EP-1006

Improved 3D printed designed Lead Shields for Breast Cancer Lymphoscintigraphy

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Objective: Scatter from the point of injection (SPI) can hinder the detection of sentinel lymph node (SLN) in breast cancer lymphoscintigraphy. Most Nuclear Medicine Departments in Spain use a flat round lead shield (FLS) to reduce the SPI. However, the remaining scatter is still extensive. Furthermore, repositioning FLS to obtain the image with less SPI increases the acquisition time. This study aimed to design a lead shield that could reduce the SPI and diminish the acquisition time. **Material and Methods:** For this study, two different concave lead shields geometries were designed, a semioval lead shield (OLS) and a semispherical lead shield (SLS), in order to introduce the PI inside the lead shield and reduce the scatter. A SICNOVA JCR 1000 3D printer was used to achieve the shield geometry polymeric pattern. Sand molds were then manufactured according to the reference patterns and pure lead alloy was casted. Both casted lead shields were properly surface finished. 20 breast cancer patients were examined after 111 MBq nanocolloid intratumoral or periareolar single injection, making early (5 minutes p.i.) and delayed (2 hours p.i.) studies in anterior oblique and anterior projections, achieving 2 minute images with each lead shield, obtaining a total of 225 valid images. The absolute and normalised subtracted background corrected scatter counts (CSC) as well as the percentage of scatter reduction (%SR) related to the FLS in early and delayed studies were calculated. Additionally the need of repositioning the LS in each projection and with each LS was estimated. **Result:** A mean %SR of 91.8% with OLS and 92% using SLS in early images and 87.2%SR in OLS and 88.5% in late images were obtained. There were statistically significant differences between CSC using FLS and OLS ($p<0.001$) and between FLS and ELS ($p<0.001$), but no differences between OLS and ELS ($p=0.17$) in early images, with the same results observed in delayed studies ($p<0.001$ in relation to FLS, and $p=0.1$ between both curve shields). Also, repositioning the lead shield in anterior oblique projection 6/10 times was necessary with FLS, 2/10 times with OLS and 1/10 times with ELS. In anterior projection, 8/10 times with FLS, 2/10 using OLS and 1/10 in ELS. **Conclusion:** Two concave lead shields that significantly reduce the scatter from the point of injection and diminish the need of centring were created, optimising the sentinel lymph node lymphostintigraphy in breast cancer patients, with slightly better results from semispherical geometry.

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Radioguided surgery with beta radiation: a novel application with Ga^{68}

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Aim: A novel approach to radio-guided surgery (RGS), based on β- radiation, has been recently proposed, and has been proved to be effective in first ex-vivo trials. The technique relies on the detection of beta particles with a dedicated instrument ("beta-probe"). The number of application cases of this technique are today limited by the availability of Beta- emitting radiotracers. Thus, to evaluate the possibility to extend its application cases to Ga68, a retrospective study on Ga68-PSMA PET images was performed. This beta+ emitting tracer could indeed significantly enlarge the application scope of beta-RGS. **Materials and Methods:** A retrospective study on 68Ga-PSMA PET images of 45 patients with prostate cancer was performed. All of them gave written informed consent to participate in the clinical trial, already approved by the Ethics Committee. From PET images, SUV and TNR were acquired for tumor and healthy tissue, and Monte Carlo simulations of the detector were used to evaluate the expected counts on both tissues, and thus to infer the time the surgeon should spend on the sample to discriminate it during surgical interventions. **Results:** Median SUV on prostatic tumors was found to be 4.1 (IQR 3.0-6.1), and median TNR was found to be 9.4 (IQR 5.2-14.6). Median probing time was 3.7s (IQR 1.6-6.9s). **Conclusions:** Despite the expected variability among patients, the majority of cases have been found to be compatible with beta RGS within a reasonable scenario of injected activity and sampling time (5s).

EP-76 **e-Poster Area**

Technical aspects -> Instrumentation and data analysis -> Instrumentation -> PET and PET/CT

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Image Quality Evaluation of SiPM-Based and Standard PMT-based Time-Of-Flight Systems for Yttrium-90 PET/CT imaging

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This study evaluated the image quality of a next-generation SiPM-based (GE Discovery MI) and a PMT-based PET/CT (Siemens Biograph mCT Flow) for ^{90}Y using NEMA NU 2-2012 measurements. **Methods:** A NEMA IEC phantom (6 fillable spheres: 10-37 mm) with a ^{90}Y background concentration of 201 kBq/ml and a sphere to background ratio of ~ 8:1 was measured on both systems (Ghent University Hospital, Belgium) during a 14h single bed scan. Both the full 14h data and a 25 min time window (representative for clinical count statistics) were corrected for scatter and attenuation and reconstructed using time-of-flight ordered subset expectation maximization (TOF-OSEM GE:5i/17s-Siemens:4i/21s) including resolution modeling and a Gaussian post-filter (FWHM:4.5-10 mm). For the GE system, data were also reconstructed with a block sequential regularized expectation maximization (Q.Clear) for different penalization factors (β:300-3000) allowing full convergence and edge preservation. All reconstruction schemes were compared using recovery coefficients (RC) of the 14h data and background noise levels (coefficient of variation, CoV) of both the 14h and 25 min data with the aim to determine optimal reconstruction settings for clinical use of ^{90}Y-PET. **Results:** RCs were as expected with higher RCs for lower β and post-filter FWHM values. For TOF-OSEM reconstructions, GE and Siemens RCs were similar with slightly higher GE RCs for the same post-filter settings. In terms RC mapping, a Q.Clear β of 1500 corresponded to 6-7 mm and 5-6 mm post-filter for GE and Siemens TOF-OSEM respectively. Noise characteristics of GE and Siemens TOF-OSEM reconstructions were again similar with a slightly higher background CoV for Siemens TOF-OSEM compared to GE. For the 14h data, Q.Clear outperformed TOF-OSEM reconstructions in terms of noise levels with a 1.5 times lower background CoV. However, for the 25 min data, Q.Clear noise reduction was limited compared to TOF-OSEM with a highly non-linear penalization effect, revealing an optimal β value of at least 1000 to reach equivalent noise levels. **Conclusion:** Based on phantom measurements, the SiPM-based TOF PET/CT system demonstrated better bias-noise characteristics for ^{90}Y. Q.Clear reconstructions substantially improved bias-noise characteristics for longer ^{90}Y measurements with better count statistics. For clinically relevant count statistics, Q.Clear reconstructions had limited impact on noise levels of ^{90}Y-PET. However, these findings need to be confirmed by clinical data and the performance for the corresponding quantification or detection task.

EP-1009

^{68}Ga-PSMA-11 Imaging for Biochemical Relapse of Prostate Cancer Using Dual-Time LYSO and SiPM-Based Detectors PET/CT

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Objectives: 68Ga-labeled prostate-specific membrane antigen (PSMA-11) is a highly specific tracer for biochemically recurrent prostate cancer at low PSA levels. In this study we aim to compare the diagnostic performance of a new PET/CT scanner (Discovery Molecular Insights - DMI) using silicon photomultipliers (SiPM) detectors vs standard LYSO detectors PET/CT (Discovery 690 - D690) in patients with biochemical relapse following a single injection of radiopharmaceutical. **Methods:** Forty-four patients were prospectively recruited to undergo imaging on the D690 and DMI scanners, in randomized order. Images from the DMI PET/CT were reconstructed using ToF and a Bayesian penalized likelihood algorithm (Q.Clear®) whereas images from the D690 PET/CT were reconstructed using time-of-flight (ToF) and an ordered subset expectation maximization (OSEM) protocol. Two experienced nuclear medicine physicians reviewed both scans for each patient in random order, recorded the number and location of each lesion, and acquired standardized uptake value (SUV) measurements. **Results:** Twenty-three patients underwent imaging on the D690 PET/CT first followed by the DMI scanner, and twenty-one underwent scanning in the reverse order. The median PSA was 4.33 ng/mL with one outlier of 1170 ng/mL. PSMA PET detected sites of recurrence in 32/44 (73 %) patients, including 6/12 (50 %) patients with PSA below 1 ng/mL with the lowest PSA and a positive scan at 0.05 ng/mL. The mean lesion SUVmax measurements were higher on DMI than D690 regardless of the timely order of the scan (6.5 vs. 5.7 in D690 scan first and 4.6 vs. 4.2 for DMI performed first). However, the difference in mean lesion SUVmax was only significant for patients scanned on the D690 first ($p<0.018$). Although the performance of the two scanners was equivalent on a per-patient basis, the DMI identified additional sites of metastases in 2 patients. **Conclusions:** These preliminary results suggest that the SiPM-based DMI PET/CT system offers better performance and superior detector technology and image quality compared to conventional LYSO-based D690 PET/CT. These results need to be confirmed in larger studies.

EP-1010

FDG-uptake in adrenal glands; Comparison between new-generation Silicon Photomultiplier (SiPM) -based PET/CT with respiratory synchronization and conventional PET/CT

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Purpose: Prior studies have documented increased physiological FDG-uptake in adrenal glands along with the development of the PET camera. Furthermore, the spatial resolution of the upper abdomen has improved due to the appearance of the respiratory synchronization. The purpose of this study was to determine whether the SiPM-PET/CT performs better than the conventional PET/CT and investigate the contribution of the respiratory synchronization to the physiological FDG-uptake in adrenal glands. **Methods:** 63 patients, who underwent both SiPM-based and conventional FDG-PET/CT for the follow up after acute treatment were investigated. We excluded the cases with adrenal mass, and with differences in FDG dose per body weight or blood sugar level between SiPM-based and conventional PET/CT. In 24 right adrenal glands and 43 left adrenal glands, we measured the SUVmax in the adrenal gland and compared