IT

Purpose: To prospectively evaluate clinical outcome of transarterial chemoembolization (TACE) in patients with early-stage (BCLC A) hepatocellular carcinoma (HCC) clinically unfit for liver transplantation (LT) and excluded from surgical resection and percutaneous ablation.
Material and Methods: From January 2006 to May 2009, 67 patients (43 males, mean age 70 ± 7.6 years) with unresectable early-stage HCC, within Milan selection criteria but clinically unfit for LT, underwent TACE. The primary endpoint of the study was overall survival. Secondary endpoints were: safety,

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toxicity on liver function, 1-month tumour response evaluated according to the amended RECIST criteria, time to tumour recurrence and local recurrence and time to radiological progression.

Results: Forty-one patients (61.2%) received conventional TACE, whereas 26 (38.8%) were treated using drug-eluting beads. Mean follow-up was 924 ± 399 days. Two major periprocedural complications occurred (3%). Periprocedural mortality rate was 1.5%. ALT and bilirubin levels significantly increased 24h after treatment and decreased at discharge. At 1-month follow-up, complete and partial tumour response rates were 67.2% and 29.9%, respectively. The 1-, 2-, and 3-year overall survival rates were 90.9%, 85.2% and 80.8%, respectively. Median expected time to recurrence and local recurrence were 480 and 364 days, respectively. Radiological disease progression was observed in 11 patients (16.4%) with a mean expected time of 809 days.

Conclusion: In patients with unresectable, early-stage HCC, clinically excluded from LT, TACE is safe and effective, with favourable long-term survival.

SS 11.07

Tumour response to transarterial chemoembolization in hepatocellular carcinoma before liver transplantation: are the amended RECIST criteria reliable?

I. Bargellini, V. Battaglia, P. Carrai, A. Cicorelli, D. Campani, F. Filipponi, R. Cioni, C. Bartolozzi; Pisa/IT

Purpose: To retrospectively analyse tumor response to transarterial chemoembolization (TACE) in a series of consecutive HCC transplanted patients and evaluate the agreement between amended RECIST criteria and percentage of tumour necrosis, assessed at pathology.

Material and Methods: From January 1996 to December 2009, 384 HCC patients (M/F= 336/48, mean age 55 years) underwent liver transplantation (LT). Among them, 201 (52%) patients (mean number of nodules 2.2 ± 1.6, mean diameter 46.2 ± 27.3 mm) were treated by TACE prior to LT. CT examinations performed 1 month after TACE were retrospectively reviewed to assess tumour response to TACE according to amended RECIST criteria. After LT, percentage of tumour necrosis was assessed on the explanted liver.

Results: 1-Month CT follow-up was available in 145/201 (72.1%) patients. According to amended RECIST criteria, objective response rate was 88.3%, with 68 cases (46.9%) of complete response. In the entire series, on the explanted livers, mean percentage of tumour necrosis was 71.8 ± 30.7%, with 49.7% of patients with necrosis ≥ 90%. A significant correspondence ($p < .0001$) was found between amended RECIST criteria and percentage of tumour necrosis; mean rate of necrosis was 85.5% in patients with complete response, 75.4% in patients with partial response and 26.2% in subjects with stable disease.

Conclusion: TACE induces >90% necrosis in about 50% of cases. Amended RECIST criteria, assessed by triphasic CT, nicely correlate with pathologic necrosis, allowing differentiation between responders and non-responders.

SS 11.08

Can psoas muscle area, as a measure of sarcopaenia, predict outcomes in liver transplantation?

O.S. Jaffer, D. Lewis, V. Patel, C. Kachramanoglou, N. Vidas, F. Gorman, J. Wendon, J. Karani, W. Bernal; London/UK

Purpose: Objective measures of disease burden, such as sarcopaenia, may aid clinicians when prioritising patients for liver transplant. The aim of our study is to determine if psoas area is a predictor of patient outcomes, such as mortality and hospital length of stay.

Material and Methods: The cross-sectional psoas area was measured from CT scans of 141 consecutive patients prior to liver transplantation. Demographic data and biochemical profiles were collected at initial assessment. In addition, anthropometric measurements were taken and Model for End-Stage Liver Disease (MELD) score was calculated. Multivariate regression analysis was used to determine the relationship between psoas area and primary (90 day and 1 year mortality) and secondary (hospital length of stay) outcome measures.

Results: Median age was 53 years (96 males:45 females); median psoas area 2334cm^2(M):1467cm^2(F). Positive correlations were observed with height ($r = 0.51$, $p =< 0.0001$), weight ($r = 0.538$, $p =< 0.0001$), mid-arm circumference (0.447, $p =< 0.0001$), tricep skin-fold thickness ($r = 0.597$, $p =< 0.001$), mid-arm muscle circumference ($r = 0.223$, $p = 0.009$) and hand grip ($r = 0.348$, $p < 0.001$). Hospital stay had a negative correlation ($r = -0.272$, $p = 0.008$). No correlation was identified with sodium and albumin, or MELD. When stratified into quartiles, those in the lower two quartiles for psoas area had a higher rate of mortality at both 90 days ($X^2 = 4.19$, $df = 1$, $p = 0.041$) and 1 year ($X^2 = 6.059$, $df = 1$, $p = 0.14$).

Conclusion: Psoas area is an easily quantifiable predictor of post-transplant outcome measures. It correlates strongly with other anthropometric and functional parameters, but remains independent of more conventional markers of liver disease.

SS 11.09

The value of Gd-EOB-DTPA-enhanced MRI in short-term prognosis of patients with orthotopic liver transplantation

A. Wibmer, S. Magnaldi, N. Bastati, D. Muin, S. Baroud, A. Ba-Ssalamah; Vienna/AT

Purpose: The aim of this study was to evaluate Gd-EOB-DTPA-enhanced MRI in terms of prediction of short time survival in patients after orthotopic liver transplantation.

Material and Methods: Fifty-three liver transplant recipients underwent 83 Gd-EOB-DTPA-enhanced MRI of the liver between 2007 and 2010. T2w images, MRCP sequences, unenhanced and dynamic-enhanced T1w sequences (after 25 seconds, 70 seconds, 5 minutes and 20 minutes) were performed after injection of 10ml Gd-EOB-DTPA. In case of delayed excretion, additional sequences after 60 and 180 minutes were obtained. The images were analyzed qualitatively by two experienced radiologists and quantitatively by measurement of the contrast-to-noise-ratio in the common bile duct, right and left hepatic duct as well as the relative enhancement of the liver parenchyma. Probability of one-year survival was estimated by the method of Kaplan and Meier.

Results: Delayed excretion and poor relative enhancement in the Gd-EOB-DTPA-enhanced MR images were seen in 17 cases (20.5%). Probability of one-year survival was significantly inferior in these patients when compared to those with normal relative enhancement and excretion (70.7% vs. 91.5%, $p = 0.011$). Time from transplantation and age were not significantly different between the two groups ($p = 0.45$, $p = 0.44$, respectively).

Conclusion: Delayed or missing excretion of Gd-EOB-DTPA as well as poor enhancement during the hepatospecific phase is a negative predictor of one-year survival in patients after orthotopic liver transplantation.

SS 11.10

Ischemic-type biliary lesions after liver transplantation: utility of Gd-EOB-DTPA-enhanced MR cholangiography

F. Donati, P. Boraschi, R. Gigoni, S. Salemi, F. Filipponi, C. Bartolozzi, F. Falaschi; Pisa/IT

Purpose: To evaluate the utility of contrast-enhanced MR cholangiography (MRC) using Gd-EOB-DTPA for identifying ischemic-type biliary lesions (ITBLs) in liver transplant recipients.

Material and Methods: Twenty-eight liver transplants with ischemic biliary changes underwent MRI at 1.5T-device. After acquisition of T1w/T2w images and conventional T2w MRC, 3D fat-suppressed breath-hold T1w sequence (TR/TE, 3.6ms/1.6ms; 2.4mmthk/-1.8mmsp; matrix, 224 x 192; one NEX) was performed before and 15, 20, 25, 30, 35, 40 minutes after intravenous administration of gadolinium-EOB-DTPA (Primovist® Bayer Schering Pharma; 10ml), followed by isotonic saline (20ml). In 9/28 cases T1w sequence was also obtained after 90 minutes. Depiction of intra-/extra-hepatic bile ducts, biliary dilation or stricture and stone/sludge were evaluated on images by consensus reading of two observers using a 3-point scale: 0, absent; 1, visible; 2, excellent. Imaging results were correlated with direct cholangiography and/or follow-up.

Results: The grading of visualization and depiction of dilation of the intra-hepatic bile ducts was significantly superior on T2w MRC compared with Gd-EOB-DTPA-enhanced T1w MRC; on the contrary, this latter significantly tended to out-perform conventional T2w MRC in delineating strictures involving hepatic bifurcation and extrahepatic donor bile duct ($p < 0.0001$). Sludge/stone formation was correctly identified with both techniques. Biliary enhancement was recognized within 20 minutes post-Gd-EOB-DTPA injection in 6 subjects, between 25 and 40 minutes in 16, and at 90 minutes in 6.

Conclusion: Gd-EOB-DTPA-enhanced MRC may provide both anatomical and functional information of ITBLs in liver transplants.

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11:15 -12:45 **Sala Perla**

Scientific Session 12

Focal liver lesions (Liver 4)

SS 12.01

Decreased detection of hypovascular liver tumors with multi–detector row CT in obese patients: a phantom study

S.T. Schindera[1], J. Charimo Torrente[1], T. Ruder[1], H. Hoppe[1], R. Raupach[2], B. Schmidt[2], P. Vock[1], Z. Szucs-Farkas[1]; [1]Bern/CH, [2]Forchheim/DE

Purpose: To assess the impact of large patient size on the detection of hypovascular liver tumors with MDCT and the effect of a noise filter on image quality and lesion detection in obese patients.

Material and Methods: A liver phantom with 45 hypovascular tumors (diameters 5, 10, and 15 mm) was placed into two water containers mimicking intermediate and large patients. The containers were scanned with a 64-MDCT scanner. The CT dataset from the large phantom was post-processed using a noise filter. The image noise was measured and the contrast-to-noise ratio (CNR) of the tumors was calculated. Tumor detection was independently performed by three radiologists in a blinded fashion.

Results: Image noise was significantly higher in the non-filtered large phantom compared to the intermediate phantom (35.3 and 18.3 HU, respectively; P<.001). No significant difference in image noise was seen between the filtered large and the intermediate phantom (20.6 and 18.3 HU, respectively; P=.15). The CNR values of the tumors in the non-filtered and filtered large phantom were lower than in the intermediate phantom (P<.05). In the non-filtered and filtered large phantom, 24% and 19% fewer tumors, respectively, were detected on average compared to the intermediate phantom (P<.01).

Conclusion: The risk of missing hypovascular liver tumors with CT is substantially increased in large patients. A noise filter improves image quality and lesion detection in obese patients.

SS 12.02

Contrast-enhanced ultrasonography versus multidetector-computed tomography in detection of liver metastases from colorectal cancer. A prospective, blinded, patient by patient analysis

S.R. Rafaelsen, A. Jakobsen; Vejle/DK

Purpose: To compare the sensitivity and specificity of contrast-enhanced ultrasonography (CEUS) and multidetector-computed tomography (MDCT) in the detection of liver metastases in patients with colorectal cancer (CRC).

Material and Methods: In this study 271 consecutive patients with primary colorectal cancer were evaluated (146 males and 125 females, with a mean age of 67.4 years, range: 34-91 years). All patients underwent combined liver ultrasonography and CEUS using 2.4 ml Sonovue IV. Time from injection to arrival time in the hepatic vein (ATHV) was noted. Contrast-enhanced MDCT in the portal phase was performed and interpreted blindly. In all patients intraoperative ultrasound was used as gold standard. Additional follow-up, MRI or biopsy was performed on all suspicious lesions or if there was any inconsistency in the results. When liver resection was performed, the pathological examination contributed to the gold standard.

Results: Liver metastases were detected in 21 patients (8%). Both CEUS and MDCT had sensitivity of 85.7%. Specificity of CEUS was 97.6% and MDCT 95.6%. Compared to MDCT, CEUS tended to show a higher positive predictive value, 75% vs. 62%. In patients with and without liver metastases ATHV was 18 sec. and 22 sec., respectively, $p < 0.05$.

Conclusion: CEUS has potential as a diagnostic alternative to MDCT in the detection of liver metastases. In this study, we also observed that ATHV was shorter in the metastatic group compared to patients without liver metastases.

SS 12.03

Hepatic focal nodular hyperplasia: contrast-enhanced ultrasound findings with emphasis on lesion size, depth and liver echogenicity

T.V. Bartolotta, A. Taibbi, L. La Grutta, C. Genova, L. Tortorici, M. Midiri, R. Lagalla; Palermo/IT

Purpose: To correlate contrast-enhanced US (CEUS) findings of hepatic focal nodular hyperplasia (FNH) with lesion size, depth and liver echogenicity and to compare CEUS with baseline US.

Material and Methods: Two radiologists evaluated baseline US and CEUS examinations of 92 FNHs (mean size: 3.1 ± 1.7 cm) in 71 patients (59 women and 12 men, mean age: 38.9 years), for detecting the spoke-wheel sign, central scar and feeding vessel. The FNHs were grouped and analyzed by dimension, depth and liver echogenicity.

Results: At least one sign could be detected at CEUS in 27 of 36 (75%) FNHs larger than 3 cm and in 17 of 56 (30%) FNH measuring 3 cm or less ($p < 0.0001$). No statistically significant differences were noted between lesion depth or liver echogenicity and detection rate of these sign at CEUS ($p > 0.05$) as well as between CEUS or baseline US/CD with regard to lesion size, depth or liver echogenicity ($p > 0.05$).

Conclusion: The detection rate of the central scar and spoke-wheel sign in FNH at CEUS is strongly dependent on lesion size and CEUS can confidently diagnose the majority of FNHs larger than 3 cm.

SS 12.04

Navigator-triggered diffusion-weighted MR imaging in characterization of focal liver lesions compared to T2-weighted imaging

H. Haradome, K. Al Manea, T. Bonaventure, L. Grazioli; Brescia/IT

Purpose: To compare navigator-triggered diffusion-weighted imaging (DWI) with T2-weighted imaging (T2WI) and to determine the value of apparent coefficient (ADC) measurements in focal liver lesion (FLL) characterization.

Material and Methods: One hundred sixty-six consecutive patients with 269 FLLs (153 benign and 116 malignant) were retrospectively evaluated. Two readers visually assessed DWI and T2WI in an independent and blinded manner, and ADCs of FLLs were measured. DWI and T2WI were compared and the value of ADC measurements was determined with respect to their abilities in discriminating benign from malignant FLLs, using receiver operating characteristic analysis. Pathologic results, consensus reading, and follow-up imaging were used as reference standard.

Results: The Az values of DWI were higher than those of T2WI for both observers, with a significant difference ($P = 0.049$) for the reader with the least experience in hepatic imaging. The Az of ADC measurements was 0.915, and a cut-off ADC value of $1.12 \times 10^{-3} mm^2/s$ yielded a sensitivity of 82.8% and a specificity of 88.9% for discriminating benign from malignant FLLs. The optimal cut-off ADC values of benign solid tumors showed moderate merit with relatively large overlap in ADCs, however, in focal nodular hyperplasia cases, a higher diagnostic yield may be expected when using a combination of visual assessment and ADC analysis.

Conclusion: Navigator-triggered DWI is more useful than T2WI in discriminating benign from malignant FLLs. ADC measurements could provide supplementary information for FLL characterization.

SS 12.05

Role of diffusion-weighted echo-planar MRI in the detection of hepatic metastasis in patients candidate to surgical resection

A. Pecchi, M.C. Righi, S. Togni, M. De Santis, F. Di Benedetto, P. Torricelli; Modena/IT

Purpose: The purpose of the study was to compare accuracy of diffusion-weighted (DW) echo-planar MRI with other MRI sequences (T2W SESS TE80, THRIVE and T1W FFE) and CT examination in the detection of hepatic metastasis.

Material and Methods: Sixteen patients with extrahepatic primary malignant tumors were studied with CT examination and hepatic MRI at 1.5 T with the following sequences: DW, T2W SESS TE80, THRIVE and T1W FFE post-hepatospecific mdc (Gd-BOPTA). DWI was performed with triggered EPI sequence (single-shot echo-planar imaging) with 4 different b values, included between 0 and 1000 s/mm^2. Two different radiologists classified the visible lesions at CT and MRI as benign or malignant according to contrast-enhancement and signal intensity values of the lesions. Sensitivity, specificity and accuracy were calculated and results were correlated with surgical and histopatologic findings or follow-up imaging.

Results: A total number of 75 hepatic metastasis were evaluated. Accuracy values and sensitivity were higher with DWI EPI (91%-95%) then with the T2W SESS TE80 (67%-64%), THRIVE (75%-74%), T1W FFE (68%-67%) and CT (47%-37%).

Conclusion: In our study, DWI EPI was more accurate then T2W SESS TE80, THRIVE, T1W FFE and CT for the preoperative detection of hepatic metastasis in patients with extrahepatic tumors. In particular, in patient with hepatic metastasis candidate to surgical resection, the introduction of DWI sequence in the standard MRI protocol was recommended.

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SS 12.06

Reproducibility of perfusion and pure diffusion parameters in multi-b diffusion-weighted MR imaging of liver tumors

M. Wagner[1], S. Doblas[1], J. Daire[1], N. Haddad[1], H.S. Leitão[2], R. Sinkus[1], B.E. Van Beers[1], V. Vilgrain[1]; [1]Clichy/FR, [2]Coimbra/PT

Purpose: To investigate the reproducibility of diffusion-weighted MR imaging (DWI) with a multi-b, bi-exponential fitting approach in patients with liver tumors.
Material and Methods: Ten patients diagnosed with liver tumors (for a total of 13 lesions) underwent two successive multi-b (0 to 500 s/mm^2) DWI acquisitions. Measurements of apparent diffusion coefficient (ADC), pure diffusion coefficient (ADCslow), perfusion-related diffusion coefficient (ADCfast), perfusion fraction (DCfast), and pure diffusion fraction (DCslow) were performed by two independent observers in each tumor, for each acquisition.
Results: All parameter measurements were similar between acquisitions and between observers (p values ranging from 0.25 to 0.73 and from 0.29 to 0.71 respectively). Measurements of reproducibility from successive DWI acquisitions were high for conventional ADC, ADCslow and DCslow (ICC = 0.850; 0.831 and 0.73 and 95% limits of agreement = 29%–32%, 24%–32% and 15%–20%, respectively) and moderate for DCfast (ICC = 0.63; 34%-49%). The reproducibility of ADCfast appeared to be poor, with ICC of 0.621 and 95% limits of agreement of 87%–98%. Inter-observer reproducibility of DWI data was high for any considered parameter (ICC ranging from 0.844 to 0.924 and 95% limits of agreement ranging from 5% to 25%), except for ADCfast.
Conclusion: The reproducibility of the perfusion-related diffusion coefficient (ADCfast) in liver tumors was poor, whereas a maximal variation in DWI measurements of 49% was observed for the others parameters.

SS 12.07

Diffusion weighted MR imaging of focal liver lesions: qualitative and quantitative evaluation of inter-slice variation in apparent diffusion coefficient and its impact on lesion characterization

C. Schmid-Tannwald, F. Dahi, Y. Jiang, I. Sethi, A. Oto; Chicago, IL/US

Purpose: To evaluate inter-slice variation in apparent diffusion coefficient (ADC) values of focal liver lesions (FLL) and to determine impact of this variation on lesion characterization.
Material and Methods: 91 patients with 128FLL (>2 cm, 70 benign, 58 malignant) were included. ADC map images demonstrating FLL without any partial volume effect were reviewed. Two independent observers evaluated each lesion to subjectively determine if there is a change in its signal among ADC slices. A third observer measured ADC of each FLL and neighboring normal liver on all included slices. ADC range for each lesion (maximum-minimum lesion ADC) and normal liver (maximum-minimum liver ADC) were calculated. 1. Mean of ADC range for benign and malignant FLL and neighboring liver and 2. mean ADC of slices through benign and malignant FLL were compared using t-test.
Results: Inter-slice signal variation was present in 18/70 (25.7%) and 19/70 (27.1%) of benign FLL and 30/58 (51.7%) and 29/58 (50.0%) of malignant FLL by observer 1 and 2, respectively. Mean ADC range for both benign FLL (0.28 x 10-3mm2/s) and malignant FLL (0.26 x 10-3mm2/s) was significantly higher than mean ADC range of normal liver surrounding benign and malignant lesions (0.16 and 0.15 x 10-3mm2/s, respectively)($p < 0.01$). Mean ADC of slices through benign FLL was significantly higher compared to malignant FLL (1.65 vs 1.45 x 10-3 mm2/s) ($p < 0.01$).
Conclusion: FLL demonstrate inter-slice signal variation on ADC maps indicating heterogeneous restricted diffusion within lesions. This variation limits ability of DWI to differentiate benign and malignant FLL.

SS 12.08

Characterization of Liver lesions using magnetic resonance diffusion tensor imaging: preliminary results

S.M. Erturk, E. Kaya, A. Ozel, O. Yapici, M. Basak, O. Tufaner, Z. Karpat; Istanbul/TR

Purpose: To evaluate MR diffusion tensor imaging (DTI) in the characterization of liver lesions using ADC and fractional anisotropy (Fa) values.
Material and Methods: Sixty-six patients with 77 lesions were examined with DTI. Two radiologists performed ADC and Fa measurements. The differences were compared using ANOVA and Tukey tests. A ROC analysis was applied; sensitivities and specificities were calculated. ADCs and Fa values were correlated using Pearson correlation. Interobserver agreement was evaluated using Bland-Altmann plots.
Results: There were 32 metastases, 13 cysts and 32 hemangiomas. The mean ADC value of cysts (3.30 ± 0.8 mm2/sec) was significantly higher than that of hemangiomas (2.23 ± 0.5 mm2/sec) and metastases (1.62 ± 0.4 mm2/sec). The mean Fa value of cysts (0.2 ± 0.05) was significantly lower than hemangiomas (0.37 ± 0.1) and metastases (0.46 ± 0.1). The Az values for discriminating metastases from benign hepatic lesions for ADC and Fa value were 0.885 and 0.731, respectively. The sensitivity-specificity of ADC and Fa were 87.5%-84.4%, and 78.1%-57.8%, respectively. The Az value for discriminating cysts from hemangiomas for Fa was 0.96. The sensitivity and specificity were 90.6% and 92.3%. The correlation between ADC and Fa was negative, weak and significant (r = -0.36). The interobserver agreement was very good.
Conclusion: DTI can be used to characterize hepatic metastases, hemangiomas and cysts. Whereas malignant lesions tend to have low ADCs and high Fa values, cysts have high ADCs and low Fa values and hemangiomas have high ADCs and high Fa values.

SS 12.09

Magnetic resonance elastography measurements of viscosity: a novel biomarker for human hepatic tumor malignancy?

M. Wagner[1], S. Doblas[1], P. Garteiser[1], N. Haddad[1], J. Daire[1], H.S. Leitão[2], V. Vilgrain[1], R. Sinkus[1], B.E. Van Beers[1]; [1]Clichy/FR, [2]Coimbra/PT

Purpose: To determine the value of magnetic resonance elastography (MRE) with tissue elasticity (Gd) and viscosity (Gl) measurements in the differentiation between benign and malignant lesions.
Material and Methods: Seventy-six consecutive patients who had MRI examinations for the assessment of focal liver lesions were included, with 42 benign and 37 malignant hepatic tumors. Standard MRI (including dynamic contrast-enhanced MRI) and MRE were performed in the same session. Gd and Gl maps were reconstructed by fitting a polynomial function to the local displacement field under physical constraints of mechanical isotropy and tissue incompressibility. Average Gd and Gl values were obtained after placement of ROIs covering the whole tumor section or the viable enhancing tumor regions.
Results: Malignant tumors were found to be significantly more viscous than benign lesions (global ROI: Gl = 1.97 ± 1.44 kPa and 0.99 ± 0.63 kPa ; viable tumor ROI: 2.13 ± 1.54 kPa and 0.98 ± 0.66 kPa, for malignant and benign lesions, respectively). A significant elasticity difference between malignant (Gd = 2.35 ± 0.75 kPa) and benign lesions (Gd = 2.02 ± 0.69 kPa) was only found after inclusion of cysts in the benign group.
Conclusion: MRE measurement of viscosity appears to be a promising biomarker for the determination of hepatic tumor malignancy.

11:15 -12:45 **Sala Laguna**

Scientific Session 13

Technical advances

SS 13.01

Clinical value of conventional follow through examinations compared with modern sectional imaging

L. Egger, C. Friedrich, G. Schill, C. Stroszczynski, A. Schreyer; Regensburg/DE

Purpose: Abdominal follow through examinations are functional radiological examinations to analyse the intestinal passage after application of oral contrast media under continuous fluoroscopy. Although ultrasound as well as other modern sectional imaging methods such as CT and MRI are well-established methods for intestinal diagnosis, conventional fluoroscopy is still requested when it comes to find out about uncertain abdominal conditions. The objective of our study was to assess the clinical value of follow through examinations compared to endoscopy and sectional imaging.
Material and Methods: We retrospectively analyzed all available data of 300 consecutive patients, who underwent a follow through between 2001 and 2009 in a university hospital.
Results: In 32 patients (11%) the examination was performed with complications, which in 6 (2%) led to an abort of the examination. 179 (60%) of 300 patients suffered from a malignant disease. In most cases the follow through was requested to exclude ileus or other not specified gastrointestinal passage problems (70%, n = 228). 45% (n = 134) of the patients had undergone a surgical intervention at the abdomen, within those the examination was indicated after 8 days after the surgery. In 172 cases (58%) there were no specific or unconspicuous findings, in 116 (40%) patients the question which led to the examination was not clearly answered. 74% of the patients (n = 221) had been examined additionally with CT, MRI, ultrasound or endoscopy. Results of the follow through and other type of examinations were partially confirmed in 54% (n = 120) and did not match in 30 cases (13.6%). The average radiation of a follow through examination was 7 mSv.
Conclusion: According to the results of our study, a conventional radioscopy of the abdomen should be indicated very restrictivly considering the low explanatory power of the method and the associated exposure to radiation.

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SS 13.02

Iterative reconstruction in image space for abdominal multidetector CT at different tube voltages: assessment of diagnostic accuracy, image quality and radiation dose in a phantom study

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Purpose: To assess diagnostic accuracy, image quality and radiation dose of iterative reconstruction in image space (IRIS) compared to filtered back projection (FBP) for abdominal CT imaging at different tube voltages.
Material and Methods: A custom liver phantom with 45 hypovascular tumors was placed into a water container that mimicked an intermediate-sized patient. The phantom was scanned at 120, 100 and 80 kVp. The CT datasets were reconstructed with FBP and IRIS. The image noise was measured and the CNR of the tumors was calculated. The radiation dose was assessed by the $CTDI_{vol}$. Tumor detection was independently performed by three radiologists.
Results: Compared to the FBP dataset at 120 kVp, the IRIS dataset at 100 kVp demonstrated significantly lower mean image noise (20.9HU and 16.7HU, respectively; $P < .0001$) and greater mean CNR values ($P < .05$). The IRIS dataset at 120kVp yielded the highest sensitivity for tumor detection, while the FBP dataset at 80kVp yielded the lowest. The sensitivity for the IRIS dataset at 100 kVp tended to be greater than that for the FBP dataset at 120kVp (79.3% and 74.8%, respectively; $P > .05$). The $CTDI_{vol}$ decreased by 39.8% between the 120-kVp protocol and the 100-kVp protocol.
Conclusion: A 100-kVp abdominal CT protocol with an IRIS algorithm may increase image quality and diagnostic accuracy in intermediate-sized patients at a reduced radiation dose when compared to a 120-kVp protocol with an FBP algorithm.

SS 13.03

The effect of statistical image reconstruction on measured Hounsfield unit densities and noise at various anatomical sites: the experience with 40 patients

S.B. O'Neill[1], S. Mcwilliams[1], M. Breen[1], F. O'Neill[1], J. Bye[2], O. Craig[1], A. McGarrigle[1], F. Shanahan[1], M. Maher[1]; [1]Cork/IE, [2]Chalfont St Giles/UK

Purpose: The effect of statistical iterative image reconstruction (SIR) methods on measured Hounsfield unit (HU) densities and objective noise properties of CT images is not known. Effects of algorithmic non-convergence may manifest as differences in absolute density which may have clinical impact, such as in the assessment of adrenal lesions.
Material and Methods: 40 patients with Crohn's disease underwent low dose CT abdomen-pelvis for clinical indications. All were imaged on a 64-slice CT scanner with retrospective image reconstruction with varying amounts of SIR (0-100% in increments of 10%), 11 series per patient. Spherical 10mm diameter regions-of-interest (ROIs) were drawn at 20 identical anatomical sites per series (liver, spleen, and femur, among others) and the mean HU and standard deviation (SD) within each ROI were measured. The noise index (NI) was calculated as NI = SD/mean*100.
Results: There was a significant decrease in median HU for the background ROI ($p < 0.001$); there was a trend for decreased median in all other ROIs but this was not significant. Higher levels of SIR led to significantly lower standard deviations and noise indices in all ROIs ($p < 0.001$).
Conclusion: Regional quantitative analysis in 40 patients showed the median density to drop slightly as level of SIR increased but this difference was not significant. There was a significant improvement in the objective noise properties within the regions with increasing SIR.

SS 13.04

Impact of iterative reconstruction in image space on image quality and radiation dose in patients undergoing abdominal MDCT examinations

G. Desai, N. Kulkarni, A. Abou Elias, A. Thabet, D. Sahani; Boston, MA/US

Purpose: To compare image quality and radiation dose exposure using low dose computed tomography (LDCT) with iterative reconstruction in image s[illegible](IRIS) and routine dose CT(RDCT) without IRIS in patients undergoing [illegible]ations.
Material and M[illegible] WITHDRAWN BY AUTHOR [illegible]ved study, 121 patients (82M:39F; mean age 55.6yrs, mean wt: 252.[illegible] [illegible]inal MDCT exams with IRIS (Somatom Flash, Siemens). In 48 patie[illegible] for comparison. Common parameters = 120kVp, 55mm table feed, [illegible] and 3mm reconstructed coronal/saggital slices, IRIS = 160 reference mAs; FBP = 200 reference mAs/NI = 20-28. Randomized blinded review by 2 readers for image noise, diagnostic acceptability, sharpness, artifacts was done with European Guidelines on Quality criteria for CT. Objective image noise (mean std dev of HU value in abdominal subcutaneous fat), CTDI(mGy)and dose length product (mGy-cm) for each scan was estimated.
Results: All images were considered of optimal quality. Subjective image noise was lower in IRIS [mean = 1.39 ± 0.72 (p = 0.29)] compared to FBP (1.72 ± 0.58). IRIS images were rated slightly better for diagnostic quality [1.2 ± 0.38 (p = 0.62)] over FBP (1.45 ± 0.81). Visual sharpness scores were 1.75 ± 0.56 (p = 0.28) for IRIS and 2.1 ± 0.37 for FBP. IRIS showed better score for image artifacts [1.15 ± 0.43 (p = 0.5)] over FBP 1.4 ± 0.39]. Objective image noise was lower (20.5% reduction) with IRIS mode [12.8 ± 5.3 ($p \leq 0.001$)] compared to FBP (16.1 ± 6.7). Average CTDI and DLP in low dose CT(IRIS) and standard dose CT (FBP) groups were 10.1mGy, 506mGy-cm and 15.6mGy, 760mGy-cm with an average radiation dose reduction of 35.3% with IRIS.
Conclusion: In patients with undergoing abdominal MDCT examinations, IRIS enabled CT renders low dose CT images of optimal quality compared to FBP.

SS 13.05

Is low-dose CT with iterative image reconstruction an advantageous strategy for reducing radiation dose in Crohn's disease? A prospective study

S.B. O'Neill[1], S. Mcwilliams[1], S. Leong[1], F. O'Neill[1], J. Bye[2], O. Craig[1], A. McGarrigle[1], F. Shanahan[1], M. Maher[1]; [1]Cork/IE, [2]Chalfont St Giles/UK

Purpose: Crohn's disease (CD) patients are "at risk" of significant cumulative effective doses (EDs) of radiation from diagnostic imaging. This study's purpose is to examine the effectiveness of iterative reconstruction (IR) to reduce ED due to CT in CD patients.
Material and Methods: Following ethical approval, 50 patients with CD referred for clinically indicated abdomino-pelvic CT (CTAP) [40% male; mean age 37 years, range 17-73] consented to undergo an additional low-dose CTAP (LD) at the time of CTAP. Conventional and LD images were independently reviewed by two radiologists who calculated the Crohn's disease activity score (CDAS) and graded images using image quality indices. The ED for each study was calculated.
Results: The mean ED for LD and conventional CTAP were 1.3 ± 0.9mSv and 4.8 ± 3.2mSv, respectively, a mean dose reduction of 74% ($p < 0.001$). Image quality indices of LD images were uniformly inferior at all levels of the abdomen-pelvis except at the iliac crest. The mean CDAS was less for LD (3.6 ± 2.7) than conventional CTAP (4.1 ± 2.5) ($p < 0.05$). However, no diagnostic finding seen on conventional CTAP was missed on LD.
Conclusion: IR facilitated a 74% reduction in ED with ED equivalent to that of two plain radiographs of the abdomen. LD images had inferior image quality and underestimated CDAS, yet no significant finding was missed. LD CTAP was seen to effectively reduce ED due to CT without compromising diagnostic yield.

SS 13.06

Comparative assessment of three image reconstruction techniques for image quality and radiation dose in patients undergoing MDCT examinations of the abdomen

G. Desai, N. Kulkarni, A. Kambadakone, A. Thabet, D. Sahani; Boston, MA/US

Purpose: To assess the image quality and radiation dose benefits with two iterative reconstruction techniques (IRIS and ASIR) and filtered back projection (FBP) scans in patients undergoing abdominal CT examinations.
Material and Methods: In this IRB approved study, 20 patients (11M:9F,mean age = 53.6yrs, mean body wt: 174.5 lbs) underwent abdominal MDCT exams with iterative reconstruction in image space (IRIS, Somatom Flash, Siemens), adaptive statistical iterative reconstruction (ASIR, Discovery CT750HD, GE) and FBP. Common scan parameters included 120 kVp, 55mm table feed, 5mm axial and 3mm reconstructed coronal/saggital slices. Parameters for IRIS-160 reference [illegible] minimum tube current of 150mA and a maximum of 450mA, NI 36-42 and [illegible] 200 reference mAs/NI 20-28. Randomized blinded review by 2 readers [illegible] WITHDRAWN BY AUTHOR [illegible] acceptability, sharpness, artifacts was done with European Guidelines [illegible] Objective image noise (mean std dev of HU value in abdominal subcut[illegible] dose length product (mgy-cm) for each scan was estimated.
Results: All images were of optimal quality. Subjective image noise was lower in both ASIR [mean = 1.39 ± 0.62 (p = 0.29)] and IRIS [1.39 ± 0.72 (p = 0.29)] compared to FBP (1.72 ± 0.58). ASIR images were rated slightly better for diagnostic quality [1.22 ± 0.46 (p = 0.62)] over FBP (1.27 ± 0.61) and IRIS scans [1.50 ± 0.73 (p = 0.15)]. visual sharpness scores on ASIR = 1.27 ± 0.44 (p = 0.63), 1.44 ± 0.64 (p = 0.28) on IRIS and 1.11 ± 0.67 on FBP. All techniques showed comparable score for minimal image artifacts [1.17 (p = 0.5)]. Objective image noise was lower with ASIR (10.64 ± 3.5 ($p \leq 0.001$)] and IRIS [(9.97 ± 3.5 ($p \leq 0.001$)] compared to FBP (16.4 ± 4.0). Average CTDI and DLP in ASIR, IRIS and FBP were 11.8mGy, 618.6mGy-cm; 12.3mGy, 539.7mGy-cm and 16.9mGy, 747.3mGy-cm with average radiation dose reduction of 30.1% (ASIR) and 27.2% (IRIS).

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Conclusion: In patients evaluated by abdominal MDCT examinations, iterative reconstruction techniques using IRIS and ASIR render optimal diagnostic quality images at 30% lower radiation dose to images acquired using routine dose FBP images.

SS 13.07

Body composition determinants of radiation exposure when automatic tube current modulation is employed during routine abdominopelvic CT

L.J. Chawke, S. Mcwilliams, S. O'Neill, M. Maher; Cork/IE

Purpose: With ATCM, it is assumed that patient exposure is determined by body mass index (BMI). However, it is unknown what determinants of BMI (body fat, organ, or muscle volume) are most predictive of final dose in abdominopelvic CT (CTAP).
Material and Methods: Institutional ethical approval was received. BMIs were recorded for 243 consecutive patients that presented for routine CTAP. All patients were imaged on 64-slice CT (General Electric Lightspeed VCT-XTE) at 120kVp and 120-300mA. Dose-length-products (DLPs) were recorded from study dose-report. Exclusion criteria were patients with hip prosthesis or scan-lengths not including dome of the liver to the symphysis pubis. Body composition parameters (BCPs) including volumes of abdominal organs, subcutaneous (SAT) and visceral (VAT) adipose tissue, and muscle were calculated using threshold-based segmentation software.
Results: DLPs ranged from 42.5 to 1363.6mGy-cm. BMIs ranged from 13.9 to 49.1kg/m^2. For all BCPs, males were significantly larger ($p=0.049$-$p<0.001$) except for total adipose tissue (TAT) volume where the increase did not reach significance ($p=0.124$). Using stepwise simple linear regression with DLP as the dependent variable, TAT volume, muscle volume, and liver volume were included (standardised coefficients 0.649, 0.258, and 0.097, respectively; $R^2=0.875$, $p<0.001$).
Conclusion: TAT is seen as the strongest determinant of the DLP among the variables assessed. This information may be used to identify those patients at highest risk of receiving large doses from CTAP with ATCM and may help with refinement of ATCM.

SS 13.08

Comparison of liver tumor volume assessment using five different advanced visualization software platforms: clinical implications

M. Lubner, P.J. Pickhardt, B.D. Pooler, B. Durkee; Madison, WI/US

Purpose: To compare liver lesion volume measurement on five different 3D software platforms using a specifically constructed liver phantom.
Material and Methods: Anthropomorphic phantom was constructed with 10 implanted liver lesions of known volume and varying sizes, attenuation, and morphology. Phantom was scanned on at MDCT with standard parameters (120 kV_p, 80-440 smart mA, NI 12). DICOM data were uploaded to 5 advanced visualization software systems and evaluated by three independent readers. Tumor volumes were measured by each reader on each software platform with both manual and (semi)automated techniques. Actual and measured lesion volumes were compared for all systems and readers. Measurement time and subjective ease-of-use were assessed with 1-5 ranking of systems.
Results: Overall mean % volume error for manual volume technique by system was 8.0 ± 7.5%, 16.4 ± 14.8%, 14.2% ± 15.2%, 16.9 ± 13.8%, and 13.7 ± 11.2%. Substantial inter-observer variability was present. More automated approaches were associated with much larger measurement errors. The fastest system ranked 5th (last) in volume error and 3rd in ease-of-use, whereas the two systems that tied for 1st in ease-of-use ranked 1st and 3rd in volume error and 5th and 2nd in time, respectively.
Conclusion: Accuracy, precision, and feasibility of 3D volume assessment of liver lesions vary considerably by software system and individual readers. Manual assessment is currently most accurate but is more labor intensive. These results underscore the need for improved automation and uniformity among the available software platforms.

SS 13.09

CT perfusion as a non-invasive tool for the diagnosis of gastroesophageal varices in cirrhotic patients

A. Karatzas, C. Triantos, M. Marsigie, E. Konstadatou, P. Zampakis, K. Thomopoulos, T. Petsas, C. Kalogeropoulou; Patras/GR

Purpose: To prospectively assess the utility of perfusion computed tomography (CT) in depicting the presence of gastroesophageal varices in cirrhotic patients.
Material and Methods: CT perfusion was performed in 29 cirrhotic patients using a 16x MDCT (LightSpeed; GE Healthcare). Obtained data were processed (GE Healthcare Workstation) and the blood flow (BF), blood volume (BV), mean transit time (MTT), permeability surface area (PS) and hepatic arterial fraction (HAF) were calculated for both liver lobes. The same patients were subjected to upper GI endoscopy for the detection of gastroesophageal varices and the results were correlated with the CT perfusion parameters.
Results: Data from 3 patients were excluded from the analysis since their results of upper GI endoscopy were equivocal for the presence of varices. Among the remaining 26 patients, varices were detected in 18 of them. BV proved to be significantly higher in both liver lobes of patients with varices ($p = 0.037$ right and $p = 0.044$ left lobe). For the same group of patients, PS values were significantly higher only in the right lobe ($p = 0.004$) though HAF values proved significantly higher ($p = 0.046$) in left lobe.
Conclusion: There is significant correlation between certain hemodynamic parameters and the presence of gastroesophageal varices in cirrhotic patients. CT perfusion could potentially be used for the non-invasive detection of varices.

SS 13.10

3D Time-resolved qualitative and quantitative analyses of portal venous hemodynamics in liver cirrhosis patients

Z. Stankovic, Z. Csatari, P. Deibert, W. Euringer, S. Eggerking, P. Blanke, Z.A. Zadeh, M. Langer, M. Markl; Freiburg/DE

Purpose: To perform qualitative and quantitative analyses of portal venous (PV) hemodynamics of liver cirrhosis patients and volunteers using time-resolved flow-sensitive 4D MRI at 3 Tesla.
Material and Methods: Our study consisted of 20 liver cirrhosis patients, 20 age matched and 21 young volunteers. 3D flow characteristics in the portal vein were evaluated using time-resolved 3D MR velocity mapping at 3T MRI (spatial resolution: 1.6 x 2.1 x 2.4mm^3, temporal resolution: 44.8ms). PV flow was evaluated using 3D streamlines and time-resolved particle traces originating from 5 emitter planes in the PV system. Quantitative evaluation included retrospective extraction of regional peak and mean velocities, flow volume and vessel area. Results were compared to the clinical reference standard US.
Results: 3D streamlines and particle traces in the PV hemodynamics were successfully visualized for all patients and volunteers with a small restriction in the left intrahepatic PV branch. Almost all results revealed a significant correlation with significant lower values for 4D MRI compared to US for maximum and mean velocities, flow volume for the intrahepatic vessels and significant higher values for the vessel area. Patients showed significant lower mean velocities in superior mesenteric vein and significant higher flow volume in splenic vein compared to different age group volunteers.
Conclusion: Flow sensitive 4D MRI may be a standardized method within a multimodal setting for liver cirrhosis patients evaluating pathological changes in flow characteristics or therapy monitoring.

11:15 -12:45 **Sala Feste**

Scientific Session 14

Pancreas and bile ducts

SS 14.01

Are diffusion-weighted imaging coefficients age-related or region-related in normal adult pancreas?

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Purpose: To determine if the diffusion of water molecules within the pancreas is age-related or region-related in normal adults, using MR diffusion-weighted imaging (DWI).
Material and Methods: 53 adults devoid of pancreatic disease (mean age: 47 years; age range: 18-73 years) underwent DWI of the pancreas with an SS-EPI sequence using b factors of 0, 150, 1000 and 1600 s/mm^2 at 3T. Two independent observers (A and B) measured the perfusion fraction (f), true diffusion coefficient (D) and ADC values for the head, body and tail of the pancreas, and these were correlated to age.
Results: No correlation was found between f, D and ADC values for the three different parts of the pancreas and patient age. No statistically significant difference was observed for the f values between pancreatic head, body and tail ($p > 0.05$ for both readers). Reader B found a low but significant difference in the D between pancreatic head and tail ($p = 0.028$), D being ~7% lower in the tail. Both readers found a low but significant difference between the ADC values of pancreatic body and tail ($p = 0.006$ for reader A; $p = 0.011$ for reader B), ADC being ~8% inferior in the tail. According to the Bland-Altman analysis, standard deviation was lower and repeatability was higher for the tail of the pancreas.
Conclusion: f,D and ADC values in adult pancreas are not correlated to age. ADC values are lower in the tail than in the body of normal pancreas.

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SS 14.02

Diffusion-weighted MRI of the pancreas: correlation with secretin-enhanced magnetic resonance cholangio-pancreatography (S-MRCP) findings in patients with chronic pancreatitis

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Purpose: To evaluate the correlation between apparent diffusion coefficient (ADC) values of the pancreas on diffusion-weighted imaging (DWI) and severity of chronic pancreatitis and pancreatic exocrine function determined by S-MRCP.
Material and Methods: Mean ADC values (b = 0, 700) derived from 3 or 2 manually drawn region of interest of the pancreas on DWI were measured in 15 healthy volunteers and in 50 patients with known or suspected pancreatic diseases referred for S-MRCP. S-MRCP images of the patients were evaluated for the diagnosis of chronic pancreatitis (Cambridge score) and assessment of pancreatic exocrine function (Matos score). Correlation between ADC values in volunteers and patients was performed using t-test for unpaired data. ADC values in patients were compared to Cambridge score and Matos score with ANOVA test.
Results: Mean pancreatic ADC value was 2.71 x $10^{-3}mm^2/s$ in healthy volunteers and 2.21 x $10^{-3}mm^2/s$ in the patients' group, with a significant statistical difference in the two groups (P < .0001), even after adjusting for sex and age (P = .0033). There was no significant correlation between pancreatic ADC values and Cambridge classification or Matos score in patients with chronic pancreatitis, even after adjusting for sex and age.
Conclusion: Pancreatic ADC values were significantly lower in patients with known or suspected chronic pancreatitis than in healthy volunteers. We did not find any significant correlation between pancreatic ADC values and Cambridge classification or Matos score in patients with chronic pancreatitis.

SS 14.03

Timing of biliary excretion during Gd-EOB-DTPA-enhanced liver MRI and its effect on T2-weighted imaging

R. Musson[1], N. Hersey[2], A. Blakeborough[1]; [1]Sheffield/UK, [2]Derbyshire/UK

Purpose: To record the timing of biliary excretion, and subsequent impact on T2-W imaging of the biliary tree performed after Gd-EOB-DTPA injection.
Material and Methods: 145 consecutive patients undergoing Gd-EOB-DTPA-enhanced MRI for known or suspected liver lesions had an examination protocol which included post-contrast T1-W and T2-W imaging at 3, 6, 10 and 20 minutes. These studies were reviewed with respect to biliary excretion of contrast agent.
Results: Five studies with incomplete data and a sub-group of 21 studies in 9 patients with more than one examination were excluded. Of 119 patients, 71F:48M, aged 18-85 yrs (ave. 51), 16 had a cholecystectomy, 12/93 gallbladders had stones. Recent LFTs were available in 91 patients (57 normal). Biliary excretion was observed in 0/17/107/119 patients at 3/6/10/20 mins respectively, appearing as high signal on T1-W sequences and invariably producing loss of the normal high signal on the T2-W sequence. Duodenal opacification was noted in 0/0/4/42 cases (at 3/6/10/20 mins). Gallbladder opacification occurred in 0/2/29/63 (at 3/6/10/20 mins). Differences in excretion times did not correlate with age, sex or LFT status.
Conclusion: Biliary excretion following Gd-EOB-DTPA was not detected in any patient at 3 minutes, but by 6 minutes was evident in 17/119 (14%) on T1-W imaging with corresponding signal loss on T2-W imaging. This signal loss may disguise or mimic biliary pathology and we recommend T2-W sequences are performed either pre-contrast or early (3 minutes) post-contrast.

SS 14.04

Flip angle modulations in late phase Gd-EOB-DTPA MRI improve the identification of bile duct anatomy variations as compared to MRCP

L. Stelter, C. Grieser, C.M. Perez Fernandez, J.H. Rothe, B. Hamm, T. Denecke; Berlin/DE

Purpose: The additional value of flip angle modulations in late phase contrast-enhanced magnetic resonance cholangiography (EOB-MRC) using the hepatocyte-specific contrast media Gd-EOB-DTPA, as compared to magnetic resonance cholangiopancreatography (MRCP), was estimated in this study.
Material and Methods: 35 adult patients underwent Gd-EOB-DTPA-enhanced MRI of the liver including an early unenhanced T2-weighted MRCP in single shot thick slab technique as well as late phase (20 min. post-contrast injection) T1-weighted THRIVE sequences applying an alternating 10° (fa10) and 35° (fa35) flip angle, respectively. Images were evaluated by three experienced observers in consensus regarding the delineation of different biliary regions, the order of branching detectable and overall anatomical visualization of the biliary tree. ROI analysis was performed to estimate the signal intensity in the liver parenchyma and the common hepatic duct in the EOB-MRCs and branching of the biliary system was classified and compared to the MRCP.
Results: The overall quality in EOB-MRC was rated as good in fa10 and fa35 for the grade of visualization of the different anatomical biliary regions and the whole biliary tree. Delineation of the biliary system proved to be significantly better (p = <0.01) than in MRCP. Comparing the different applied flip angles in the post-EOB studies, the fa35 images revealed a significantly higher contrast of the biliary system to the liver tissue (p = <0.001) as compared to fa10 imaging. Changes in classification of bile duct branching were made in about 15% of the patients applying fa35 images as compared to MRCP.
Conclusion: Flip angle modulations in Gd-EOB-DTPA-enhanced magnetic resonance cholangiography revealed an additional diagnostic value regarding anatomical variations of the biliary tree as compared to MRCP. Applying a flip angle of 35° to the late phase post-contrast images significantly improved the contrast of the biliary system to the surrounding liver tissue, indicating a superior diagnostic assessment of anatomical and functional bile duct abnormalities.

SS 14.05

Assessment of acute cholangitis by MR imaging

J.H. Kim, H.W. Eun, S.S. Hong, J.K. Han, B.I. Choi; Seoul/KR

Purpose: To assess common MRI findings of acute cholangitis compared with a non acute group.
Material and Methods: During 31 months, we performed MRI in 173 patients with biliary abnormality. The causes of biliary abnormality include biliary stone (n = 85), cholangiocarcinoma (n = 47), periampullary cancer (n = 20), GB cancer (n = 4) and others (n = 17). Among them, 66 consecutive patients confirmed acute cholangitis according to Tokyo guideline and 107 confirmed non-acute group. The two radiologists independently assessed MR findings including cause of biliary abnormality, periductal T2 signal change, periductal transient attenuation difference, abscess, thrombosis, and ragged duct. They also measure dilated duct and thickened wall. Student's t-test and Pearson Chi-square were used. The Kappa statistics were used to determine interobserver agreement. Logistic regression was used to identify the MR findings that predict acute cholangitis.
Results: MRI correctly accesses the cause of biliary abnormality in 163 patients (94%). The statistically common findings for acute cholangitis were as follows: periductal T2 signal change (n = 26, 39%, p < 0.05); periductal transient attenuation difference (n = 31, 47%, p < 0.05); abscess (n = 18, 27%, p < 0.05); thrombosis (n = 12, 18%, p < 0.05); ragged duct (n = 11, 17%, p < 0.05). Interobserver agreement was good to excellent in each findings (? = 0.74 to 1.000). Wall thickness showed statistically difference between two group (2.65mm: 2.32mm, p < 0.05); however, duct dilatation showed no difference. Periductal transient attenuation difference was independent predictor of acute cholangitis (Exp(B) = 6.389, p = 0.018).
Conclusion: By means of statistically common MR findings, MR image is very useful for prediction of acute cholangitis.

SS 14.06

Diagnostic work-up of segmental cholangitis using DWI and Gd-EOB-DTP-enhanced MRI

S. Magnaldi, A. Wibmer, N. Bastati, D. Muin, S. Baroud, A. Ba-Ssalamah; Vienna/AT

Purpose: To describe the MRI features of segmental cholangitis using diffusion-weighted imaging (DWI) and Gd-EOB-DTPA dynamic-enhanced MRI and distinguish it from THADs.
Material and Methods: All patients underwent a standard Gd-EOB-DTPA-enhanced MRI of the liver including axial DWI (b = 30, 300 and 600). Patients with at least one wedge- or fan-shaped enhancing area in the arterial phase were selected for further analysis. THAD was defined as hyperenhancing area in the arterial phase and isointense in all remaining sequences. Segmental cholangitis was considered in the presence of hyperenhancing area in the arterial phase, hyperintensity in the DWI and hypointense in the hepatospecific phase. Blood laboratory parameters were compared with the Wilcoxon or the Kruskal-Wallis test.
Results: Of a total of 513 patients undergoing an enhanced MR examination of the liver, 42 showed at least one wedge- or fan-shaped enhancing area in the arterial phase. The typical appearance of a THAD was present in 12 patients (28.6%) while 19 patients (45.3%) had signs of segmental cholangitis. When compared to patients with THADs, patients with segemental cholangitis had significantly higher mean plasma levels of alkaline phosphatase (91.9 vs. 268.8 U/l; p = 0.015) and C-reactive protein (0.05 vs. 3.27 mg/dl; p = 0.006).
Conclusion: Segmental increased signal intensities on DWI, combined with segmental wash-out of hepatospecific contrast agent after administration of Gd-EOB-DTPA, is additional evidence of focal areas of parenchymal damage in the course of segmental cholangitis.

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SS 14.07

Evaluation of the bilio-enteric anastomoses with contrast-enhanced MR cholangiography using Gd-EOB-DTPA: comparison with conventional T2-weighted MRC

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Purpose: To compare Gd-EOB-DTPA MR-cholangiography (MRC) with conventional T2-weighted MRC in patients with bilio-enteric anastomoses.

Material and Methods: Twenty-eight patients with pre-existing bilio-enteric anastomoses and clinical-echographical suspect of biliary pathology underwent MR imaging at 1.5T device. After acquisition of T1w/T2w images, conventional MRC was performed through thin-slab 3D FRFSE and thick-slab SSFSE T2w sequences. In each patient a 3D fat-suppressed LAVA sequence was performed before and 15, 20, 25, 30, 40 minutes after intravenous administration of 10 ml Gd-EOB-DTPA (Primovist®, Bayer HealthCare), and in 3/28 cases it was also obtained after 90-120 minutes. Visualization of each segment of the biliary tree and anastomotic bowel was graded by two radiologists in conference on a four-point scale: 0, absent; 1, poor; 2, good; 3, excellent. All segments were assessed for the presence of ductal dilatation, stricture, bile leakage, intraductal filling defects and other abnormalities. MRI findings were compared to surgical findings, when scheduled, and/or a six months-lasting clinical-radiological follow-up.

Results: Gd-EOB-DTPA-enhanced-MRC significantly out-performed conventional MRC in the visualization of the extra-hepatic biliary system and anastomotic region and in the assessment of anastomotic strictures and pneumobilia ($p < 0.05$). The grading of visualization and depiction of dilation of the second and third-order intra-hepatic bile ducts was significantly superior on T2w MRC ($p < 0.05$). No significant difference was identified between the two techniques in the detection of biliary stones.

Conclusion: Gd-EOB-DTPA MR-cholangiography can improve the assessment of biliary pathology in patients with bilio-enteric anastomoses.

SS 14.08

Does Courvoisier's sign stand the test of time?

K. Murphy, P. Mc Laughlin, B. O'Connor, M. Breen, C. O'Suilleabhain, P. MacEneaney, M. Maher; Cork/IE

Purpose: Courvoisier's sign states that in a jaundiced patient with a palpable gallbladder, the cause is unlikely to be gallstones. The aim of this study was to investigate the validity of this sign in modern practice using image analysis software to objectively measure gallbladder volumes at MRCP in patients with and without biliary obstruction.

Material and Methods: All MCRP investigations that were performed at a tertiary hepatobiliary and pancreatic centre over a two-year period were analysed. The information recorded included the presence or absence of gallbladder stones, common bile duct (CBD) stones or non-gallstone biliary obstruction. Gallbladder volume was calculated using Osirix v3.7.1.

Results: 645 MRCPs were examined, of which 398 (61.7%) were eligible for analysis. Mean gallbladder volumes were estimated for 4 patient groups as follows - no gallstones or biliary obstruction: 39.6 ml (SD 33.7), gallbladder stones only: 53.0 ml (SD 51.2), CBD stones: 66.7 ml (SD 58.9) and non-gallstone biliary obstruction: 98.7 ml (SD 62.9). A statistically significant difference exists between the summated obstructive and non-obstructive groups ($p < 0.001$). In addition, a significant difference exists in mean gallbladder volume between those with CBD stones and non-gallstone CBD obstruction ($p = 0.02$).

Conclusion: A significant difference was observed in gallbladder volume in the group with biliary obstruction from choledocholithiasis compared with the group with biliary obstruction due to other aetiologies. This study validates Courvoisier's sign as a valuable clinical sign for suggesting aetiology of biliary obstruction in the jaundiced patient.

SS 14.09

Dilatation of the bile duct in post-cholecystectomy patients: a retrospective study

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Purpose: To compare the bile duct (BD) diameters in patients with cholecystectomy to those without and determine the impact of age and sex on BD diameter.

Material and Methods: We retrospectively reviewed contrast-enhanced abdominal CT scans of 290 consecutive patients (119 males, mean age 55.9 years; range 30-80) between June 2009 and August 2010 who presented at the emergency department of our institution without cholestasis, proven by normal laboratory values of total bilirubin and alkaline phosphatase. The BD diameter was measured in three locations; intra-hepatic, at hepatic artery and supra-pancreatic. Measurements were performed twice, at one month interval, by two observers. Intra- and inter-observer variability was measured by intra-class correlation coefficients. Effect of cholecystectomy, age and sex on BD diameter was modeled with linear mixed model analysis.

Results: Sixty-one (21.0%) patients had history of cholecystectomy. Intra-observer agreement was 99.7% (95% confidence interval (CI): 99.7%-99.8%) and 98.0% (95%CI: 97.4%-98.4%). Inter-observer agreement was 93.9% (95%CI: 92.3%-95.1%). Cholecystectomy status and age were associated with statistically larger BD diameters. The average BD diameters for the non-cholecystectomy versus cholecystectomy patients were 4,5,5mm and 5,7,7mm ($p = 0.001$) for the intra-hepatic, hepatic artery level and supra-pancreatic BD, respectively. Older age was also associated with larger BD diameters($p = 0.001$), irrespective of cholecystectomy status.

Conclusion: Post-cholecystectomy patients can present enlarged BD unrelated to cholestasis. BD diameter increases with age regardless of cholestasis. Hence, clinicians should rely on patient history and laboratory determinants to guide the necessity of further investigation.

SS 14.10

Dual-energy iodine removal for CT-cholangiography: virtual non-enhanced imaging effective to replace true non-enhanced imaging?

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Purpose: To evaluate whether virtual non-enhanced imaging (VNI) is effective to replace true non-enhanced imaging (TNI) applying dual-energy iodine removal for CT-cholangiography.

Material and Methods: From April 2009 until February 2010, fifteen consecutive potential donors for living-related liver transplantation (nine women; mean age 37.610.8 years) were included. All subjects underwent a two-phase CT-examination of the liver. The first phase consisted of a single-energy non-enhanced CT-scan providing TNI. After administration of intravenous cholangiographic contrast, the second phase was performed as a dual-energy cholangiographic CT-scan. VNI was reconstructed with a standard dual-energy iodine subtraction tool (Liver-VNC; Siemens Medical Solutions, Forchheim, Germany). Attenuation values (intrahepatic main ducts and liver parenchyma), objective image quality (image-noise and contrast-to-noise-ratio) and subjective image quality (overall image quality [1 - excellent; 2 - good; 3 - fair; 4 - poor; and 5 - not interpretable]) were analyzed.

Results: The long axis of the microwave-ablations with flow occlusion was significantly larger compared to the microwave-ablations without flow occlusion (41.64.0 mm versus 34.25.9 mm; P 0.01). The short axis of the microwave-ablations with flow occlusion was significantly larger compared to the microwave-ablations without flow occlusion (16.61.2 mm versus 12.22.1 mm; P 0.001). The volume of the microwave-ablations with flow occlusion was significantly larger compared to the microwave-ablations without flow occlusion (6.71.0 ml versus 3.31.2 ml; P 0.001). The circularity of the microwave-ablations with flow occlusion was not significantly different compared to the microwave-ablations without flow occlusion (0.400.05 versus 0.360.07; P 0.001).

Conclusion: For CT-cholangiography, subjective image quality was comparable between VNI and TNI. However, from a quantitative point of view, significant differences exist when VNI was compared to TNI. Therefore, VNI was not effective to completely replace TNI.

11:15 -12:45 **Sala Mosaici 1**

Scientific Session 15

Colon (Tube 4)

SS 15.01

Magnetic resonance imaging contrast-enhanced mural perfusion kinetics: segmental differences exist in endoscopicaly proven normal colon

S.A. Taylor, S. Punwani, R. Hafeez, A. Bainbridge, P. Boulos, S. Halligan; London/UK

Purpose: Abnormal contrast enhancement is advocated as a biomarker for colitis, although normal perfusion kinetics are poorly described. The purpose was to assess segmental enhancement in normal colon.

Material and Methods: 8 patients (mean age 61) without prior history of inflammatory bowel disease underwent standard MR colonography followed by normal same day colonoscopy. A volumetric interpolated breath hold examination sequence to encompass the colonic volume was performed three times prior (flip angles 5, 10, 35 degrees) and every 30 seconds following intravenous Dotarem for 210 seconds. Mural signal intensity was measured in 6 colonic

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segments and colonic wall T1 calculated using a standard expression for the evolution of signal intensity in a spoiled gradient echo sequence and solving for T1. Perfusion curves (change in T1 against time averaged across all patients) were generated, and maximum T1 change compared across segments using one-way ANOVA and Tukey correction for multiple comparisons.
Results: All colonic segments demonstrated type 2 enhancement curve morphology. However, T1 change during the plateau phase (after 120 seconds) significantly differed between segments ($p < 0.001$). In particular, rectal T1 fall (mean plateau -417ms) was significantly greater that all other segments ($p < 0.001$ to 0.02), whereas the caecal T1 fall (mean plateau T1 -311ms) was significantly less than the rectum ($p < 0.001$), ascending ($p = 0.03$), and sigmoid ($p = 0.04$).
Conclusion: Normal colon shows significant intersegmental perfusion differences. Notably, rectal enhancement is highest and caecal lowest.

SS 15.02
Image quality of MR-colonography with iodine-tagged limited bowel preparation and automated carbon dioxide insufflation for colonic distension: preliminary results
M.P. van der Paardt, F.M. Zijta, T.N. Boellaard, S. Bipat, A.J. Nederveen, J. Stoker; Amsterdam/NL

Purpose: To prospectively evaluate image quality of 3.0T MR-colonography using iodine-tagged bowel preparation and CO_2 bowel distension.
Material and Methods: Twenty patients at increased risk for colorectal carcinoma underwent 3.0T MR-colonography using iodine-tagged bowel preparation and automated CO_2 insufflation. Coronal FS 3D-T1-weighted SPGR and 2D-T2-weighted SSFSE were acquired in supine and prone (only T1-weighted acquisition) position. Two observers assessed image quality for six colon segments with regard to amount, consistency of fecal residue, bowel distension, artifacts and image readability, on a 3- or 4-point scale. Wilcoxon-signed-rank test was used for comparison.
Results: Each observer evaluated 120 segments per sequence (total evaluated segments = 480). In 63.8% of the segments (306/480), less than 25% of the lumen was filled with fecal residue. Bowel content was homogeneously liquefied in 94% (451/480). Overall supine distension was adequate-optimal in 94.7% (453/480) segments. Distension was overall better in supine compared to prone position (84.6% versus 55.0%; $P < 0.0001$); prone position was favorable for rectal distension (92.5% (37/40) versus 67.5% (27/40); $P = 0.03$)). Overall image readability on T1-and T2-weighted (T2w) images was sufficient (87.9% (422/480)), although significantly lower for T1w images ($P < 0.0001$). More artifacts were found for T1w images (75.4% (181/240)) compared to T2w images (16.6% (40/240; $P = 0.0001$)); however, overall only 16 artifacts ((16/221 (7.2%)) affected image readability (15 T1w, 1 T2w).
Conclusion: Automated CO_2 insufflation is feasible for 3.0T MR-colonography and results in adequate to optimal distension of the large majority of segments. Iodine tagging results in homogeneous tagging.

SS 15.03
Hydrocolonic ultrasound for colorectal cancer detection: technique and preliminary study in 80 cases
S. Siripongsakun, L. Charoenvisal; Bangkok/TH

Purpose: To introduce hydrocolonic ultrasound technique (HUS) that can complete colorectal evaluation for detecting malignant colonic lesion and reveal preliminary study in 80 cases when compared with colonoscopy.
Material and Methods: Technique: To eliminate retained stool, the patient should obtain total colonic irrigation prior the study. The irrigation system can be adapted from barium enema system. Scanning should be performed with adequate colonic distension which can be achieved by instilling of 1-2 litre of water. Some parts are difficult to evaluate; for example, colonic flexures behind the ribs or tortuous sigmoid. Most sigmoid can be assessed by changing from supine to lateral decubitus positions, whereas colonic flexures can be easily accessed by taking a deep breath to bring the flexures down below the ribs. The aim is to evaluate rectal area which cannot be reached by transabdominal ultrasound. After rectal balloon removal, transperineal approach is performed to complete colorectal evaluation while the retained fluid still distends the rectum. Total average scan time is about 15-20 minutes.
Results: Hydrocolonic ultrasound can detect all cancers and polyps >1.5 cm(5/5 lesions), missed 1 polyp size between 1 and 1.4 cm (1/4 lesions) but it is insensitive in detection of polyp size less than 1 cm.
Conclusion: HUS is a cheap, tolerable, and non-invasive method for colon cancer detection. Without radiation exposure, hydrocolonic ultrasound can be a potential study for detecting early colorectal cancer, even though it is insensitive for small polyps.

SS 15.04
Complying with NPSA. How to make the impact on radiology a positive one
S.J. O'Shea, A. Mort, R. Sethi, S.H. Lee; Manchester/UK

Purpose: In February 2009, the National Patient Safety Agency (NPSA) in the UK issued a directive to all healthcare organisations regarding potential risks associated with inappropriate use of oral bowel cleansing agents. To comply with the requirements of this document needed a major overhaul in the booking systems within radiology for CT colonography and barium enema examinations. All healthcare organisations using bowel cleansing solutions were directed to provide: a clinical assessment to ensure no contraindication or risks from the use of a bowel cleansing solution. Authorisation for use of a bowel cleansing solution at the same time as the investigative procedure. An explanation of the safe use of the product to the patient or carer. A safe system involving an authorised clinical professional in the supply of the medicine and written information for each patient.
Material and Methods: We describe our experience in setting up a radiology outpatient clinic to comply with NPSA requirements, run by specialist G-I radiographers, in order to review patients referred for studies requiring bowel cleansing agents. This allows renal function and performance status to be reviewed as well as bowel cleansing agents to be prescribed and both written and verbal instructions given.
Results: To date patient acceptability has been 100% with no complaints despite the requirement for an additional visit to the department prior to the radiological examination. We discuss our experience of obstacles to the provision of this service, training issues, the impact on the running of the department, cost implications and impact on DNA rates for time consuming investigations.
Conclusion: It is possible to set up a G I radiographer led outpatient clinic service in order to comply with National Patient safety requirements in the UK and achieve associated improvements in patient service. Such a service may well be required in other countries in the future. We believe our service can act as a role model in this respect.

SS 15.05
Assessment of colon cancer staging by water enema-MDCT
E. Sibileau[1], C. Ridereau-Zins[1], P.J. Valette[2], N. Ibtissam Ashwar[2], S. Bertrais[1], A.H. Pavageau[1], C. Casa[1], C. Aubé[1]; [1]Angers/FR, [2]Lyon/FR

Purpose: To assess the accuracy of the WE-MDCT for the staging of colon cancer.
Material and Methods: 53 patients (mean age 70) with a diagnosis of colon cancer were prospectively evaluated by a preoperative WE-MDCT. All patients were operated on. Tumors were classified with TNM staging system. The CT features noticed were: tumor location on the colon; aspect of tumor external edges; spread to the pericolic fat or to the neighbouring organs; thickening of retroperitonal fascia; number, size and enhancement of the peritumoral lymph nodes. Tumors were estimated in 2 groups: T1/T2 and T3/T4. Subgroups T3 and T4 were analysed separately. Lymph nodes were classified positive or negative.
Results: Tumor location on colon was always right. The agreement between WE-MDCT staging and pathology staging was good ($k = 0.64$). A stiff aspect of tumor external edges had excellent sensitivity for inclusion in T3/T4 group (Se 97.7%, NPV 85.7%). Thickening of a fascia or the abdominal wall had a good specificity for T4 stage (Sp 95%; NPV 91%). Enhancement over 100 HU of at least one of the peritumoral lymph nodes was the best criteria for positivity (Se 86.4%; Sp 67.7%; NPV 87.5%).
Conclusion: WE-MDCT allows a good staging for colon cancer based on objective features.

SS 15.06
Accuracy of pre-operative MDCT staging of locally advanced colon cancer
V.C. Arora, S.H. Lee, S.J. O'Shea, S. McGrath; Manchester/UK

Purpose: Neo-adjuvant chemotherapy has been shown to improve survival in some GI malignancies. Identification of poor prognostic features in colon cancer can help direct therapy with the aim of down staging local disease . This study aims to assess the accuracy of MDCT in staging of locally advanced colon cancer as compared to postoperative histopathology.
Material and Methods: 29 patients were prospectively assessed by TNM staging for entry into the UK FOxTROT trial . Poor prognostic factors such as local invasion and extramural vascular invasion (EMVI) were recorded. Patients with distant metastatic disease were excluded. 8 patients who were randomized to neo adjuvant chemotherapy were excluded leaving 21 (mean age 72 yrs, 12M) patients for analysis.
Results: The accuracy for staging of T3/T4 colon cancer was 62%. Depth of local tumor invasion beyond the muscularis propria was accurately identified in 47%. Accuracy for EMVI and exclusion of N2 disease was 71 and 38%, respectively.

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Conclusion: Our results of pre-operative MDCT staging of colonic cancer in locally advanced tumors are at odds with those published from the major UK centre involved in the FOxTROT trial. There is good correlation with T staging but poor correlation with EMVI and depth of tumor invasion. These findings may have implications in the assessment of future trials using different neo-adjuvant chemotherapy agents to down stage colonic cancer (Dighe et al BJS 2010;97:1407).

SS 15.07

Detection of relevant colonic neoplasms with PET/CT: promising accuracy with minimal CT dose and a standardised PET cut-off

W. Luboldt, T. Volker, K. Zoephel, B. Wiedemann; Munich/DE

Purpose: To determine the performance of FDG-PET/CT in the detection of relevant colorectal neoplasms (adenomas ≥ 10 mm, with high-grade dysplasia or cancer) in relation to CT dose and contrast administration and to find a PET cut-off.

Material and Methods: 84 patients, who underwent PET/CT and colonoscopy (n = 79)/sigmoidoscopy (n = 5) for (79 x 6 + 5 x 2) = 484 colonic segments, were included in a retrospective study. The accuracy of low-dose PET/CT in detecting mass-positive segments was evaluated by ROC analysis by two blinded independent reviewers relative to contrast-enhanced PET/CT. On a per-lesion basis characteristic PET values (SUV_{max}, SUV_{mean}, and SUV-bordered volumes) as well as their combinatory products and ratios were tested as cut-offs.

Results: Low-dose PET/CT and contrast-enhanced PET/CT provide similar accuracies (area under the curve for the average ROC ratings: 0.925 vs. 0.929). PET demonstrated all carcinomas (n = 23) and 83% (30/36) of relevant adenomas. In all carcinomas and adenomas with high-grade dysplasia (n = 10) the SUV_{max} was ≥5. This cut-off resulted in a better per-segment sensitivity and negative predictive value (NPV) than the average PET/CT reviews (sensitivity: 89% vs. 82%; NPV: 99% vs. 98%). All other tested cut-offs were inferior to the SUV_{max} in separating true positive (TP) from false positive (FP) findings.

Conclusion: FDG-PET/CT provides promising accuracy for colorectal mass detection. Low dose and lack of iodine contrast in the CT component do not impact the accuracy. The PET cut-off SUV_{max} ≥5 improves the accuracy.

SS 15.08

What is the most accurate whole-body imaging modality for assessment of local and distant recurrent disease in colorectal cancer? A meta-analysis

M. Maas, I.J.G. Rutten, P.J. Nelemans, D.M.J. Lambregts, V.C. Cappendijk, G. Beets, R.G.H. Beets-Tan; Maastricht/NL

Purpose: Up to 40% of colorectal cancer (CRC) patients develop recurrence. Early and accurate identification is important to improve survival. Aim was to determine the most accurate whole-body imaging (WBI) modality for detection of recurrent/metastatic disease in patients with suspected recurrent CRC during follow-up.

Material and Methods: Medline and Embase were searched. Studies evaluating the accuracy of WBI with CT/PET-CT/MRI/PET for recurrence detection in patients with suspected recurrent CRC were included. Studies evaluating liver only or response to therapy were excluded. 2x2-contingency tables were extracted and summary receiver operator characteristics (sROC) curves with area under the curves (AUC) were constructed by a regression model. Subgroup analyses were performed to correct for interstudy heterogeneity.

Results: 14 studies were included which evaluated PET, PET/CT, CT and/or MRI. Study results were available in 12 studies for PET, in 5 studies for CT, in 5 studies for PET/CT and in 1 study for MRI. All studies used histopathology and clinical&radiological follow-up as reference method. AUCs for PET, PET/CT were 0.94 (0.90-0.97) and 0.94 (0.87-0.98), respectively. CT had significantly lower performance: AUC 0.83 (0.72-0.90), $p < 0.05$. After correction for heterogeneity, CT remained the modality with lowest diagnostic performance.

Conclusion: PET-CT and PET have the highest diagnostic performance for the detection of metastases/recurrence in patients with suspected recurrent CRC. CT has significantly lower diagnostic performance, probably because CT has lower performance in populations with high prevalence of metastasis/recurrence and CT has lower accuracy for the detection of extrahepatic metastases.

SS 15.09

Fluoro-guided CT fistulography in the occurrence of intestinal fistulas: diagnostic accuracy with respect to conventional fistulography

G. Foti, N. Faccioli, R. Pozzi Mucelli; Verona/IT

Purpose: To assess diagnostic accuracy of fluoro-guided CT fistulography (FCTF) in the evaluation of intestinal fistulas, using conventional fistulography (CF) as reference standard.

Material and Methods: In a 2-year period, 14 consecutive patients with clinical suspect of intestinal fistulas (8 males, 4 females, mean age 57 years, range 35-68) and studied with FCTF and CF were evaluated. FCTF protocol included an unenhanced (UE) scan, followed by manual injection of water-soluble contrast material under pulsed fluoroscopic guidance, and a portal enhanced scan (80 sec delay). For CF, the injection of contrast material was performed manually under fluoroscopic guidance, acquiring spot images in the crucial phases. The diagnostic accuracy of FCTF in depicting intestinal fistulas (defined as channels filled with contrast material connecting two intestinal structures) was evaluated with respect to CF. Mean fluoro-time was compared with Student's t-test. A p value ≤0.05 was considered significant

Results: FCTF presented 90% sensitivity and 100% specificity in diagnosing intestinal fistulas, missing only a fistula (because of small amount of contrast material injected), without false positive cases. Mean fluoro-time registered for FCTF and CF was similar (p = 0.1, 7.2 versus 8.1 sec).

Conclusion: FCTF is a reliable imaging tool for depicting intestinal fistulas if compared with CF, giving at the same time additional information regarding site and extent of fluid collections, and eventually the possibility to rule out other associated complications.

SS 15.10

Delayed presentation of splenic rupture following colonoscopy: clinical and CT findings

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Purpose: To assess the clinical and CT findings of symptomatic colonoscopy-induced splenic injury.

Material and Methods: Multi-center search yielded 11 adults with symptomatic splenic injury related to colonoscopy. Work-up included abdominal CT in 10 (91%) cases and abdominal radiography in one hemodynamically unstable patient. Colonoscopy findings, post-procedural course, and CT findings were systematically reviewed.

Results: Mean patient age was 62.2 years (range, 51-84 years); 8 (73%) of 11 were female. The majority (64%) of colonoscopies were for screening. No immediate complications were reported at OC; tortuosity/redundancy was noted in 5 cases. Except for one patient with a 6 mm polyp and one with a 10 mm polyp, the remaining nine patients had either diminutive or no polyps. Only one patient presented with early symptoms during post-colonoscopy recovery, the other 10 had a delayed presentation ranging from 8 hours to 8 days (mean, 2.1 days). All patients presented with abdominal pain. CT was diagnostic for splenic injury with subcapsular and/or perisplenic hematoma in all 10 CT cases. Other CT findings included hemoperitoneum (n = 8), visible splenic laceration (n = 3), and splenic artery pseudoaneurysm (n = 1). Five patients underwent splenectomy (four emergent) and six patients were treated conservatively. Average hospital stay was 5.5 days (range, 3-10 days).

Conclusion: Colonoscopy-induced splenic injury characteristically presents as a delayed and often serious complication. In cases of apparent non-traumatic splenic hematoma/rupture at CT, history of recent colonoscopy is relevant.

11:15 -12:45 **Sala Mosaici 2**

Scientific Session 16

Imaging Crohn disease activity (Tube 5)

SS 16.01

Contrast-enhanced MR enterography as a stand-alone tool to evaluate Crohn's disease in a pediatric population

S. Kim, B. Spieler, N. Hindman, J. Levy, D. Sahlein, R. Rivera, A.J. Megibow; New York, NY/US

Purpose: To assess the performance using post-contrast MRI sequences as a stand-alone tool to evaluate disease activity in Crohn's disease in comparison to all images sequences together in an attempt to suggest limitation of the number of overall non-contrast sequences need for the follow-up evaluation of Crohn's disease in a pediatric population.

Material and Methods: Twenty-five pediatric patients (mean 11.2 years, M = 12, F = 13) with Crohn's disease who underwent MRI at 1.5 T were included. Two radiologists reviewed images in 2 separate sessions in consensus; post-contrast sequences only and whole images including non-contrast and post-contrast sequences. The intestine was divided into 10 segments. Readers evaluated the presence or absence of active inflammation using a five-point grading system (grade 1-5). Sensitivity, specificity and accuracy were calculated for detecting segments showed definitive active inflammation (Score = 5). The complete MRI examination was used as a reference standard.

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Results: There were 53 bowel segments with active inflammation on reference standard in 25 subjects. Inter-reader agreement had a Kappa 0.622. Sensitivity, specificity, PPV, NPV, and accuracy for diagnosing definite active inflammation using post-contrast images alone were 83.3%, 86.9%, 89.3%, 80%, and 84.9%, respectively, for agreement of definite active inflammation (score 5) using post-contrast images alone.
Conclusion: Follow-up MRI in pediatric Crohn's patents monitoring disease activity can be performed by decreased number of sequences while maintaining diagnostic accuracy using post-contrast T1 and non-contrast HASTE sequences.

SS 16.02

Evaluation of Crohn's disease activity in children with magnetic resonance enterography and colonography

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Purpose: To determine the activity of Crohn's disease (CD) using magnetic resonance enterography and colonography (MREC) in pediatric patients with suspected or known CD.
Material and Methods: Eighteen consecutive pediatric patients with CD (median age 14.8 years) underwent MREC. MREC was performed with oral application of 5% manitol solution, rectal application of water and gadolinium injection. CD activity was measured with the Pediatric Crohn's disease activity index (PCDAI). MREC activity findings included presence of fistula, stratification, bowel wall enhancement and gadolinium enhancement of regional lymph nodes were evaluated by two blinded radiologist. MREC findings were scored findings from 0 to 5. Spearman rank correlation was used to compare PCDAI and positive MREC findings for CD; a p value of less then 0.05 indicated a statistically significant difference.
Results: In 12 patients MREC findings were positive for CD, intravenous application of paramagnetic Gadolinium contrast detect 9 (75%) with active disease. We diagnosed CD in 5 (29%) new patients. In all MREC-positive patients a significant correlation was observed between MREC score and PCDAI ($r = 0.736$, $p < 0.05$).
Conclusion: According to our results, MREC is a valuable diagnostic tool to evaluate CD activity in pediatric patients with suspected or known CD.

SS 16.03

Magnetic resonance enterography with and without biphasic contrast agent enema compared to conventional ileocolonoscopy in patients with Crohn's disease

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Purpose: Magnetic resonance imaging (MRI) of the bowel is a valuable diagnostic tool for assessing disease activity and complications in patients with inflammatory bowel disease (IBD). Major advantages of the technique are the absence of ionizing radiation, its non-invasive nature and the ability to detect extra-mural pathologies. In this study, we compared magnetic resonance enterography (MRE) with and without water enema to conventional ileoscopy as a reference method to evaluate the additional advantage of a rectal enema with biphasic contrast agent for MRI diagnostics of Crohn´s disease (CD) in the terminal ileum and the colon.
Material and Methods: We prospectively evaluated 50 patients with known CD. MRE with biphasic contrast enema was performed in 23 cases, whereas 27 patients received an MRE without rectal water enema. All included patients had a conventional ileocolonoscopy within 3 weeks before or after MRE. During the MRE, T2-weighted and contrast-enhanced T1-weighted sequences were acquired in dark lumen technique. We assessed the degree of inflammation in both modalities on a scale from 0 (no inflammation) to 3 (severe inflammation), evaluating a total of up to 7 bowel segments in each patient separately. Afterwards, we compared the results of MRE with and without rectal enema to each other and to the findings of conventional ileocolonoscopy as a reference method.
Results: MRE with biphasic contrast enema achieved a sensitivity and specificity of 100% and 74% for detection of inflammation in the terminal ileum while we found a sensitivity of 72% and a specificity of 87% for the examination without enema. Considering the entire colon MRE examinations with enema had a sensitivity of 79% (specificity 96%) while the examination without enema showed a sensitivity of 38% (specificity 99%). The MRE technique using an enema proved statistically superior to MRE without rectal enema in detecting inflammation in the terminal ileum, ascending colon and rectum.
Conclusion: MRE with rectal enema is a valuable non-invasive diagnostic tool for the assessment of inflammation in patients with CD. Rectal application of a biphasic contrast agent is well tolerated and significantly improves detection of inflammation in three bowel segments, among them the terminal ileum, which is the segment most frequently affected in CD. Rectal enema should therefore be included in MRE protocols when examining patients with Crohn´s disease.

SS 16.04

Whole intestinal distension with oral administration of polyethylene glycol in "2 steps" to monitor Crohn's disease activity through biphasic-lumen MR examination

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Purpose: Dark lumen technique (MRE and MRC) provides good results for IBD diagnosis, but it can cause discomfort for patient. We propose an alternative method to distend and evaluate the entire unprepared bowel by applying dark lumen technique: 2 time polyethylene glycol (PEG) administrations.
Material and Methods: 158 examinations in patients with known CD; they were asked to drink twice 1.5 L of PEG solution: 2-4 hours and during 45 minutes before MR examination. On axial and coronal planes we obtained T2-weighted, True-FISP and T1-weighted fat-saturation sequences, before and after i.v. dynamic administration of gadolinium. Average scanner time was ~23 min. Grading of bowel distension, cleansing and parietal inflammation (active, inactive, none) was defined, using conventional colonoscopy (CC) and post-biopsy hystopatologic results as gold standard of disease activity assessment.
Results: With respect to CC (in 125/158 pts), in 162 sick segments MR showed complete correlation of presence and localization of inflammation, and partial but good correlation of inflammatory grading (PPV 95.8%, NVP 92.3 %). Only in 84/926 evaluated colonic segments, the high amounts of residual stools made an adequate intraluminal diagnosis impracticable.
Conclusion: The combination of MRE and MRC allows complete assessment of inflammation in small and large bowel of patients with CD, requiring minimal effort to patient before MR scanning. Whole bowel assessment with "2 steps" distension is feasible, satisfying, does not need for manual colon distension.

SS 16.05

Magnetic resonance enterography in the differential diagnosis between fibrotic and active inflammatory small bowel stenosis in patients with Crohn's disease

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Purpose: To assess the accuracy of MRI in prospectively differentiating between fibrotic and active inflammatory small bowel stenosis in Crohn's disease.
Material and Methods: 111 patients with histologically proven Crohn's disease referring with clinical and plain radiographic signs of intestinal obstruction underwent coronal and axial MRI scans (T2 and pre/post-gadolinium T1 sequences) after oral administration of a polyetylenglycol solution. A stenosis was defined as a >80% lumen reduction associated with focal wall thickening. At the level of the stenosis, both the T2 signal intensity and the post-gadolinium T1 enhancement were quantified using a 5-point scale (0: very low; 1: low; 2: moderate; 3: high; 4: very high). A stenosis was judged fibrotic if the sum of the two values (activity score: AS) did not exceed 1.
Results: 48/111 patients had a small bowel stenosis. Fibrosis was confirmed at histology in 23 patients (AS 0-1) who underwent surgery within 3 days. In the remaining 25 patients (AS: 2-8) an active inflammatory stenosis was suspected and drug-induced remission of the obstruction was obtained; one patient (AS: 2), however, underwent surgery after 14 days due to recurrence (histology: severe fibrosis overlapping mild inflammation). MRI resulted 95.8% sensitive, 100% specific and 97.9% accurate in the diagnosis of fibrotic stenosis.
Conclusion: MRI reliably differentiates between fibrotic and inflammatory small bowel stenosis in Crohn's disease.

SS 16.06

Quantified small bowel motility during MR enterography in Crohn's disease as a marker of inflammatory activity

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Purpose: To investigate the relationship between software-derived small bowel motility index and conventional MRI markers of Crohn's disease activity.
Material and Methods: Bowel wall motion quantification software was applied to a coronal breath-hold cine FISP sequence (20s breath-hold, TR 4ms, TE1.7ms, slice thickness 10mm, 1 slice/0.8sec) through the terminal ileum (TI) in 16 patients (5 females, mean age 31) undergoing MR enterography. The validated software uses non-rigid registration to quantify motion changes over time in a manually placed polygonal region of interest within the bowel, providing automated estimation of bowel wall displacement, expressed as the standard deviation of Jacobian determinant (motility index). Two observers graded TI disease activity using conventional MRI markers (wall thickness, T2 signal, perimural oedema, enhancement, all scored 0-3, and enhancement pattern (1 = homogenous, 2 = mucosal 3 = layered). The scoring system has been previously validated against a histological reference. On statistical advice correlation between the motility index and activity score was performed using Kendall's rank correlation.

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Results: The mean motility index and activity score was 0.31 (range 0.07-0.53), and 4 (range 0-11), respectively. There was a significant negative correlation between the motility index and activity score (Kendall tau) -0.50 (95% CI -0.81 to -0.18), p = 0.01.
Conclusion: Quantified small bowel motility is negatively correlated with conventional MRI scores of disease activity suggesting it may be a new quantitative marker of inflammation.

SS 16.07

MR motility measurement for the evaluation of Crohn's disease activity compared to biopsy

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Purpose: The purpose of this study is to correlate MR-motility alterations with the activity of the disease and the presence of chronic changes based on histopathologic samples of the terminal ileum in patients with Crohn's disease (CD).
Material and Methods: 43 patients with known CD underwent MRI (1.5T) using 2D TrueFisp cine sequences in addition to a standard imaging protocol. An oral non-invasive preparation method (1000ml of mannitol 3% over 1h) was used for optimal distension. MR motility was measured at the level of the terminal ileum as diameter changes over time on each slice orthogonally to the small bowel axis. Motility was graded as normal, hypomotility or absence. This was correlated with biopsy of the terminal ileum, not more than 14 days from the MR. The biopsies were graded for the presence of disease, disease activity (high activity, mild activity, no activity) and for chronic changes (severe, mild or no chronic changes). The motility alterations were correlated with the presence of disease, the activity and the chronic changes using the Spearman rank order correlation.
Results: Biopsy proved CD in 28 patients at the level of the terminal ileum, 15 had active CD (7 highly active, 8 mild) while 17 showed chronic changes (4 severe, 13 mild). MRI revealed motility changes in 21 patients (13 hypomotility, 8 absent). The degree of motility alterations correlated with the grade of activity (R = 0.522) and chronic changes (R = 0.521; p 0.001). The sensitivity and specificity for motility changes were 0.79/0.67 for detection of activity and 0.81/0.72 for detection of chronic changes.
Conclusion: MR-motility alterations of the terminal ileum in patients with CD correlate with biopsy proven active and chronic changes. MR-motility scans are good alternative to endoscopy in evaluating inflammatory changes in the terminal ileum in CD patients.

SS 16.08

Activity assessment of Crohn's disease of terminal ileum: MR with free-breathing diffusion-weighted imaging and dynamic motility evaluation as a possible alternative to MR with intravenous contrast agent

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Purpose: MR-enterography (D-CE-MRE) is accepted method to assess Crohn's disease(CD) activity, although dynamic-contrasted-enhanced MR-enterography (D-CE-MRE) needs for gadolinium contrast agent. Recently, diffusion-weighted MR imaging (DWI) and its related ADC map have been used in multiple clinical conditions. Our purpose is to investigate the value of free-breathing DWI MRI in assessing small bowel CD activity.
Material and Methods: 77 patients with terminal ileum CD underwent MR-examination after bowel oral distension with polyethyleneglycol solution. We based MR-assessment of disease activity on morphology and motility of small bowel and perivisceral structures evaluation (true-FISP, cine-true-FISP, HASTE T2W sequences), parietal signal intensity in DWI and parietal D-CE (FLASH T1W-sequence). Patients were divided into three categories (negative, inactive and active), using endoscopic biopsy as the standard reference (38 cases) or whole of clinical findings and MR sequences (24 cases).
Results: On DWI, inflammatory bowel tracts showed higher signal intensity compared to normal segments (accuracy: 89.1%, sensitivity: 89.7%, specificity: 88.2%, PPV: 92.9%, NPV: 83.3). For quantitative assessment, ADC value in active disease was lower than in inactive disease (negative: $1.9x10^{-3}\pm0.3x10^{-3}mm^2/s$, inactive: $1.38x10^{-3}\pm0,26x10^{-3}mm^2/s$, active: $1.08x10^{-3}\pm0.22x10^{-3}mm^2/s$). In all patients complete MR examination allowed to perform detailed and panoramic evaluation of small bowel.
Conclusion: Valuable functional information about motility of affected loops and condition of proximal loops are allowed by cine-MR mode. Free-breathing-DWI gives some information in visual assessment of CD activity; ADC values may facilitate quantitative analysis of disease activity, decreasing in inflamed bowel segments, because of restricted diffusion.

SS 16.09

Therapeutic response assessment by MRI for mucosal healing in Crohn's disease: preliminary results in a multicentric study

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Purpose: To assess the ability of MRI to reflect therapy-induced changes in Crohn's disease (CD) inflammatory lesions, using ileocolonoscopy as reference standard.
Material and Methods: Patients with active CD (CDAI > 200), and ulcers in at least one segment at ileocolonoscopy, received corticosteroids (n = 7) or adalimumab (n = 20) for induction of remission. Colonic and ileal disease activity was assessed by magnetic resonance index of activity (MaRIA), endoscopy (CDEIS), clinical evaluation (CDAI), and biomarkers at baseline and week 12 after initiation of therapy.
Results: 27 patients have completed the study. Clinical remission (CDAI < 150) was achieved in 4/7 patients treated with steroids and 15/20 of those treated with adalimumab. Mucosal healing (CDEIS < 3.5) was observed in 2/5 steroid treated patients and 15/20 adalimumab treated patients. Complete healing of all segments with ulcers detected by endoscopy at baseline was observed in 2/5 patients treated with steroids and 9/20 treated with adalimumab. A significant correlation was observed between CDEIS and MaRIA both at baseline ($r = 0.73$, $p < 0.001$) and at week-12 ($r = 0.70$, $p < 0.001$). The magnitude of reduction in MaRIA closely paralleled changes in CDEIS ($r = 0.74$; $p < 0.001$). A global MaRIA score ≤40 predicted endoscopic remission (sensitivity = 0.82; specificity = 0.85). The kappa coefficient between endoscopical and MRI healing (MaRIA < 11) was 0.72 ± 0.09 ($p < 0.001$).
Conclusion: MRI is an accurate method to assess therapeutic responses in CD, sensitive to changes in lesion severity, and able to determine mucosal healing.

SS 16.10

Dynamic contrast-enhanced MRI for the evaluation of perianal fistulas in patients with Crohn's disease

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Purpose: To determine if dynamic contrast-enhanced MRI (DCE-MRI) can evaluate disease activity in patients with perianal fistulizing Crohn's disease.
Material and Methods: Patients with perianal fistulizing Crohn's disease underwent DCE-MRI. The van Assche MRI-based score and perianal disease activity index (PDAI) were determined. Transversal DCE-MRI was performed at 3T during intravenous contrast injection (TE 2.3, TR 5.1, FA 30, 15 slices, total duration of dynamic scan 5.05 min, 70 scans per slice, temporal resolution 4.2 sec per volume). The qualitative parameters maximum enhancement (ME), slope of the enhancement curve (SoE) and curve shape type (as by Lavini et al) as well as the quantitative parameters Ktrans, Vep, Kep as in the Tofts model were calculated (using a measured arterial input function) on a pixel by pixel basis, and then averaged of over an ROI drawn around the fistula. Spearman correlations between DCE-MRI parameters and PDAI and MRI-based score were calculated.
Results: Sixteen patients (7 males) were included, mean age 37 (range 18-63). PDAI correlated with ME ($r = 0.669$, $p = 0.005$), SoE ($r = 0.582$, $p = 0.018$), ROI volume ($r = 0.786$, $p < 0.001$) and MRI-based score ($r = 0.574$, $p = 0.020$), but not with Ktrans, Vep and Kep. ME correlated with Ktrans ($r = 0.701$, $p = 0.002$) and Kep ($r = 0.626$, $p = 0.009$).
Conclusion: ME, SoE and MRI-based score seems to be the best choice to evaluate perianal disease activity. None of the quantitative model-based parameters showed a direct significant correlation with disease activity.

SS 16.11

Diffusion weighted MRI of primary squamous cell carcinoma of the anal canal treated with chemoradiation

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Purpose: To assess the diffusion weighted MRI (DW-MRI) characteristics of anal canal cancer.
Material and Methods: 20 patients with squamous cancer and 20 controls underwent T1W, T2W and STIR pelvic sequences, supplemented by DW-MRI (b-values: 0, 150, 500, 800 s/mm2) (Avanto, Siemens Healthcare). Tumor stage, signal intensity and whole tumor apparent diffusion coefficient (ADC; mean and functional ADC histogram) were assessed using commercial software (Oncotreat, Siemens Healthcare) before and 8 weeks after chemoradiation (50.4 Gy radiotherapy, 5-flurouracil and mitomycin-C). ADC pre- and post-chemoradiation were compared using t-test; statistical significance 5%.

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Results: Median follow-up was 21.3 months. There were T1 (3), T2 (8), T3 (6), T4 (3) cancers; 13/20 had nodal involvement: N1 (3), N2 (4), N3 (6). Tumors were hyperintense on T2, STIR and b 800 DWI sequences. Mean tumor ADC was lower than controls (1.08 X 10^{-3} versus 1.42 X 10^{-3} mm^2/s, respectively; p = <0.001). 14/20 (70%) cancers underwent additional MRI 8 weeks following completion of chemoradiation: there was a reduction in tumor size (mean reduction = 69.3%; p = 0.002), signal intensity (iso- or hypointense) and an increase in ADC (mean increase = 48.8%; p = <0.001). Functional ADC histograms demonstrated a shift to the right. Disease relapse was noted in 2 patients. Baseline ADC was slightly higher for relapsed tumors (1.14 X 10^{-3} mm^2/s versus 1.07 X 10^{-3} mm^2/s).
Conclusion: Tumor ADC increases following chemoradiation indicating cell kill. DW-MRI may augment morphological assessment.

11:15 -12:45 **Mangano**

Scientific Session 17

Mesentery, peritoneum and abdominal wall

SS 17.01

Abdominal fat distribution at CT as a predictor for the metabolic syndrome

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Purpose: The metabolic syndrome describes a cluster of metabolic disturbances associated with an increased risk of cardiovascular events. Distribution of abdominal fat may be a useful indicator for metabolic syndrome. The purpose of this study was to assess subcutaneous fat area (SFA), visceral fat area (VFA), visceral fat percentage (VF%), and other CT-based measurements for predicting the metabolic syndrome.
Material and Methods: Standard SFA, VFA, and VF% measurements were obtained at the umbilical level from CT colonography studies in 474 consecutive asymptomatic adults (217 men, 257 women) using a dedicated software application (Fat Assessment Tool, EBW 4.5, Philips). Noncontrast liver attenuation was also recorded. Diagnosis of the metabolic syndrome was based on the 2005 International Diabetes Foundation (IDF) criteria, which incorporates abdominal obesity, glucose intolerance, hypertension, and dyslipidemia. Uni- and multivariate gender-specific analyses were performed.
Results: The ROC area under the curve (AUC) for SFA was 0.865 (95% CI: 0.823-0.899) in men and 0.762 (0.711-0.806) in women (p = 0.0238). AUC for VFA was 0.887 (0.848-0.918) in women and 0.830 (0.784-0.867) in men (p = 0.162). AUC for VF% was 0.527 (0.472-0.581) in men and 0.820 (0.774-0.859) in women (p < 0.001). SFA threshold value of 204.7 cm^2 in men yielded a sensitivity and specificity of 80.3% and 84.5%, respectively. VFA threshold value of 71.5 cm^2 in women yielded a sensitivity and specificity of 83.7% and 80.7%, respectively. The best multivariate models did not substantially improve performance over SFA in men and VFA in women alone.
Conclusion: Important gender-specific differences were observed. SFA alone was a better predictor than either VFA of VF% for metabolic syndrome in men, whereas VFA was the single best predictor in women. These straightforward CT measures appear to have prognostic importance and could be reported prospectively in practice.

SS 17.02

Does size matter? Correlation of volumetric abdominal adipose and C-reactive protein with CT findings of inflammatory response in the acute abdomen

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Purpose: To correlate positive CT findings with CT determined volumetric abdominal adipose measurements and raised inflammatory markers in the setting of the acute abdomen.
Material and Methods: We conducted a study of 653 patients with an acute abdomen presenting to the emergency department of a single tertiary referral centre. Patients with known malignancy were excluded. All patients underwent CT abdomen/pelvis and a series of laboratory tests including CRP. Scans were reviewed by two independently blinded radiologists and a coding system for diagnostic grouping and severity of inflammatory change was developed. Volumetric visceral and subcutaneous adipose was measured using Osirix 3.7.1, 2010 (Apple Freeware, California, USA). Statistical analysis was performed used Chi-squared and Kruskal-Wallis tests.
Results: A total of 411 patients were included. 128 were females and 113 were males. Average age was 54. There were very significant differences between CT inflammatory findings when grouped by CRP quartile (p > 0.001). There were significant differences also in abdominal adipose (p = 0.015) and CRP (p > 0.001) (Kruskal-Wallis) between diagnostic groups. Elevated CRP was significantly associated with a positive scan result (p > 0.001) and this increased in significance as CRP level increased. There was no significant association however between CRP and levels of abdominal adipose in patients with positive CT scan findings (p = 0.425).
Conclusion: Elevated C-reactive protein is a predictor of positve findings on CT in the clinical setting of the acute abdomen. We found no association however between CRP levels and volumetric abdominal adipose levels in this patient cohort.

SS 17.03

Diffusion-weighted 3T MRI of peritoneal carcinosis: comparison with 64 MDCT and surgical and histopathologic findings—a feasibility study

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Purpose: To evaluate the utility of single-shot spin-echo echo-planar diffusion-weighted imaging (DWI) using a b value of 1000 s/mm2 for depicting peritoneal metastases. To retrospectively measure the diagnostic performance of 64 MDCT and DWI 3T MRI results in the detection of peritoneal metastases (PMs) in patients with advanced ovarian cancer undergoing peritonectomy and hypertermic intraperitoneal chemotherapy (HIPEC).
Material and Methods: In 68 patients with ovarian cancer who were undergoing cytoreductive surgery the presence of PM was prospectively rated as grade 0 (absent), grade 1 (equivocal), or grade 2 (present) on CT scans and 3T MRI using DW sequences after dividing abdomen into 14 different sites. Results of HIPEC surgey and histopathologic evaluation were compared with DWI MRI and MDCT results. Sensitivity, specificity, and accuracy were calculated for DWI, MDCT, and combined DWI and MDCT.
Results: 447/952 sites of PMs were proven by surgical and histopathologic findings. The combination of DWI and MDCT was most sensitive and accurate for PMs for the two observers (sensitivity, 89%, 82%) compared with DWI alone, with sensitivity of 74%, 73%, and MDCT alone (sensitivity of 85%, 80%). Combining DWI and MDCT, sensitivity increases but remaining low for lesions <0.5 cm (51% , 54%).
Conclusion: Adding DWI MRI to MDCT seems to improve the sensitivity and specificity for depicting PMs providing precise location of implants and showing a satisfactory correlation with surgical findings.

SS 17.04

MDCT in the early diagnosis of recurrence in patients with peritoneal carcinomatosis treated by means of cytoreductive surgery and hyperthermic intraoperative peritoneal chemotherapy: correlation with serum tumor markers

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Purpose: To assess the value of MDCT in the early detection of peritoneal recurrence in patients with peritoneal carcinomatosis (PC) treated by means of cytoreductive surgery and HIPEC, in comparison to serum tumor markers.
Material and Methods: Thirty-five patients with PC from ovarian (n = 21), colorectal (n = 9) tumors, uterine sarcoma (n = 2) , fallopian tube tumors (n = 2) and peritoneal liposarcoma (n = 1) treated by means of cytoreductive surgery and HIPEC were included. They underwent serum tumor marker measurements (CEA, CA 125) every month after surgery and MDCT follow up at 3 and 6 months interval. Two readers in consensus evaluated axial and multiplanar reconstructed MDCT images of the abdomen obtained during the portal venous phase of contrast material enhancement, with a collimation of 4 x 2.5 mm and a slice-width of 3 mm. MDCT findings were correlated to tumor markers measurements obtained within 15 days.
Results: Sensitivity, specificity and diagnostic accuracy were, respectively, 75%, 100% and 77% for serum tumor markers and 94%, 66% and 91% for MDCT. In 8/11 patients with normal tumor markers, MDCT showed peritoneal neoplastic implants confirmed at pathology and MDCT follow up. In 1/11 patients with normal tumor marker levels, MDCT revealed one peritoneal nodule demonstrated to be necrotic lesion at pathology.
Conclusion: MDCT is able to early detect peritoneal recurrence in patients treated by means of cytoreductive surgery and HIPEC and can predate rising tumor markers levels.

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SS 17.05

Abdominopelvic actinomycosis: analysis of imaging findings and which diseases does it mimick?

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Purpose: Abdominopelvic actinomycosis is often a retrospective diagnosis by exclusion with much overlap to imaging findings of more serious, often neoplastic disease. The purpose of the study was to analyze the imaging findings of the disease and to indicate discriminative findings for a better prospective diagnosis.

Material and Methods: The radiology, pathology and infectious disease databases of two hospitals, one university and one general, were structurally searched for cases of actinomycosis. Ten cases (6 women, 4 men) were selected and all cross-sectional imaging studies were reviewed and checked against pathological and clinical records of the participating institutions.

Results: The sigmoid colon was most commonly involved. Most patients showed concentric bowel wall thickening, enhancing homogeneously. Inflammatory infiltration of the pericolonic fat was diffuse and severe in 5 cases, while in 7 patients one or more pelvic abscesses were revealed. A pelvic mass adjacent to the involved bowel segment was seen in 3 cases and lymphadenopathy was noted in 5 patients. Infiltration into the abdominal wall was seen in two patients, while in one case there was thoracic dissemination. Five cases were misdiagnosed at imaging as complicated diverticulitis, Crohn's disease, ulcerative colitis, tubo-ovarian abscess and perforated colonic cancer.

Conclusion: Actinomycosis is not only related to long-term use of intrauterine contraceptive devices but should also be included in the differential diagnosis when imaging shows bowel wall thickening with pelvic masses and extensive inflammatory fat infiltration.

SS 17.06

Rectosigmoid endometriosis: comparison between CT findings and laparoscopy

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Purpose: This study aims to evaluate the diagnostic accuracy of MDCT examination for the preoperative definition of rectosigmoid endometriosis in patients for whom MRI is contraindicated.

Material and Methods: Seventeen patients (mean age 32) affected by endometriosis and with contraindications to MR examination underwent preoperative 16-row CT water colonography with intravenous injection of contrast material. Axial and MPR images were retrospectively evaluated searching for site, number, enhancement and longitudinal extension of bowel implants; alterations of intestinal peristalsis; presence of bowel wall thickenings or other extraintestinal endometriotic implants. CT findings were then compared with surgical and pathological data, having the latest as the reference standard. Three patients affected by ileo-cecal endometriosis were excluded.

Results: Fourteen rectosigmoid endometriotic implants were diagnosed by CT examination. A diagnostic accuracy value of 79% was found for CT examination with a correct diagnosis in 11 out of 14 cases.

Conclusion: CT examination with water colonography provides useful information for the diagnosis and evaluation of extension of rectosigmoid endometriotic implants in patients for whom MRI is contraindicated and allows to identify a correct therapeutic strategy.

SS 17.07

Diffusion-weighted MR-imaging in diagnosis of abdominopelvic internal fistulae: comparison with T2-weighted and contrast-enhanced MR images

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Purpose: To retrospectively determine additional value of diffusion-weighted MR-imaging (DWI) to T2-w and contrast-enhanced (CE) images in the diagnosis of abdominopelvic internal fistulae (IFs).

Material and Methods: Fourteen patients with 25 IFs arising from the small bowel (16), in the colon (8) and biliary tract (1) were included. Two independent observers reviewed T2-w images alone, T2-w images together with DWI images and T2-w images together with CE images at three sessions to detect IFs based on a confidence scale of five. Sensitivity of each session was calculated considering the confidence rating of 4 or 5 as positive for diagnosis. Sensitivity and confidence score of each session was compared.

Results: Nine (36%) and ten (40%) IFs were detected on T2-w images by observer 1 and 2, respectively. Both observers detected 19 (76%) and 24 (96%) IFs on their review of T2-w+DWI and T2-w+CE image combinations, respectively. Detection rate and confidence scores improved significantly for both readers when T2-w images were reviewed in combination with DWI or CE images ($p \leq 0.01$). There was no significant difference between the detection rate of T2-w+DWI and T2-w+CE image combinations. Confidence scores with CE-images and T2-w images combined were significantly greater than DWI+T2-w images ($p = 0.01$ for reader 1 and 0.03 for reader 2).

Conclusion: DWI showed additional value to T2-weighted imaging in the diagnosis of abdominopelvic IFs by improving their detection rate and confidence level of diagnosis.

SS 17.08

Primary treatment of visceral pseudoaneurysms with percutaneous injection of thrombin: a viable alternative to angiographic embolization?

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Purpose: To study the efficacy of percutaneous thrombin injection as primary mode of treatment for visceral pseudoaneurysms and as a viable alternative to angiographic embolization.

Material and Methods: Over nine months, 12 patients with pseudoaneurysms were treated with percutaneous human thrombin injection. Of these, seven patients had previous attempted angiographic embolization. Human thrombin (500 to 1000 IU) (Tisseel VH; Baxter, Glendale, CA) was injected into the pseudoaneurysm under USG guidance. Follow-up USG was performed 24 hours and one week after the procedure to confirm persistent thrombosis. If residual flow was present, the procedure was repeated. Complete persistent thrombosis at one week was considered as cure.

Results: Of 12 pseudoaneurysms, five were treated primarily with percutaneous thrombin injection. Cure was achieved in all five. Seven were treated following failure of attempted angiographic embolization. Cure was achieved in six; one remained patent but did not bleed. Five patients of 12 required repeat thrombin injections (2 to 3 attempts). The mean number of required injections was 1.5 (18/12). The mean dose of thrombin required was 812.5 IU (9750/12). There were no embolic complications related to the procedure. Considering the angiographic failures as the control group: RRR = 1; ARR = 0.143(-0.11, 0.402); NNT = 7 (2.48, -8.59).

Conclusion: Percutaneous thrombin injection is an effective and safe technique as the primary mode of treatment for amenable visceral pseudoaneurysms, and can be used even in the absence of angiographic equipment.

SS 17.09

Visualization of mesh implants using conventional MRI and positive-contrast susceptibility imaging in an animal model

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Purpose: Polymer-based textile meshes often cause complications. In most cases, conventional imaging methods, including MRI, fail to delineate these implants. By integrating tiny iron particles in the mesh base material, MRI-visualization of meshes becomes feasible. To differentiate iron-induced voids from proton-free structures such as bowl gas, positive-contrast-susceptibility-imaging (PCSI) was proposed. Purpose of the study was to evaluate conventional MRI and PCSI for assessment of iron-loaded surgical meshes in an animal model.

Material and Methods: Iron-loaded polymer meshes were implanted into the abdominal wall of 9 rabbits. After 7, 30, and 90 days, MRI using conventional gradient-echo (GRE), turbo-spin-echo (TSE), and PCSI sequences were performed at 1.5 Tesla. On transverse and sagittal MR-images, the visibility and diagnostic value of the sequences for mesh visualization was scored and statistically compared.

Results: GRE-sequences were rated best and clearly depicted the meshes as signal voids allowing for a precise assessment of the mesh deformation. PCSI contributed valuable information in discrimination between different signal voids. TSE-sequences were rated worst and only delineated the meshes when surrounded by fat as a thin hypointense line.

Conclusion: Both, PCSI and conventional MRI, contribute valuable information for precise mesh assessment and precisely delineated SPIO-loaded meshes in vivo. Gradient echo sequences facilitated best mesh delineation. The hyperintense mesh signal on PCSI clearly delineates the meshes and facilitates a good discrimination against signal free-structures and other off-resonant sources.

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SS 17.10

Peritoneal carcinomatosis due to ovarian cancer: comparison between MDCT, MRI and positron emission tomography-computed tomography with F18-fluorodeoxyglucose

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Purpose: To compare MDCT, MRI and positron emission tomography-computed tomography with F18-fluorodeoxyglucose (^{18}F-FDG PET/CT) for the detection of peritoneal carcinomatosis due to ovarian cancer.

Material and Methods: Fifteen women (mean age 65) with clinical suspicion of ovarian cancer and peritoneal carcinomatosis underwent MDCT, MRI and ^{18}F-FDG PET/CT, simultaneously and shortly performed before surgery (delay 8.1 days). According to the peritoneal cancer index, nine abdominopelvic regions were defined. We applied four scores of lesion size on MDCT and MR images, while the maximal standard uptake value (SUVmax) was measured on ^{18}F-FDG PET/CT. Three sites of lymphadenopathy and posterobasal pleural carcinomatosis were also analyzed. First, one radiologist blindly and separately read MDCT and MR images, while one nuclear physician blindly read PET/CT images grading each lesion according to four diagnostic certitudes. Secondly, all the images were reviewed jointly and compared with histopathology. Receiver operating characteristics (ROC) analysis was performed.

Results: Peritoneal implants were proven in ten women (75%). Altogether, 228 abdominopelvic sites were compared. Sensitivity and specificity for MDCT was 90.2% and 90.6%, for MRI 93.5% and 86.3%, and for ^{18}F-FDG PET/CT 92.7% and 95.7%, respectively. ROC area under the curve were 0.93 for MDCT and MRI, and 0.96 for ^{18}F-FDG PET/CT, respectively. No significant differences ($p = 0.11$) were found between the three modalities.

Conclusion: Although MRI revealed to be the most sensitive and ^{18}F-FDG PET/CT the most specific modality, no significant differences were shown between the three techniques.

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