PROSTATE BRACHYTHERAPY

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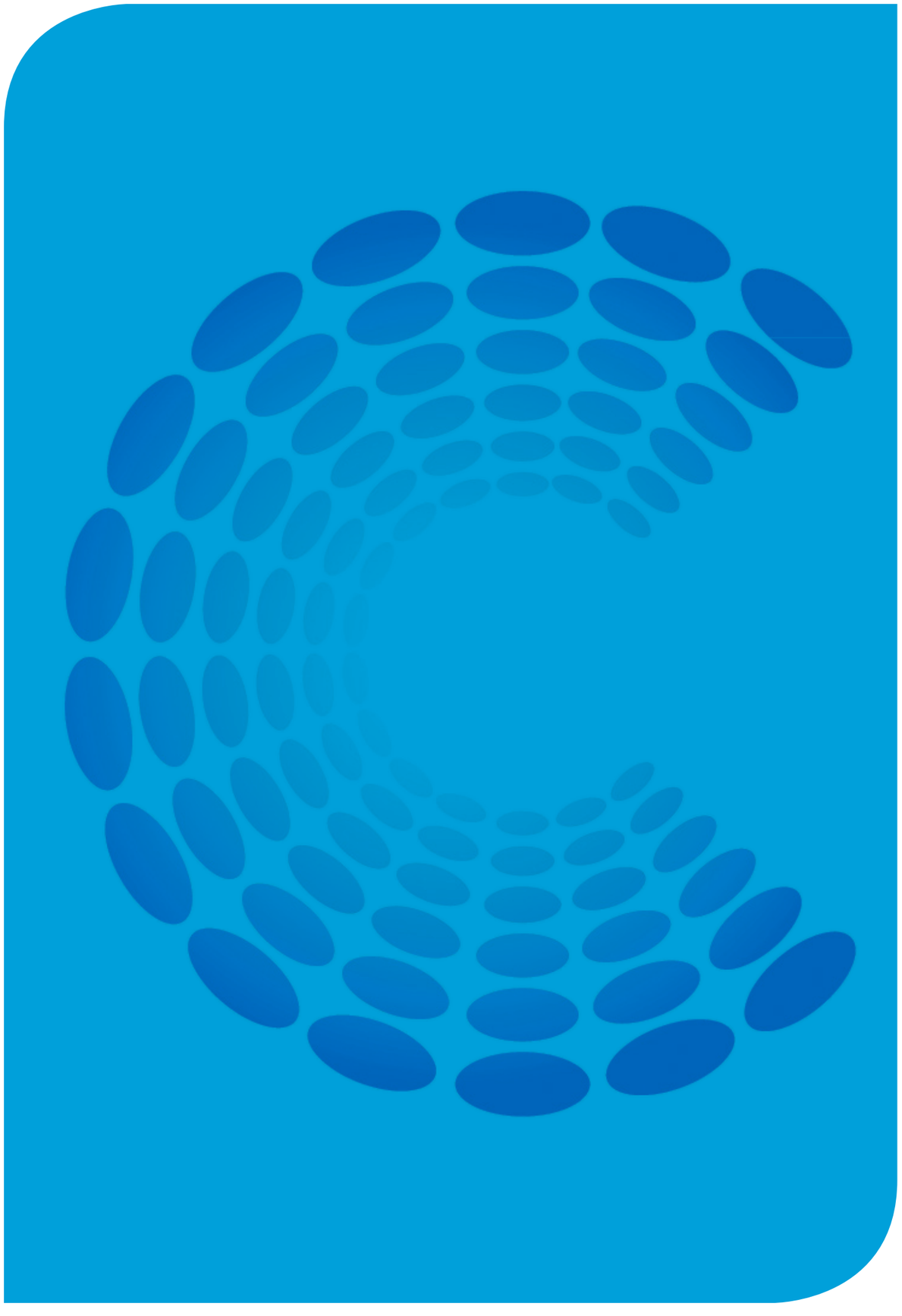
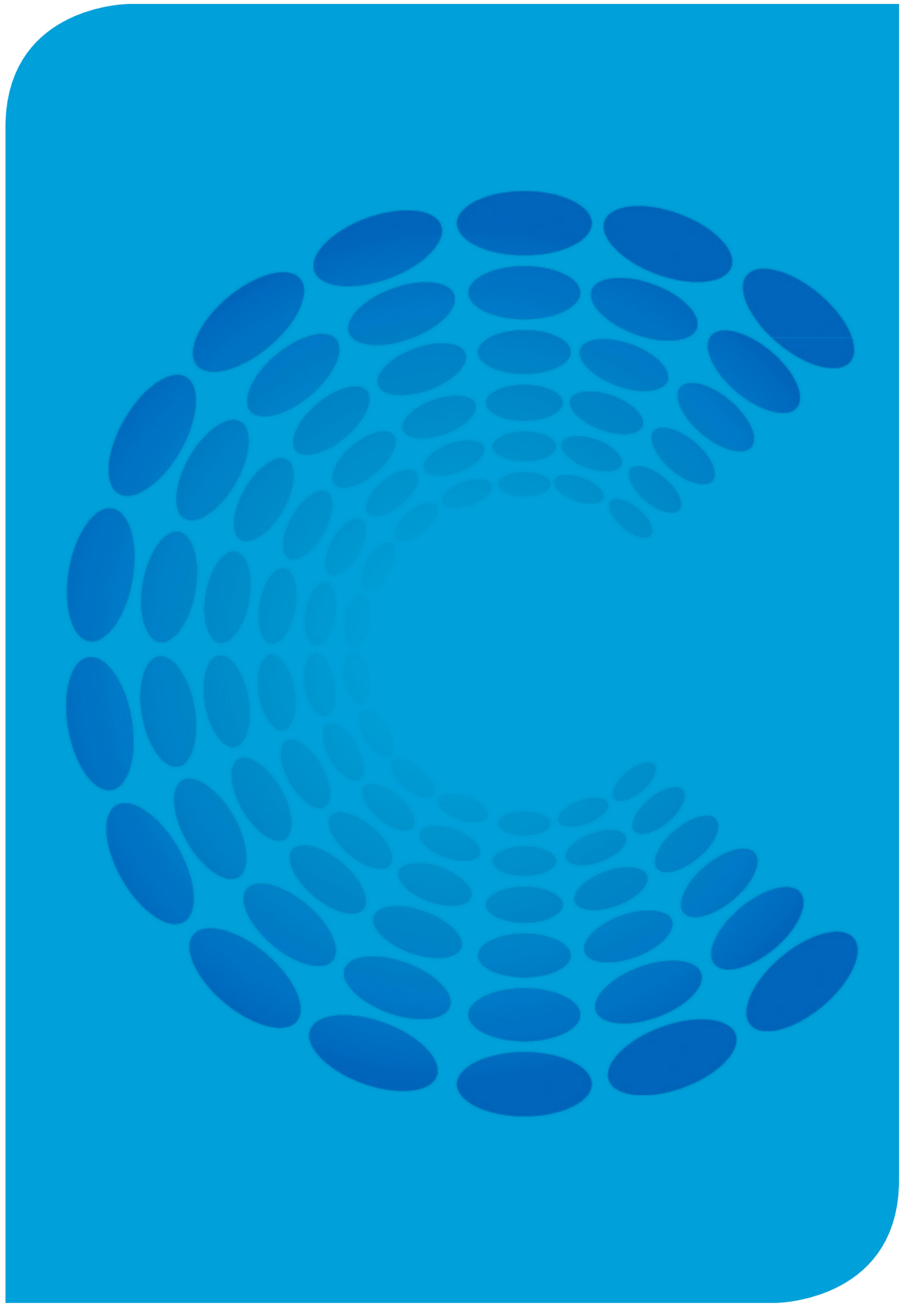
Abstracts





NOTES

ABSTRACTS FOR PRESENTATION

1 MRI based pre-planning method for I-125 seed "one-step" implantation

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ABSTRACT: There are several different ways of performing I-125 seed implantation employed by centres throughout the UK. Many centres perform an outpatient ultrasound based volume assessment, where length, width and height of the gland are measured and the volume is calculated. The number of seeds ordered is then based on this estimation of volume. At least one manufacturer offers a class solution based on 5 measurements of prostate dimensions using ultrasound imaging. At Mount Vernon, we wanted to develop a method for performing a "one-step" I-125 seed implantation without having an additional patient visit to hospital. We have developed a technique which uses the diagnostic MR scan and the new MR re-sampling feature in Variseed 9.0, to create a more personalised seed order for each patient, which can then be implanted as a one-step technique.

This talk will discuss this technique, its benefits and pitfalls, and our experience to date.

NOTES

9 Long-term biochemical control and morbidity outcomes with HDR prostate brachytherapy boost in combination with external beam radiotherapy

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AIMS/INTRODUCTION: HDR brachytherapy boost in combination with external beam radiotherapy (EBRT) and short term androgen deprivation therapy (ADT) is an effective treatment in locally advanced intermediate- and high-risk prostate cancer. This study reports the long-term biochemical control and morbidity outcomes from our institution.

MATERIALS/METHODS: Data from patients treated with HDR brachytherapy boost in combination with EBRT was extracted from electronic clinical notes. Patients who were on androgen deprivation therapy for over 12 months were excluded from the analysis, leaving 95 evaluable patients. All patients received either 17Gy in two fractions or 15 Gy in a single fraction of HDR brachytherapy boost followed by external beam radiotherapy 37.5Gy in 15 fractions. Seventy percent of patients received androgen deprivation therapy (ADT) for less than or equal to 6 months, 15% received 6-12 months ADT treatment, and 15% received no hormones. Biochemical relapse was defined using the Phoenix definition.

RESULTS: Median follow-up was 52 months. Median PSA at last follow-up was 0.19. There were 13 relapses - 3 biopsy-proven local relapses, 4 radiological distant relapses and 6 biochemical relapse only. 4-year biochemical relapse-free survival was 91.2%. There were late RTOG grade 3+ urinary toxicity in 6(6.3%) patients – 5 irritable urinary symptoms and 1 urethral stricture requiring dilatation. There were late RTOG grade 3+ bowel toxicity in 3 (3.2%) patients – 2 per rectal bleeding and 1 proctitis requiring steroid enemas.

CONCLUSIONS: HDR brachytherapy boost with EBRT provides good biochemical control with acceptable urinary and bowel late toxicity.

2 The effect of calcifications on prostate brachytherapy

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AIMS/INTRODUCTION: Prostate calcifications are common in patients and even though there is no evidence to suggest a direct link to prostate cancer, they may have an effect on the treatment dose received. Treatment options available include HDR and LDR brachytherapy. Treatment plan dose distributions are usually calculated presuming a uniform water density. The aim of this project was to identify any differences in dose due to calcification by comparing HDR plans with and without a heterogeneity corrected dose calculation applied.

MATERIALS/METHODS: 6 patients with prostate calcifications were identified. All of these patients had previously received LDR brachytherapy using I-125 seeds. An HDR template was applied and a plan was optimised using Brachyvision. Plans were then compared with and without the Acuros dose calculation. These plans were also exported to the 3DVH software for additional gamma analysis.

RESULTS: Whole prostate and calcium wall (2mm around calcification) doses were analysed. The mean gamma pass rate (1%/1mm) was 99.0%. The whole prostate D95% was reduced by up to 1.4% and the calcium wall minimum dose was reduced by up to 1% compared with the uncorrected calculation.

CONCLUSION: The results suggest that the presence of prostate calcifications is likely to have an insignificant impact on the dosimetric quality of HDR plans. Further work is recommended to investigate the effects on the lower energy LDR treatments.

3 Monte Carlo in the assessment of the effects of tissue composition on dose distributions in low dose rate prostate brachytherapy

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AIMS/INTRODUCTION: The method outlined in the AAPM TG-43 report was the gold standard for calculation of doses in brachytherapy for many years and is still used in many clinical treatment planning software packages. The TG-43 calculation makes several assumptions in order to simplify the more complex reality, such as assuming all tissues are equivalent to water. The purpose of this study was to investigate the differences in dose distributions of Low Dose Rate (LDR) Prostate Brachytherapy I125 sources due to tissue composition/heterogeneity against the TG-43 method.

MATERIALS/METHODS: Several models, each consisting of 79 individual I125 sources in a clinical arrangement were simulated using Monte Carlo techniques with PENELOPE/penEasy code. The system is capable of simulation of x-ray transport in various materials/tissues at a range of energies including those used for LDR brachytherapy.

The geometry and energy spectrum of individual seeds was based on the Oncura 6711 model, and the simulated dose distributions were acquired in a 5cc sphere of water/tissue material. The elemental composition of simulated tissues was based on ICRP reports (1975&2002), and the work of Woodard and White (1986).

All simulations were conducted using an off the shelf laptop computer with 1.8GHz processor and 6GB of RAM.

RESULTS: The results of the simulations demonstrated observable differences in dose distributions between the TG-43 water based model, and the other more realistic tissue models using various tissues compositions. Heterogeneous tissues containing simulated calcifications also demonstrated differences in dose distributions, the magnitude of which depended on factors such as calcification size, location and composition.

CONCLUSION: Future work will include validation of the Monte Carlo seed models against TG-43, inclusion of more particle histories, and the development of more accurate voxel based anatomical phantom models. This will allow for a robust quantitative analysis of simulation results and more thorough assessment of the differences observed.

8 A single centre analysis of change in dosimetric outcomes through implementing a 1-Stage intraoperative implant technique

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AIMS/INTRODUCTION: The technique at this Centre for I-125 seed implant changed in June 2015 from a pre-planned 2-stage implant technique to a 1-stage intraoperative method. A dosimetric analysis was carried out comparing the accuracy of the intraoperative dosimetry with post-implant dosimetry. This was also compared with previously obtained 2-stage results.

MATERIALS/METHODS: All pre-planning, intraoperative, and post-implant dosimetry was carried out using the Varian Variseed 8.0 treatment planning system. All implants employed fully-stranded seeds. 2-stage insertions were planned on volume studies taken up to 4 weeks prior to implant, from which customised pre-loaded needle kits were ordered. The intraoperative technique involved ordering seeds based on nomograms, as per the '4D Brachytherapy' technique provided through BXTAccelyon. Pre-Loaded strands were ordered for the periphery. Loose seeds were ordered for constructing customised central strands based on the dosimetry seen after the peripheral strands had been implanted. These strands were constructed on-site during the procedure using a Manual Isoloader device.

RESULTS: Number of seeds predicted by the nomogram was on average within two seeds of the final plan. Nine patients received >10% more seeds than the nomogram suggested. The average 2-step pre-planned prostate V100 was 99%, with the corresponding post-implant dosimetry showing V100 of 93%. The intraoperative technique averaged 98% planned V100, resulting in 97% post-implant dosimetry. Pre-planned prostate D90 was 122% 2-step, with 106% post-implant. Intraoperative D90 was 119% with 116% post-implant. Four 2-step, and six intraoperative patients receive a rectum D2cc > 145Gy. The average planned D30 to the urethra in the 2-step technique was 198Gy, and 183Gy in the intraoperative technique.

CONCLUSIONS: Intraoperative insertion enabled an increase to average prostate D90 and V100 achieved by this centre. Urethral doses appear to have been reduced using the intra-operative technique. This has not yet been confirmed with post-implant dosimetry. Rectal doses have increased.

7 Review of the dosimetry of a nine year 125-Iodine seeds prostate brachytherapy programme

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AIMS/INTRODUCTION: University Hospital Galway (UHG) commenced 125-Iodine seeds permanent implantations of the prostate in January 2007. In July 2015 the seed model was changed from Oncura/Amersham Model 6711 to Bebig Isoseed 125.S06. A retrospective study is presented reviewing the progression of the implantation dosimetry over time.

MATERIALS/METHODS: The study is based on 463 consecutive monotherapy patients treated with permanent 125-I radioactive seeds. Single seed deposition was performed using a MICK applicator. In an initial approach D90, the dose level covering 90% of the prostate volume, as well as D30 (urethra), the dose level covering 30% of the prostatic urethra volume were chosen as quality parameters. The dose-volume histogram parameters were derived from intraoperative ultrasound images. Annual descriptive statistics, that is, mean, median, and interquartile range have been calculated for the years 2007 to 2015.

RESULTS: With a nominal prescription dose of 160Gy to the prostate capsule, the annual average of D90 in 2007 of 150Gy increases to a plateau value of about 170Gy in the years 2011 to 2014. Over the entire time period the annual spread of D90 expressed as the interquartile range decreases from 40Gy in 2007 to a plateau value of about 10Gy (2011-2015). Similarly, D30 (urethra) levels off to mean values of 175Gy and minimum interquartile ranges of 10Gy (2013-2015).

CONCLUSION: D90 and D30 demonstrate a dosimetric learning effect. However, the D30 mean value was always less than the recommended dose of 181Gy. Following the source model change no differences in D90 and D30 have been observed. The data will be discussed with regard to user variability and treatment protocol changes.

4 Global and sector based dosimetric comparison of plugged vs plug-free needles in permanent prostate brachytherapy

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AIMS/INTRODUCTION: The goal of permanent prostate brachytherapy is to achieve adequate tumour and gland coverage with minimal toxicity. Previous studies have identified relative underdosing at the anterior prostate base. One potential cause for this is the effect of the deadspace created by the bio-absorbable plug in plugged needles. Plug-free needles have the potential of improving dose to this area by removing the dead-space created by the plug. We wished to compare the post implant CT global and multi-sector dosimetry of patients treated using plugged and plug-free needles.

MATERIALS/METHODS: 58 consecutive cases were identified with Group 1 (n=28) treated with plugged needles and Group 2 (n=30) treated using plug-free needles. Dosimetric analysis was performed for the whole prostate and 12 individual sectors[1], including minimum dose to 90% of the prostate or sector (D90) and dose to 0.1 cm^3 of the rectum (D0.1cc), as well as the number of needles per unit volume (N/V) and seed loss.

RESULTS: Global dosimetry was similar for both groups, but fewer needles were required per unit volume in Group 2 (0.58±0.10 cm^{-3} vs 0.66±0.15 cm^{-3}; $p<0.05$). Seed loss was significantly reduced in Group 2 ($p<0.05$). Furthermore, sector analysis indicated improvements in D90 in a number of sectors of the prostate ($p<0.05$), except for the anterior gland. The rectal D0.1cc was higher in Group 2 than Group 1 (114% vs 100%, $p<0.02$) but well within recommended tolerances[2].

CONCLUSION: Our results indicate that plug-free needles have the potential to improve implant quality via better spatial dose distribution within the prostate using fewer needles and reducing the number of seeds lost. While there was a trend towards improved anterior base dosimetry this was not significant.

References:
1. AB Mohamed Yoosuf, DM Mitchell, G Workman et al. Brachytherapy 2015; 14(5):703-10.
2. C Salembier, P Lavagnini, P Nickers et al. Radiat. Oncol. 2007; 83: 3-10.

5 Training for care of prostate brachytherapy patients

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INTRODUCTION: Brachytherapy is a technique for treating localised prostate cancer using tiny radioactive seeds of Iodine-125 (I125) that are inserted permanently into the prostate gland. 1 The procedure is carried out under general anaesthetic. Post operatively the patient will be cared for on either the Oncology or Wytham ward before being discharged home on the following day. Staff training is crucial and must follow the local rules for radiation protection for care of brachytherapy patients.

AIMS AND OBJECTIVES: The need for the training had been highlighted by the occurrence of three incidents involving the post-operative care of prostate brachytherapy patients. The training aims to enable all registered nurses to feel confident and competent in caring for the prostate brachytherapy patient safely on the wards. It should also assess the nurses' competencies in the knowledge and skills for the effective management of brachytherapy patients post training sessions.

TRAINING PROCESS:

1. Initial plan
2. Engage the ward managers and PDN
3. Tailored training package
4. Running the training
5. Evaluation of the training
6. Further development

OUTCOMES: There were 19 registered nurses attended training from two wards. The competencies assessment pass rate was 75% at the first time. The training outcome was evaluated after three months. It was found that there had been no near misses or incidents on the wards relating to brachytherapy patients.

FURTHER DEVELOPMENT: To revise the training content and format and negotiate with the ward managers to include the training in the new staff induction programme. To refresh training for all registered nurses will be every other year.

References:
1. The Royal College of Radiologists. Quality assurance practice for transperineal LDR permanent seed brachytherapy of prostate cancer. London: The Royal College of Radiologists, 2012 2. Ionising Radiation Regulation 1999. Health and Safety Executive Ionising Radiation (Medical Exposure) Regulations (IRMER) 2000, Legislation.gov.uk

6 Predictors of survival and causes of death following low-dose rate brachytherapy and robotic-assisted laparoscopic prostatectomy in low- and intermediate-risk prostate cancer: a UK Cancer Registry-linked study

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AIMS/INTRODUCTION: Comparative studies of prostate brachytherapy and radical prostatectomy have focussed on biochemical relapse rather than hard clinical endpoints such as overall survival (OS) and prostate cancer-specific survival (PCSS). Here, we assessed the two treatments by risk-adjusted OS and PCSS in patients with low- and intermediate-risk prostate cancer.

MATERIALS/METHODS: Patients were included if treated for organ-confined prostate cancer between 2003-2013 with low-dose-rate prostate brachytherapy (LDR-PB) or robotic-assisted laparoscopic prostatectomy (RALP) as monotherapy. Patients with high-risk disease, prior prostate cancer treatment, or planned adjuvant therapy, were excluded. Data on PSA, biopsy-derived maximum Gleason score, age, ethnicity, treatment date, modified Charlson comorbidity score, mode of diagnostic biopsy (transrectal/transperineal), and socioeconomic status were collected using electronic records. Vital status was retrieved from the National Cancer Registry. Statistical methods included Kaplan-Meier and Cox regression analyses.

RESULTS: 1392 patients received either LDR-PB (n=408) or RALP (n=984) as monotherapy. Median follow up was 57.8mths (range 1-136mths). 2 deaths occurred due to prostate cancer. 5-year OS and PCSS for the cohort was 96.9%, and 100%, respectively. OS and PCSS did not differ significantly between LDR-PB and RALP by multivariate regression analysis (HR 0.92, 95% C.I. 0.45-1.89, p=0.82). Comorbidity score ≥1 (p=0.005) and ethnicity (p=0.01) were identified as being independent predictors of lower OS. Hazard of death increased 2.4- and 3.4-fold with 1, or ≥2 comorbidity points.

CONCLUSION: Prostate cancer mortality risk following treatment for low- and intermediate-risk cancer is very low in the first 5 years following treatment by RALP or LDR-PB. Comorbidity is an important predictor of early death which can be reliably assessed and risk-stratified using a modified Charlson scoring system. Our data adds to the limited literature on comparative outcomes following prostate brachytherapy and radical prostatectomy.