Gy) followed by 3 weekly applications of intraluminal high dose rate brachytherapy (HDRBT)starting 6 weeks after EBRT. The starting dose level was 3x5 Gy with escalation of 1 Gy per fraction if acute toxicity was acceptable. Toxicity was acceptable if <2/6 patients or <3/9 patients exhibited dose limiting toxicity (DLT), defined as grade 3 proctitis (CTCAE v 3.0), within 6 weeks after HDRBT. Secondary endpoints were severe treatment-related late toxicity, clinical tumor response and progression free survival (PFS). Clinical tumor response was evaluated based on all available endoscopy pictures and defined as complete clinical response (CR), partial response (PR), stable disease (SD) or progression (PD).

Results: Thirty-eight patients with a mean age of 81 years, entered the study of whom 36 received HDRBT. Two patients died directly after HDRBT and 3 patients refused follow-up endoscopies, leaving 31 patients for response evaluation. At time of current analyses 13 patients were still alive, with a median FU of 30 months. Primary endpoint was reached at the 8 Gy dose-level with 3/9 patients showing a DLT. Response was observed in 25 patients (80.6%); of the 18 patients achieving a CR, 6 developed progressive disease later on. Of the 7 patients with PR, 4 showed progression, whereas this occurred in 5/6 patients with SD. Median time to progression was 6.3 months. PFS at 1,2 and 3 years was 65.6%, 46.4% and 22.1% respectively. Late treatment related grade 3/4 toxicity occurred in 13 patients, of those 9 patients also showed progressive disease. Outcomes related to doselevel are displayed in table 1.

Table 1. Outcomes

Dose level	5Gy	6Gy	7Gy	8Gy
Dose limiting toxicity	1/6	0/5	0/11	3/9
Late toxicity grade 3/4	2/6	1/5	5/13	5/9
Complete response	2/7	1/4	9/12	7/9
Progression	4/7	2/4	5/12	4/9

‡due to missing data number of patients per evaluation group could vary.

Conclusion: A combination of EBRT and HDRBT is feasible in inoperable elderly patients with acceptable acute toxicity and a promising overall response rate of 80.6%. However, given the observed toxicity, a randomized trial comparing EBRT with or without HDRBT boost is necessary. In this trial the clinical relevance of the added tumor control in light of additional toxicity from HDRBT will be evaluated in this fragile population.

OC-0149

Patterns of relapse in rectal cancer patients following pre-operative high dose rate brachytherapy

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Purpose or Objective: Radiation therapy is an established neoadjuvant modality for patients with advanced rectal cancer. As the quality of surgery improved with Total Mesorectal Excision surgery (TME), radiation is now being challenged, as the number of patients needed to treat remains high when facing long-term normal tissue toxicity in the pelvis. High dose rate endorectal brachytherapy is a highly targeted form of radiation based on quality imaging with magnetic resonant imaging and was introduced in our institution along with TME. Unlike external beam radiation therapy, the clinical target volume is aiming mostly at the tumor bed. We are reporting the patterns of relapse of our patients after 15 years experience.

Material and Methods: Patients with operable rectal cancer based on pelvic MRI staging, are considered at risk for local recurrence were included; for physical reasons, those with obstructive tumors and positive extramesorectal nodes were excluded. Patients received treatment with 26 Gy in 4 fractions using a remote afterloader with an endoluminal cylindrical multichannel applicator and an Iridium 192 source. The CTV is defined as the gross tumor volume observed on the diagnostic MRI with no attempt to cover the perirectal nodes. 667 patients treated from 1999-2015, most of which were T3 tumors (84%), low T2 (13%) and early T4 (3%); 36 % of the patients had positive nodes on pre-operative imaging. The local failure in our patient population is 4.7 % with a median follow up time of 65 months for 608 patients (range 6-165 months). Twenty-eight patients had pelvic recurrence, of which 25 were documented with MRI and 3 were found with CT scan. The Imaging was reviewed by two radiologists.

Results: The location of recurrence were identified as: iliac or lateral nodes in 11 patients, anastomotic in 10 patients, inguinal nodes in 3 patients, anterior compartment in 4 patients and pre-sacral space in one patient (one patient had more than 2 sites). In the patients with nodal pelvic relapses, the relapse was isolated for 3 patients and in the other 8 patients there were associated systemic relapses, and these patients were asymptomatic and did not require pelvic radiation while the former 3 patients underwent successful salvage radiation with IMRT (1) /SBRT for 2 patients. Another 9 patients with isolated pelvic relapses received pre-operative pelvic radiation with salvage surgery.

Conclusion: In patients with rectal cancer treated with pre-operative HDRBT, pelvic nodal relapse was the most common site of recurrence and was often associated with asymptomatic systemic relapse. Those patients with isolated nodal relapse are salvageable with either IMRT of SBRT. For patients with localized recurrence, pre-operative pelvic radiation was possible with salvage surgery. Pre sacral recurrence is a rare event, with a single patient observed.

OC-0150

Intraluminal brachytherapy in unresectable biliary carcinoma with malignant biliary obstruction

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Purpose or Objective: Locally advanced unresectable biliary carcinoma often present as extrahepatic malignant biliary obstruction with jaundice. The aim of treatment is to relieve jaundice and pruritus either by endoscopic biliary drainage (EBD) or percutaneous transhepatic biliary drainage (PTBD) followed by stenting. Stent is frequently blocked due to either tumour ingrowth or overgrowth. Intraluminal brachytherapy (ILBT) allows high dose to of radiation to local tumor area and delays the stent block. The purpose of this study is to assess the safety and efficacy of ILBT and impact of external beam radiotherapy(EBRT) on stent patency and survival.

Material and Methods: From 1998-2008, 172 unresectable, locally advanced biliary cancers (pancreas-12, gallbladder-140, cholangiocarcinoma-20), presenting with malignant extrahepatic biliary obstruction were prospectively treated with PTBD and stenting followed by ILBT with or without EBRT. The 110/172(64%) patients received ILBT alone (ILBT group) while 62/172(36%) received ILBT followed by EBRT(EBRT group). Endoscopic retrograde cholangio pancreaticography (ERCP) and/or percutaneous cholangiogram (PC) was done in all. Biliary drainage was done by standard ultrasound and fluoroscopy guided percutaneous transhepatic puncture. The stricture was dilated by balloon catheter over the guide wire. The biliary tract was dilated repeatedly and upsized till 12 French Malecot catheter. High

dose rate brachytherapy with Ir192 source used to deliver 10 Gy/1fr at 1 cm radius from the center of source. PTBD tube was replaced by 10 mm, non sheathed self expandable metallic modified Giantruco Z stent. In EBRT group, stenting, followed by EBRT(dose of 45Gy/25fr/ 5 weeks) by conformal technique to primary tumour and stent area. All the patients were given single agent 5-Fluorouracil chemotherapy 370 mg/m2 Day1-5 at 4 weekly for 6 cycles.

Results: Palliation of jaundice and pruritus was achieved in all. The median overall survival in ILBT and EBRT group was 8 and 9 months with the stent patency 7 and 8 months and overall survival at 1 year was 21% and 23%. Gastric outlet obstruction was 29% in ILBT group and 19% in EBRT group(p=ns), while distant failure rate were 60 % & 55%. No ILBT related morbidity was observed.

Conclusion: PTBD is safe, well tolerated and effective in palliation of Jaundice. Intraluminal Brachytherapy (ILBT) appears to prolong stent patency The addition of EBRT to ILBT does not show any advantage in terms of stent patency and overall survival.

OC-0151

Radiation induced toxicity and tumour control in pts treated for uveal melanoma with ru-106 plaques

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Purpose or Objective: In a retrospective study of 100 consecutive patients treated with Ru-106 eye plaques for uveal melanoma from 2005 to 2008 at our clinic, we aimed to investigate the correlation between the dose to the optic nerve and optic nerve damage; the dose to the macula and macular damage; and the minimum dose to the tumour and tumour control.

Material and Methods: Pre-treatment fundus images were imported into Plaque Simulator TM and the tumour was retrospectively contoured by an ophthalmologist. The plaque position was determined from the radiation scar on post-treatment images. 3D dosimetric data was calculated. The point doses to the optic nerve and macula and minimum dose to the tumour were estimated. TCP, and damage to the optic nerve and macula, were determined from the patients' notes. The correlations between optic nerve damage, macular damage and TCP with dose, dose rate, gender, and plaque type was investigated using univariate and multivariate analyses.

Results: 16 % of the patients developed optic nerve damage. Only optic nerve dose was correlated with damage to the optic nerve (p=0,000063) in univariate analysis.
51% of the patients had macular damage. Only macular dose was correlated with damage (p=0,00049) in univariate analysis.
32 % of the patients did not achieve tumour control. TCP was correlated with minimum tumour dose and gender in univariate analysis. Patients with minimum doses > 80 Gy had 100% TCP.For 80% of the patients with tumour recurrence, the plaque did not geometrically overlap the tumour.
Dose response curves were drawn for optic nerve damage, macular damage and TCP. Such curves could not be found in the literature so no comparison was possible. Previously published values for TCP are similar to, or higher than, the one found in the present material. However, the papers citing higher values have selected patients with smaller tumours, which tend to have higher values of TCP. We emphasise that the number of patients is quite small and that a study of a large patient cohort is planned.

Conclusion: Tumour control only failed in patients who received less than the prescription dose. The use of image guided planning software (such as Plaque Simulator TM) may aid in optimizing tumour control in the future. The present analysis presents the first reported dose response curves for damage to the optic nerve and macula. This information may be useful in delivering the optimal treatments in future.

OC-0152

Novel software modules for treatment planning of 106Ru eye plaque brachytherapy

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Purpose or Objective: Treatment of uveal melanoma by means of brachytherapy using 106Ru eye plaques achieves very good tumor control while keeping morbidity at an acceptable level. However, a deeper understanding of the underlying dose-response relationship is still missing not least because of the lack of appropriate software packages for 3D treatment planning and volumetric dose assessment. This motivated the in-house development of software modules to calculate the dose distributions in critical, ophthalmologic structures as well as tumor for an eye model.

Material and Methods: A resizable 3D model of an eye was created in Sidefx Houdini, consisting of lens, ciliary body and optic nerve as well as macula, retina and sclera. A dome-shaped tumor model can be added with apex height and basal diameter as adjustable parameters. The position of the tumor model can be fixed by reference to the distance between tumor and macula and tumor and optical nerve. Alternatively fundus images can be incorporated into the 3D model in order to account for the individual tumor shape. A specially designed algorithm projects the images onto the virtual eye model and converts them to volumetric data. Different types of BEBIG eye plaques (CCA, CCB and COB) can be positioned within the computer model. Corresponding dosimetric lookup tables were generated from MC simulations using MCNP6. Superposition onto the 3D eye model enables the calculation of doses and dose volume parameters for the tumor and adjacent healthy tissue. Finally, dosimetric safety margins have been obtained by performing film measurements and can be included in order to determine dosimetric uncertainties.

Results: The software modules can calculate full 3D dose distributions with a cubic dose grid of 200 µm in < 5 s (and < 1 s with GPU). The 3D eye model can be adjusted on the basis of simple geometric measures such as the measured size of the eye as well the distances between tumor, macula and optic nerve and thereby be used for individual treatment planning, i.e. the selection and positioning of the type of plaque. The registered fundus projection can be used to guide the tumor delineation. Dose-volume metrics can be generated for all structures of the individualized model which in turn can be used for assessing dose-response relationships for the target volume and organs-at-risk. The dosimetric uncertainty assessment provides information on safety margins. Local agreement between MC and film was better than 6 % for the first 7 mm.

Conclusion: In this study we presented novel software modules for treatment planning in 106Ru eye plaque brachytherapy of uveal melanomas. It is aimed to be used in daily treatment planning as well as for performing pro- and retrospective studies to provide further information on dose-response relationships and prognostic values for treatment morbidity and local control. Future works involves the registration of pre- and/or post-application MR images as