Intra-operative margin detection using Cerenkov luminescence Imaging during radical prostatectomy – Initial results from the PRIME study

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OBJECTIVES

Cerenkov Luminescence Imaging (CLI) is a new imaging technology(1-3) for intra-operative assessment of surgical margins and lymph nodes status, based on optical imaging of PET radiopharmaceuticals(4-6). The PRIME (PRostate Imaging for Margin Evaluation) study is currently being conducted to evaluate the feasibility and safety of 18F-choline (7) CLI to intra-operatively assess margin status in prostate cancer specimens and lymph node metastases(8, 9).

RESULTS

Intra-operative CLI of 3 prostatectomies showed an elevated radiance with TBR 3.45, 4.90 and 2.49 respectively for each patient. For 2 prostate with high-grade disease (figure 1 and 2), CLI analyses agreed with histological reports but not for the third one, which was a low-grade. Lymph nodes were negatives both on CLI and pathology reports. No surgical complication occurred due to the CLI protocol. Basal signals, regarded as artefacts from the electro cautery device, were excluded from the analysis. Staff radiation doses (10, 11) mirrored the proximity to the patient and the duration of the procedure (table 1). To allow for radioactive decay (18-F half-life = 110 min), instruments were stored overnight before sterilisation and likewise pathology samples before transfer for analysis (12).

![Figure 1: patient 1, view from the base of the prostate. Basal tumour, no margins](image1)

<table>
<thead>
<tr>
<th>Radiation dose in μSv</th>
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<tbody>
<tr>
<td>Assisting surgeon</td>
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<tr>
<td>Scrub nurse</td>
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<tr>
<td>Anaesthetic staff</td>
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<tr>
<td>All other staff</td>
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Table 1: average staff radiation doses during the 3 CLI procedures

CONCLUSION

Intra-operative 18 F-choline CLI is a feasible and low risk procedure. The CLI results from the first 3 patients show promise, and more data are needed to further evaluate this new intra-operative technique for measuring surgical margin and lymph node status. As CLI has a depth sensitivity of a few millimetres, further development is also required to restrict the signal to the surgical margin depths used in pathology(13)

METHODS

The PRIME study will recruit 30 patients with high-risk prostate cancer (clinical stage >T2c, or PSA>20 ng/ml, or Gleason Score 8-10) undergoing radical robotic prostatectomy. Initial data from 3 patients are reported. After intravenous injection of 18F-choline, the specimens were imaged intra-operatively with an investigational CLI specimen analyser (Lightpoint Medical Ltd, UK), just after the excision. The normalised decay-corrected radiance (ph/s/cm²/str/ MBq) was calculated for each region of interest and the apparent tumour-to-background ratio (TBR) was reported. Radiation doses to staff were measured using badge dosimeters.

REFERENCES