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National survey of fiducial marker insertion for prostate image guided radiotherapy

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ABSTRACT

Introduction: In the United Kingdom fiducial marker IGRT is the second most common verification method employed in radical prostate radiotherapy yet little evidence exists to support centres introducing or developing this practice. We developed a survey to elicit current fiducial marker practices adopted in the UK, to recommend standardisation of practice.

Methods: A 16 question survey was distributed across UK Radiotherapy centres via promotion at the British Uro-Oncology Group Conference, 2016. Included were questions relating to workforce planning, patient preparation, insertion procedure and verification methods. The survey was open from September 2016 to January 2017.

Results: Results from 15 centres routinely inserting fiducial markers for prostate IGRT are presented. Eleven professional groups insert fiducial markers across the UK. Fourteen centres insert fiducial markers trans-rectally; one trans-perineally. Centres adopting a trans-rectal approach administer prophylactic ciprofloxacin as a single agent or combined with gentamicin or metronidazole; poor agreement between regimes presented. One centre has introduced targeted antibiotic prophylaxis.

Five brands of fiducial markers are utilised nationally. Fourteen centres standardly insert three single fiducial markers, two common configurations emerged. Coupled fiducial markers are routinely implanted by one centre.

All centres delay at least one week between fiducial marker insertion and planning CT; seven centres wait two weeks. The most common fiducial verification method is two-dimensional, paired kilo Voltage imaging.

Conclusion: Variation in fiducial marker practice across the UK is considerable. Standardisation is required to support centres and healthcare professionals developing this service. Seven recommendations, to unify practice, have been proposed based on survey results and literature.

Introduction

Image guided radiotherapy (IGRT) is considered essential both to reduce the risk of geographical miss and minimise toxicity in prostate cancer radiotherapy.[1]

The implantation of fiducial markers (FMs) into the prostate gland and their visualisation on two-dimensional (2D) or three-dimensional (3D) images, acquired immediately before treatment delivery, is one of various methods employed to localise the prostate gland. Implanted FMs have been shown to improve prostate localisation accuracy, facilitating CTV-PTV margin reduction[2–4] with the potential to reduce treatment morbidity and late normal tissue toxicity.[5] The implementation of simultaneous integrated boosts, dose-escalated and stereotactic treatments further demand advanced IGRT.

The implantation of FMs has been standard of care in our centre for many years with progressive refinements in sepsis reduction protocol detailed.[6] However there is limited evidence supporting our practice.[7–13] Only one of these articles, documenting technique for fiducial marker (FM) insertion, originates from the United

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Kingdom.[12] Furthermore a recent comprehensive review article calls for standardisation of clinical protocols to enable robust comparisons between prostate FM toxicity, treatment accuracy and outcome data across trials.[14]

This survey was designed to elicit current national UK adoption of prostate FM IGRT and evaluate local practices employed; to recommend standardisation of practice based on survey results and literature.

It should be noted that although FM insertion is safe in the majority of patients[8–10] not all patients are suitable; the benefit of FM insertion must be carefully weighed against the risks.

Methods

A 16 question survey was developed to gather information regarding the insertion of FMs including; patient preparation, imaging during treatment and multi-professional workforce development in the UK. A combination of yes/no, multiple-choice and open-ended questions were used. The survey was reviewed and approved by the Trust's Quality Assurance Team and Service Evaluation Committee (SE550) and was made available electronically through SurveyMonkey.net in addition to a paper copy (Appendix 1).

Currently there are sixty-two National Health Service (NHS) and eight private sector providers of radiotherapy services in the UK[15], the majority of which use kilo Voltage Computer Tomography (kVCT) matching to soft-tissue as the main verification imaging modality in radical prostate radiotherapy.[16] The use of FMs in combination with imaging is the second most common verification method in the UK, employed standardly by 16 centres.[16] To sample as wide a population as possible the survey was publicised via a flier, given to all delegates attending the British Uro-Oncology Group (BUG) Conference, 2016. This flier presented an overview of the survey and information on how to access both the electronic and paper form. Radiotherapy Service Managers were also informed of the survey, via an e-mail sent early December 2016 and asked to forward the survey link to the appropriate individual within their centre.

The survey was open to responses from September 2016 to January 2017. Participation in the survey was voluntary without remuneration. Completion of the survey constituted informed consent.

Results

Twenty surveys were returned. Four responses were from centres not utilising prostate FMs and one response was duplication, these are not reported. Fifteen responses were received from centres routinely inserting FMs for prostate IGRT, these results are presented.

Professional responsible for fiducial marker insertion

A diverse array of Healthcare Professionals assume responsibility for FM insertion across the UK, see Fig. 1. Eleven different professional groups insert FMs with more than one profession assuming responsibility in six (40%) of the responding centres.

The professional groups most commonly inserting FMs were Urology Consultants (six centres) and Urology Clinical Nurse Specialists (four centres). Consultant Clinical Oncologists and Urology Specialist Radiographers also adopted responsibility across three centres apiece.

The competency training completed by the different professional groups was not examined.

Use of anaesthetic for fiducial marker insertion

Fourteen centres routinely inserted FMs trans-rectally; one centre performed trans-perineal insertions. Twelve centres (80%) administered anaesthetic prior to FM insertion. Eleven of which inject local anaesthetic, typically Lidocaine/Lignocaine, into peri-prostatic tissue via the patients' rectum or perineum. A general anaesthetic is administered by the centre carrying out trans-perineal placement.

Fiducial markers and their placement

Five brands of FMs were identified as being used across the UK. The most common FM brand employed was Civco (Iowa, USA), used by seven centres with one centre specifying they use their Poly-Mark™ FMs; three centres use Cortex Implanted Needles (Washington, USA). BrachySolutions Inc. (Hattingen, Germany) and Gold Anchor™ (Huddinge, Sweden) FMs are utilised by one centre each; three responders were unsure which brand of FMs their centre use (Fig. 2).

FM specification was consistent. Eleven centres utilised FMs measuring 3 mm in length, with a diameter ranging from 1 mm to 1.2 mm. Two centres used FMs measuring 5 mm long with a diameter of 1 mm and three centres routinely used coupled FMs with 20 mm between each gold marker. Fourteen centres (93%) inserted three prostate FMs as standard, one centre inserted four. Two centres specified that different FMs were inserted if the patient was due CyberKnife (Accuray Inc., Sunnyvale, CA) treatment. Both utilised coupled FMs in CyberKnife patients; one inserted two coupled FMs, the other inserted one coupled FM (coupled FMs are designed to ensure a set spacing between markers is achieved) and two free FMs.

The two most common FM configurations are presented in Fig. 3. Five centres inserted two FMs into the prostate base, one left and one right and another in the apex (Fig. 3A). Seven centres inserted one FM into the prostate base, one in the mid-gland and another in the apex (Fig. 3B). The centre implanting two coupled FMs inserted one in the left and one in the right base. One centre specified they inserted one in the apex, one in the base but did not specify the location of the third marker, another responder did not specify FM position.

Patient preparation prior to procedure

Fourteen centres (93%) prescribed prophylactic antibiotics to cover FM insertion. The one centre not using antibiotics inserted FMs via the perineum. Ciprofloxacin was the antibiotic of choice, prescribed by all 14 centres however poor agreement between regimes presented (Table 1). Eight centres prescribed ciprofloxacin as a single agent, four combined it with metronidazole and two combined it with gentamicin. In preparation for FM insertion, only one centre screened for fluoroquinolone resistance.

Prior to FM insertion five centres asked patients to stop taking low dose (75–150 mg) aspirin. Three stopped aspirin five days prior to the procedure, one stopped it seven days prior and another stopped it between seven and ten days prior to procedure. Nine centres continued patients on low dose aspirin. One centre continued aspirin use if the patient was taking 75 mg but stopped higher doses.

Delay from fiducial marker insertion to planning CT

A wait of two weeks between FM insertion and the planning CT scan was favoured by seven centres. Seven centres allowed a period of one week between FM insertion and the patient's planning CT scan. One centre left a gap of between seven and ten days.

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