PROSTATE BRACHYTHERAPY

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Abstracts

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1 Early outcomes of 19 Gy single fraction High-dose-rate brachytherapy as monotherapy for localised prostate cancer

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AIMS/INTRODUCTION: High dose rate (HDR) brachytherapy is an attractive treatment option for localised prostate cancer (CaP) utilising the radiobiological advantage of using high dose/fraction. We report the toxicity and early clinical outcomes of HDR monotherapy for low to intermediate-risk CaP.

MATERIALS/METHODS: Eighty-five patients with low to intermediate-risk CaP were treated from October-2013 to February-2017. Patients had catheters placed transperineally under spinal anaesthesia, using trans-rectal ultrasound guidance. Dose delivered was 19Gy/single fraction prescribed to the prostate ± seminal vesicles base, with an isotropic 3mm margin. Toxicity was assessed using common toxicity criteria.

RESULTS: A range of volumes were implanted (20–120 cc, median: 35), using a median of 17 needles (range:13–20). Satisfactory implants were achieved in patients with volumes>60cc, by excluding pubic arch interference on the pre-implant MRI pelvis. All patients were discharged home within 24hours, with 10 patients (12%) requiring re-catheterisation. The median (range) follow-up was 16 (1-42) months. Of the 85 patients, 22% (19/85) had Gleason score 6. The median age was 71yrs (range:59-82yrs). The incidence of acute and chronic genito-urinary (GU) toxicity was Gr2: 22%&1.2%, Gr3: 17%&3.5%, respectively. Acute and chronic grade 2 gastro-intestinal (GI) toxicity was seen in 2%, but none had chronic Gr3 GI toxicity. PSA bounce was seen in 22% (12/55) predominantly between 9-18months post brachytherapy. Four patients experienced a biochemical failure, around 12-18months post treatment, giving a cumulative incidence estimate of 4.7% at 1 year. Out of these 4, 2 had salvage prostatectomy and 2 developed metastatic disease.

CONCLUSION: Our initial experience with HDR monotherapy confirms this to be safe, with favourable and promising preliminary biochemical control rates. It is possible to implant volumes higher than 60cc, if adequate measures are taken.

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2 Focal salvage LDR brachytherapy for prostate cancer – Edinburgh Cancer Centre experience

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In the ECC, we treat around 80 patients per year for early to intermediate stage prostate cancer using LDR brachytherapy. Focal salvage brachytherapy has the potential to be an effective treatment for local recurrence with no metastases. Since 2015, we have identified 7 patients, with local recurrence, that were good candidates for focal salvage brachytherapy. Patients presented with slow rise in PSA during follow up on average 9 years post initial treatment. Tumour volume was mapped via template biopsy using pre biopsy choline PET and then fused with their post implant CT scan to determine if there was a treatment miss in the first instance and to assess dose coverage to recurrent tumour.

Tumour recurrence position varied. Common areas of recurrence were found in the base of the prosate and one patient had localised disease in the seminal vesicles. Only one patient had bi-lateral disease and this was treated accordingly. Mean number of seeds and needles used was 27 and 12, respectively.

Treatment was planned using 2 step process. The PTV was outlined by the radiologist and oncologist based on the pathology results and choline PET scan allowing the planner to optimise dose to this area with a margin (CTV+5mm). Prescribed dose was 145Gy to PTV. Mean planned V100 to PTV was 98.9% and D90 was 162.3%. Considerations taken into account when planning included attenuation from previous I-125 seeds and any calcifications identified since EBRT.

Patients attended follow up (3monthly clinic review) and a post implant CT scan was carried out and results were identified from EBRT group. All patients are doing well, with some toxicity including rectal dysfunction and nocturia. PSA levels have dropped and stabilised in all patients treated (IPSS and PSA results available). Focal salvage therapy has proven to be a successful treatment within the ECC.

3 Short-term clinical toxicity of HDR Brachytherapy in prostate cancer patients with inflammatory bowel disease

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AIMS/INTRODUCTION: The Royal Sussex County Hospital (Brighton UK) abstract : Introduction: Inflammatory bowel disease (IBD) has historically been considered a risk factor for increased bowel toxicity in patients receiving pelvic external beam radiotherapy (EBRT). The risk is reduced in IMRT, compared to 3D-CRT. The effect of brachytherapy (BT) has been less extensively researched. Despite the increased dose to GTV and decreased dose to organs at risk (OAR), previous studies have recommended avoidance of low dose rate (LDR) brachytherapy in patients with IBD, due to increased bowel toxicity. We investigated the effect of high dose rate (HDR) brachytherapy in IBD.

MATERIALS/METHODS: 11 IBD patients across 4 different sites (in the UK and Spain) who received HDR brachytherapy, between 2012 and 2015, were followed up for up to 12 months. Acute bowel and urinary toxicity data was collected and recorded.

RESULTS: The median length of follow up was 6 months (range of 6 weeks to 12 months). 5 patients had Crohn's Disease, and 6 patients had Ulcerative Colitis. Only 1 patient (Crohn's Disease) had active disease at the time of treatment. This patient reported no bowel toxicity. Of the remaining patients, 2 patients suffered Grade 1 diarrhoea (at 6 weeks, and 6 months). 3 patients suffered Grade 1 proctitis (at 6 weeks, and 6 months). There was no ≥ Grade 2 bowel toxicity. The most severe toxicity was Grade 2 urinary frequency in 1 patient (at 6 weeks).

CONCLUSION: This small, prospective case-series suggests that, in the short-term, HDR brachytherapy is safe and well tolerated in IBD patients. Therefore, IBD should not automatically disqualify patients from, at least, HDR brachytherapy. The reason why these results differ from previous LDR studies likely reflects the benefit of inverse planning, which more readily achieves rectal dose constraints in HDR brachytherapy.

20 Fabry-Pérot based optical fiber sensor for real time measurement of oxygen level in hypoxic tumors for prostate cancer during radiation therapy

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The hypoxia detecting sensors described in this article are developed to assist clinicians in diagnosis and real-time monitoring of radiation dose in radiotherapy of hypoxic tumors, which are tumors with a lower oxygen level compared to the surrounding tissues, especially in the case of prostate cancer. An optical fiber sensor based on a Fabry-Pérot interferometer is described as a new and innovative sensor. The sensors have an outer diameter of 220μm with a 20-30μm length air-cavity and a 30μm thickness end cap located at the tip of the sensor. They are made entirely of silica glass optical fiber, which is a passive material, and coated with gold, which is a biocompatible material. Therefore, the sensor can be used as an invasive tool to access within the tumors while receiving the radiation treatment by integrating within biopsy or Brachytherapy needles. Partial pressure of oxygen (pO2) level is a key parameter used to differentiate the hypoxic tumors from surrounding healthy tissues. The pO2 level is related to the hemoglobin level which can be interpreted from the change of the refractive index in red blood cells in this work. The sensors are used to measure the phase change in the received optical spectrum when there is a change in refractive index using a Fast Fourier Transform based analysis method. The FFT method is independent of signal amplitude allowing a simple phase based measurement as the amplitude (intensity) control and wavelength evolution tracking are not required. The device is able to detect the changes when there is a very small change of the refractive index in the blood solution which is in a range between 1.343 and 1.348. The resolution of the device is in order of 10-3 refractive index units (RIU) with a sensitivity of 9.44 rad/RIU.

19 A new technique on 4D real time interactive permanent prostate seed implant brachytherapy

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AIMS/INTRODUCTION: Kent Oncology Centre adopted in 2015 a new system for delivering Low Dose Rate Brachytherapy. This is a 4D prostate seed implant technique from the company BXT Accelyon.

MATERIALS/METHODS: 153 consecutive patients with carcinoma of the prostate were included in the study spanning 21 months. They were treated with an Iodine-125 permanent implant monotherapy giving a total dose of 145 Gy. 5 patients were excluded mainly because they had different treatment schemes. This new technique requires the data of a volume study of the prostate done between 3 - 4 weeks before treatment. The output in form of a nomogram gives us the needed number of radioactive sources along with their location. The day of treatment, the sources are implanted by means of several pre-waxed needles using transrectal ultrasound (TRUS) image guidance.

4 weeks later we perform a follow up CT (FU-CT) scan of the prostate.

RESULTS: The predicted volume of the prostate is on average 14.3(0.2)% smaller than that on the treatment day, partly because patients undergo hormone therapy. Despite this, the number of implanted sources is on average -0.6(0.1)% respect to the nomogram. Although some edema is produced due to needle insertion the FU-CT shows an average volume change of the prostate of only -0.1(0.1)%. Nonetheless some changes have been seen on the dosimetric quantities. Prostate V150 is the only that increases (5.5(0.2)%). V100 decreases 2.5(0.0)% and D90, the most significant factor accounting for biochemical control, decreases by 4.6(0.1)%. Regarding Organs at Risk the V100 to the rectum shows an increase of 0.3(0.9) cc, being our constraint of 2 cc.

CONCLUSION: The nomogram provides a good estimation that tends to overcome the inherent uncertainty of the volume study. This technique shows consistency as long as after 4 weeks (when 28% of dose has been delivered) key dosimetric quantities have no significant changes.

4 Moving from 2 stage to intra-operative technique for LDR Brachytherapy

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AIMS/INTRODUCTION: In October 2007 we started LDR prostate brachytherapy initially as a 2 stage procedure – treated 328 patients. March 2014 moved to a single intra-operative process using the Bard Prolink system. As on February 2017 we have treated 188 using the PROLINK.

The case for change:
The 2 stage process - involved 2 GA's , difficult to reproduce prostate position, as the implant progressed unable to adapt plan due to swelling. The intra-operative technique is a real time and adaptive giving greater flexibility and improved dosimetry involving only one GA.

It did however create some challenges –
- Took longer - the waiting list increased.
- Theatre space also limited requiring additional staff and more equipment,
- Increased radiation risk.

MATERIALS/METHODS: Overcoming the challenges: Detailed work flow study highlighted where improvements could be made.
- Theatre space was maximised
- Roles were clearly defined and the skill mix was interchangeable- giving greater flexibility
- Robust radiation seed accounting system was developed.

RESULTS: The service has now become streamlined which means 2 implants can be done per session. Waiting list now improved. Patients on average take 70 minutes to implant (including the time it takes to anaesthetise the patient). Prostate D90 is approved with this new technique with other dosimetric parameters remaining good.

CONCLUSION: Ergonomic design has maximised theatre space and a robust radiation accounting system has minimised risk. Defined roles within the team and has a good skill mix provides a supportive and flexible service. The intra-operative procedure is now a quick technique - on average takes 70 minutes to implant a patient increasing capacity and reducing the waiting list. More convenient and safer for patients - only involves the one technique/GA. Dosimetry is maintained and perhaps improved – though this will require a fuller analysis there was no learning curve effect seen in the dosimetry.

5 610 Patients, What Went Wrong? What Did We Learn?

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AIMS/INTRODUCTION: Transperineal interstitial implantation of radioactive I125 seeds is a technique which utilises three-dimensional image-based treatment planning and real-time visualization of needle insertion and seed deposition. Seed placement and dosimetry are verified using a CT scan between 0 to 30 days post implant, ideally within 24 hours of implantation with a catheter in place. Having a catheter in place allows for much more accurate contouring of the urethra and thus more accurate dose calculations are possible. The aim of this presentation is to provide an overview of the past nine years' clinical experience within our programme and to describe the various incidents and problems we encountered.

MATERIALS/METHODS: Approx 610 patients have received LDR Brachytherapy and over that period of time we have recorded three incidents and three near misses which affected the workflow. We will describe these events and how we overcame the issues to provide a quality implant to the patient. The objective is to share our experience with other centres so we can all learn and create an awareness of these possible risks.

RESULTS: March 2011 – Atmospheric Pressure incorrect units in calculation.

April 2012 – 3 seeds missing in Catridge May 2014 – Calibrated seed differences Dec 2015 – Contaminated Seed (Comprimised) March 2016 – Missing Seed July 2016 – Varian Treatment Planning System Crashes.

CONCLUSION: Some of these events may not be preventable but the attitude should always be how will we adapt and cope with the issue so our patient can receive a quality implant.

18 LDR Prostate Brachytherapy service streamlining

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AIMS/INTRODUCTION: Low Dose Rate (LDR) prostate brachytherapy was established in 2009 as a 2 step procedure requiring inpatient admission prior to procedures and post implant stay. Volume study and implants performed under GA, current capacity was based on 3 patients per session with 40 sessions per annum, allowing a maximum of 60 implants to be performed per annum.

MATERIALS/METHODS: A review of the different components of the service to ensure best use of resources currently being employed was carried out. The multi-disciplinary team involved, discussed the patient pathway and staff roles, networked with other UK centres to determine if any changes could be integrated into our pathways that would provide patient benefits to our service.

RESULTS: Agreed with ward staff that all patients admitted on the morning of the procedure and would be discharged the same day. Overnight in-patient stay reduced by 100%.

Volume study patients undergo procedure with sedation, not GA, quicker recovery time and quicker discharge with reduced anaesthetic risks. Agreed that additional volume study could be accommodated by re-use of a bed. Probe decontamination method changed saving time and staff requirements.

CONCLUSION: Increased capacity per session to 2 volumes and 2 implants, now able to treat 80 implants per annum, reducing the waiting time for patients by offering more treatment slots.

Routine post implant dose assessment peer review of the implants has confirmed the same high quality of implant procedure.

17 Comparison of MR and trans-rectal US volumes obtained with and without General Anaesthetic

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AIMS/INTRODUCTION: In streamlining a two-step Low Dose Rate (LDR) brachytherapy service by moving from general anaesthetic to non-anaesthetic trans-rectal ultrasound prostate volume we wished to compare the volumes obtained with a pre-implant diagnostic MRI.

MATERIALS/METHODS: 50 retrospective cases were identified, with 25 having PVS under general anaesthetic and 25 having non-anaesthetic PVS. Pre-implant diagnostic MRI for each case was uploaded to a brachytherapy planning system and contoured by a dedicated prostate MRI radiologist. The captured volumes were compared with the USS.

RESULTS: Across both study groups the patient ages ranged from 45 to 73, and MR calculated prostate volume sizes ranged from 19cc to 53cc.

The average ratio of MRI:USS volume was 0.953 *(range 0.613-1.33) for the anaesthetic group and 0.958 *(0.539-1.342) for the non-anaesthetic cases.

CONCLUSION: Satisfactory, good quality, reproducible images can routinely be obtained from non-anaesthetic trans-rectal prostate volume study with equivalent MRI volumes when compared to anaesthetic PVSs. The data collected demonstrates that there is no statistically significant difference in the MR:US ratios between the groups, supporting the ability to achieve similar quality US images without the use of anaesthetic. This reduces the risk to patients of undergoing GA and allows a greater throughput of cases and improves overall efficiency in time.

6 Can MRI based pre-planning replace ultrasound for permanent prostate brachytherapy treatment planning? – A feasibility study

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AIMS/INTRODUCTION: The objective of this study is to assess the feasibility, benefits and effectiveness of staging MRI based pre-planning in permanent prostate brachytherapy and to compare the dosimetric parameters of MRI based and US based pre-planning.

MATERIALS/METHODS: In this retrospective study the planning US images of ten men treated with permanent prostate implant were re-planned using their staging MRI datasets, primarily axial T2 weighted images. All images were anonymized and the structures were contoured by an experienced Radiation Oncologist and independently reviewed by a MRI Radiologist. Contours were compared in terms of volume and dimensions (height, width and length). Treatment plans for MR images were created independently and the dosimetric parameters were compared against US plans.

RESULTS: The mean US/MRI prostate volume ratio was 1.10 ± 0.12 ($p = 0.05$). The mean US based prostate volume was over-estimated (3.17 cc in mean volume) in comparison to MRI based volume. The width, height and length ratios (US/MRI) for the prostate were 1.06 ± 0.06 ($p = 0.01$), 0.99 ± 0.08 ($p = 0.54$) and 1.08 ± 0.15 ($p = 0.14$) respectively. All dosimetric constraints and objectives could be achieved with MRI pre-planning and were comparable to US based pre-planning. The mean dose to Urethra D10% and total number of needles were reduced significantly ($p < 0.02$) with MRI plans.

CONCLUSION: Staging MRI is comparable to US imaging for pre-implant planning and dosimetric constraints. Significant differences were noticed in the contouring of prostate width between the image sets which could potentially be due to prostate deformation by the US probe. From the results, MRI based pre-planning was found to be a useful modality as it could potentially replace the US volume study visit thereby reducing the staging to treatment timeframe. Further, MRI/CT fused image sets could potentially be used for accurate post-implant dosimetry.

7 Review and optimisation of Seed Migration detection following LDR permanent prostate loose seed implants

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AIMS/INTRODUCTION: Low dose rate (LDR) permanent seed implantation is associated with a risk of seed migration (SM) and subsequent embolisation (SE), which is most likely to occur in the pulmonary vasculature[1], with an average rate of 25% (range 10-55%)[2]. The potential for adverse dosimetric or clinical sequelae effects resulting from SE[3,4], highlight the importance of patient pathway optimisation. Consequently, a large cohort of LDR prostate brachytherapy patients, at a single UK centre, was reviewed.

MATERIALS/METHODS: Treatment pathway data from 503 patients implanted with loose ^{125}I seeds (STM1251, BARD - USA) were retrospectively reviewed, with seed loss (SL) and SM rates quantified. SL was determined from post-implant ward monitoring. SM rates were quantified from seed count mismatch (SCM) between the total number of Implanted Seeds (IS), the post-implant Pelvic X-Rays (PXR) and the 1 month follow-up Post-Implant Dosimetry (PID) CT scan. SM was assumed to have occurred if any seed was undetected in the PXR / PID images. SE was assessed from review of available post treatment images.

RESULTS: SL was observed to be 0.1% of the total number of implanted seeds. 80 patients (15.9%) were identified as SM candidates. 48(9.5%) were identified from IS/PXR and 57(11.3%) from IS/PID, with 25(4.9%) common to both. SCM in the remaining 23(4.6%) and 32(6.4%) patients from IS/PXR and IS/PID respectively were due to differences in PXR/PID image acquisition field of view, PXR image angulations, post-PXR SL and SM, and false positives. Of the 80 SM candidates, 23 had post treatment images available, with 11 showing confirmed SE - 8(thorax), 2(pelvis) and 1(abdomen).

CONCLUSION: The observed SM rates were within levels reported by other studies. Further optimisation of the PXR and PID imaging protocols may be required to improve accuracy in SM detection rates. This could potentially benefit patients with pre-implant contraindications by determining appropriate post-implant care.

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16 Testing and evaluation of image registration in brachytherapy

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Real-time ultrasound (US) is used to guide implantation for temporary and permanent prostate brachytherapy treatment. MRI, CT and US fusion is available in dedicated treatment planning systems used for these procedures. The registration of these imaging modalities requires additional image verification and tests to ensure accuracy. Using a CIRS Tissue Equivalent Ultrasound Prostate Phantom we evaluated the accuracy of the registration system of a Hitachi Preirus US scanner for fusing MRI and live US images. The phantom contains 3 lesions, a urethra and a prostate volume of 53 cm3. The MRI and US images were registered using the urethra as a marker in the central slice of the image. The registration was then checked at the base and apex of the prostate. Along the urethra, the registration was accurate to within 2mm. Another common fusion software, Variseed™, was assessed by measuring the percentage of overlapping volumes for the prostate and a lesion within the prostate for CT, US and MRI images. The overlapping volumes were compared for CT–MRI, CT–US (un-deformed prostate), CT–US (deformed prostate), MRI-US (un-deformed prostate), MRI-US (deformed prostate) and US–US(un-deformed prostate and deformed prostate). Contour overlap varied from 90% to 40% for the lesion, which was approximately 1 cm3, and 96% to 78% contour overlap for the whole prostate. This study demonstrates how a tissue equivalent phantom can be used for testing and commissioning of multi-modality registration systems in brachytherapy.

15 The Grandfather Effect- personalizing radiation safety precautions following prostate implantation with I-125 Seeds

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AIMS/INTRODUCTION: After implantation of I-125 seeds into the prostate gland, patients can emit low levels of radiation. For the safety of the public and the patient's family, patients are advised to restrict their contact with others, particularly small children. These radiation protection guidelines last for 1 year. Clinicians report that patients may refuse prostate brachytherapy due to these guidelines. The aim of this work is to develop patient specific radiation protection guidelines.

MATERIALS/METHODS: Surface dose rate measurements of 95 I-125 seeds in a full-scatter phantom were taken. An algorithm was then developed to model the attenuation of the radiation emitted from the seeds through the phantom material. Once validated for the phantom material the algorithm was then modified to reflect attenuation through the patient anatomy. Estimated dose rates from the algorithm were compared with dose rates measured at 0cm(surface) and 30cm from these patients. From these doserates, the exposure times to meet 1mSv were calculated. A programme was created to estimate patient specific guidelines.

RESULTS: Estimated and measured doserates were found to agree within uncertainties. Measured surface mean & 30cm mean (15.23uSv+/-7.77uSv & 2.14uSv+/-1.20uSv) compare with estimated surface mean & 30cm mean (15.03uSv+/-7.59uSv & 2.28uSv+/-1.21uSv). Dose rates were found to vary significantly. 75% of patients couldn't induce 1mSv from 30cm, time for remaining 25% ranged from 102 days to 235 days. It was found that the standard guidelines were significantly overly restrictive for most patients.

CONCLUSION: The study shows that standard guidelines are overly restrictive. The algorithm developed here is capable of accurately estimating dose rates from prostate brachytherapy patients, within respective uncertainties. The programme developed can be used clinically to better advise patients on the radiation precautions that are specific to them.

The incorporation of this programme will help healthcare professionals provide patient specific care to individuals undergoing I-125 prostate brachytherapy treatment

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8 Optical fibre luminescence sensor for real-time LDR Brachytherapy dosimetry

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AIMS/INTRODUCTION: An optical fibre sensor for monitoring low dose radiation is presented. The sensor is based on a scintillation material embedded within the optical fibre core, which emits visible light when exposed to low level ionising radiation. The incident level of ionising radiation can be determined by analysing the optical emission. An optical fibre sensor is presented, based on radioluminescence whereby radiation sensitive scintillation material, terbium doped gadolinium oxysulphide (Gd_2O_2S:Tb), is embedded in a cavity of 400µm of a 500µm plastic optical fibre. The sensor is designed for in-vivo monitoring of the radiation dose during radio-active seed implantation for brachytherapy, in prostate cancer treatment, providing oncologists with real-time information of the radiation dose to the target area and/or nearby critical structures. The radiation from the brachytherapy seeds causes emission of visible light from the scintillation material through the process of radioluminescence, which penetrates the fibre, propagating along the optical fibre for remote detection using a multi-pixel photon counter. The sensor demonstrates a high sensitivity to Iodine-125, the radioactive source most commonly used in brachytherapy for treating prostate cancer.

MATERIALS/METHODS: The optical fibre sensor was fixed within a Novel Prostate Phantom to allow for comparison of results with the treatment planning system Variseed. The brachytherapy seeds were inserted into the Phantom for a fixed period of time and the response of the sensor monitored. The sensor was initially tested for its response to 6.3mCi of Iodine-125.

RESULTS: The sensor was further evaluated for its response to different levels of radiation to determine its suitability for brachytherapy applications.

CONCLUSIONS: Having now identified the most suitable size PMMA plastic optical fibre for this application (400µm), further work will investigate the sensor to a range of different activities for Iodine-125 and will be investigated for its distal response and angular behaviour at these different activities.

POSTER PRESENTATION

9 A Prostate Brachytherapy Database

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AIMS/INTRODUCTION: To develop a system of collecting and organising prostate brachytherapy information that can be easily managed, queried and updated.

MATERIALS/METHODS: The permanent seed program at the Cancer Centre treated its first patient in November 2009. Clinical and dosimetric planning data was prospectively collected in Excel format. The collection of data expanded rapidly as the service developed which led to the initiation of a project to create a more suitable data collection repository. A Microsoft Access database was developed in-house by a radiotherapy physics engineer in collaboration with brachytherapy clinicians and scientists. The database currently houses substantial inter-related data on over 400 men which includes:

- Clinical data (tumour demographics, PSA results, complications)
- Dosimetric planning data for pre and post implant dosimetry (prescription, DVH, RAKR, number of seeds and needles, needle type, backup record, seed loss record)
- Source records (new source details, seed inventory, seed disposal tools, traceability of seed batch to each patient, radiation protection – months since implant).

RESULTS: The organised collection of data in this way has enabled us to track patients quickly, extract clinical data such as IPSS and IIEFS surveys, monitor dosimetric and planning data, and create source disposal tools along with radiation protection information. The output from this database has been of use in internal audits, external audits and manuscript writing.

CONCLUSIONS: The prostate brachytherapy database has been found to be useful for patient data analysis and maintaining source records. The database is currently being expanded to include clinical and dosimetric planning data and tools for the HDR prostate service. Future development of the database will include development of nomograms to inform the treatment planning process.

14 The efficacy of cytoreduction as a bridge to brachytherapy in the treatment of prostate cancer - an Irish cohort

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AIMS/INTRODUCTION: To determine the effectiveness of neoadjuvant cytoreductive agents as a bridge to the use of brachytherapy in the treatment of non-metastatic prostate cancer.

MATERIALS/METHODS: From January 2014 to October 2016, 23 patients underwent dual agent cytoreduction (dutasteride and bicalutamide) in Cork University Hospital. Before and after completion of 3 months of cytoreductive therapy, patients underwent transrectal ultrasound (TRUS) to assess prostate volume and the absence/presence of pubic arch interference (PAI). The variables analysed include pre- and post-treatment prostate volumes and the absence/presence of PAI.

RESULTS: The mean pre-treatment prostate gland volume in this patient group was 54.93cc (range: 39-81). The mean prostate volume following 3 months of dual agent cytoreductive therapy was 37.65cc (range: 24-48). The mean percentage change in volume was 30.58%. 21/23 patients had PAI on initial TRUS. Of those individuals with initial PAI, 9/21 had persistent PAI post treatment. 6/9 were not converted to brachytherapy. Overall, 16/23 were suitable candidates for brachytherapy following 3 months of cytoreductive therapy. Factors which precluded the remaining patients from brachytherapy included persistent PAI (6/7) and in one case an obstructive pattern on uroflow studies.

CONCLUSION: The percentage of our patients converted to suitability for brachytherapy following cytoreduction is comparable to those described previously in the literature. It is also comparable to those who report conversion to suitability using hormone therapy, albeit with an overall lower side effect profile.

13 Urinary and sexual functional outcomes following successful treatment of prostate cancer using Low-Dose Rate Brachytherapy

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AIMS/INTRODUCTION: Low-dose rate (LDR) brachytherapy using implanted radioactive seeds is an established treatment modality for organ confined prostate cancer. Current guidelines suggest this as an option for men with low- or favourable intermediate-risk disease. Patients selecting LDR-brachytherapy are often those suitable for active surveillance but are seeking treatment with a low risk of complication. We aimed to assess the long-term impact of LDR-brachytherapy on urinary and sexual function in our large single institution cohort.

MATERIALS/METHODS: We retrospectively reviewed urinary and sexual functional outcomes in 300 patients successfully treated with iodine-seed brachytherapy without evidence of disease recurrence between 2005 and 2015. Prior to undergoing brachytherapy each man completed a Sexual Health Inventory for Men(SHIM) and International Prostate Symptoms Score(IPSS) questionnaire, and under took flow-rate analysis. These were repeated at regular intervals up to 5 years. Acute complications of urinary retention and incontinence of urine were also assessed. IPSS and SHIM scores were categorised into subgroups(Mild/Moderate/Severe). Statistical analysis of outcomes was undertaken by using Chi2-test and Paired T-test for categorical and continuous variables, respectively.

RESULTS: 8.5% of patients developed acute urinary retention and 0.9% suffered incontinence of urine. Variance analysis showed a statistically significant difference of IPSS, flow-rate and SHIM between pre-treatment values and outcomes at the follow-up time points. A maintained trend of improvement is observed after the 3-month follow-up time point.

CONCLUSION: Patients undergoing low-dose brachytherapy experienced deterioration in their urinary and erectile function with maximal effect at 3 months post treatment. Recovery of erectile function is observed beyond 3 months though baseline levels are not typically achieved. Recovery to pre-treatment baseline urinary function is likely to happen beyond 3 months with the improving trend maintained at long-term follow-up. LDR brachytherapy is confirmed to be well tolerated with low incidence of long-term urinary toxicity, incontinence or acute urinary retention.

10 Independent verification of brachytherapy planning system calculations using Matlab Code

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AIMS/INTRODUCTION: To investigate the accuracy and performance of an independent dose calculation program (Matlab) in the verification of treatment dosimetry data for both HDR and LDR treatment planning systems.

MATERIALS/METHODS: Fifteen individual treatment plans created using Oncentra Masterplan, OMP v4.1 (n=5), Oncentra Prostate, OCP v4.2.2 (n=5) and Variseed, VS v9 (n=5) were evaluated. The program uses the published source data (Ir-192 and I-125) as the primary input for dose calculation (TG 43) and accounts for 2D anisotropy. DICOM RT files from patient plans, exported from the TPS, were directly used as input data in the program. For all plans, dose calculation was performed on random dose points (4 points/ patient) created in both high and low dose gradient regions. The results were compared to the TPS calculation and also a standard excel spreadsheet. Other treatment parameters were also verified including: total reference air kerma, applicator type, standard dwell positions, catheter length and total treatment time.

RESULTS: Independent dose calculations of all dose points using Matlab program were within 1% of the TPS calculated values. The mean error in dose calculation between the Matlab code and TPS were -0.01% ± 0.20% (OMP), -0.10% ± 0.02% (OCP) and -0.02% ± 0.05% (VS). The mean error between the excel program and TPS were 0.62% ± 1.6% (OMP), 1.92% ± 0.6% (OCP) and -0.50% ± 2.26% (VS) respectively. The program was also found to be sensitive to errors created deliberately in dummy cases such as incorrect dose prescription, inconsistent catheter lengths and dwell positions and wrong reference source data.

CONCLUSIONS: The program has been validated with clinical cases created with three TPS and found to be a useful tool in independently verifying the calculation of dose in brachytherapy treatments.

11 Implementation of MDT safety brief within prostate brachytherapy

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AIMS/INTRODUCTION: Surgical pauses are conducted as routine practice for all surgical procedures. This process is for all members of the multi-disciplinary team (MDT) to pause, conduct a final check of compliance in patient ID, status and procedure. The pause and check process is familiar to radiographers, ensuring patient ID, treatment technique, dose etc are correct prior to treatment delivery. As a safety initiative, in line with Trust policies and procedures, safety briefs were introduced to the prostate brachytherapy team.

MATERIALS/METHODS: A safety brief template was created to acknowledge patient demographics, diagnosis, scheduled procedure, co-morbidities/ complications, current medications, details of patient positioning and any other relevant information specifically relating to the procedure, equipment, planning or treatment. The Brachytherapy Radiographer completes a template for each patient prior to the scheduled list once all members of MDT are present, each patient is discussed, alerting staff to any issues and allowing all staff an opportunity to participate prior to patient entering theatre. Staff attending the safety brief is recorded for audit purposes.

RESULTS: To date 51 patients have been discussed with 44 observations identified e.g. medication required to be stopped, hip or knee co-morbidities impacting on patient positioning in theatre, other co-morbidities/ allergies impacting on specific patient management e.g. diabetic patient and fasting for GA. The safety brief takes 10 minutes maximum, depending on patientâĐ™s numbers and issues to be discussed, has little impact on the overall running time for the prostate brachytherapy list but is ideal for members of the MDT to engage and highlight specific patient issues.

CONCLUSION: Feedback from the Prostate Brachytherapy team has been very positive, the safety brief has proven to be of great benefit, contributing in ensuring patient safety is at the forefront.

In light of the successful implementation of the prostate brachytherapy safety briefs, they have now been introduced to other brachytherapy treatment sites.

12 Salvage prostate High Dose Rate Brachytherapy: Initial Bristol experience

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AIMS/INTRODUCTION: High dose-rate (HDR) prostate salvage brachytherapy (salvage HDR), following radical radiotherapy, is a highly conformal radiation technique, delivering minimal dose to adjacent organs. We describe our initial experience in Bristol.

MATERIALS/METHODS: 3 patients who had received radical radiotherapy (74Gy in 37 fractions to prostate +/- seminal vesicles with androgen deprivation therapy (ADT)) received salvage HDR during 2016 and 2017. Catheters were placed transperineally, using trans-rectal ultrasound. 19Gray/single fraction was prescribed to the planning target volume (PTV) (prostate + isotropic 3mm margin). Recurrences were biopsy proven. For two patients, 11CCholine-PET demonstrated prostatic uptake only. Patient 3 had standard staging CT and bone scans excluding visible metastases. Presenting characteristics are described at (a) original presentation; and (b) time of salvage:

1: (a) Age 57, T3N0M0 Gleason 3+4, PSA 18ug/L; (b) Age 61, left sided disease; PSA 8.0ug/L;

2: (a) Age 68, T3aN0M0 Gleason 3+4, PSA not known (b) Age 72, anterior disease, PSA 1.8ug/L (on ADT);

3: (a) Age 63, T2aN0M0, Gleason 3+3, PSA 17.5ug/L (b) Age 69, right sided disease; PSA 0.6ug/L; (on ADT).

RESULTS: V100 (PTV volumes receiving 100% prescription) were 94.28%, 91.1% and 95.27% (target 95%), with rectal and urethral doses within tolerance. All patients underwent successful trial without catheter within 24 hours. Initial urinary frequency improved to baseline by 8 weeks in 2 of 3 cases; patient 1 has ongoing Grade 1 GU toxicity at 12 months. No bowel or sexual function toxicity was observed.PSA fell in all cases initially. A subsequent increase has occurred in Patient 1 (9 and 12 months; 4.6 ug/L, 2.16 ug/L nadir).

CONCLUSION: Salvage HDR is feasible with acceptable dosimetry, albeit PTV coverage is reduced compared with 'non-salvage' HDR, usually to allow rectal sparing. Biochemical responses are observed, with further follow-up required to determine significance of rising PSA at 9-12 months.