Percutaneous minimally invasive stereotactic primary radiotherapy for breast cancer

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A 73-year old lady, admitted to our breast clinic, was found to have a lump in the left breast. She had recently been diagnosed with motor neurone disease and pseudobulbar palsy with a generally poor prognosis. Physical examination, mammography, and fine-needle-aspiration cytology (triple assessment) showed a 2·5 cm infiltrating duct-carcinoma. Since she was too frail for conventional surgery, the usual option would have been to treat her with tamoxifen. However, there is some evidence that local treatment is effective, in combination with tamoxifen, because it reduces breast cancer morbidity and deaths (risk reduction=0·62, 95% CI 0·41–0·94) and may improve survival.[1] We recently received ethics approval to use a novel method of delivering interstitial radiotherapy while withholding tamoxifen (20 mg/day) for 1 month after treatment. Our patient was happy to undergo this single dose outpatient-based treatment. We assessed response objectively using contrast-enhanced MRI and core-cut biopsy before, and at various intervals after, treatment (figure 1).

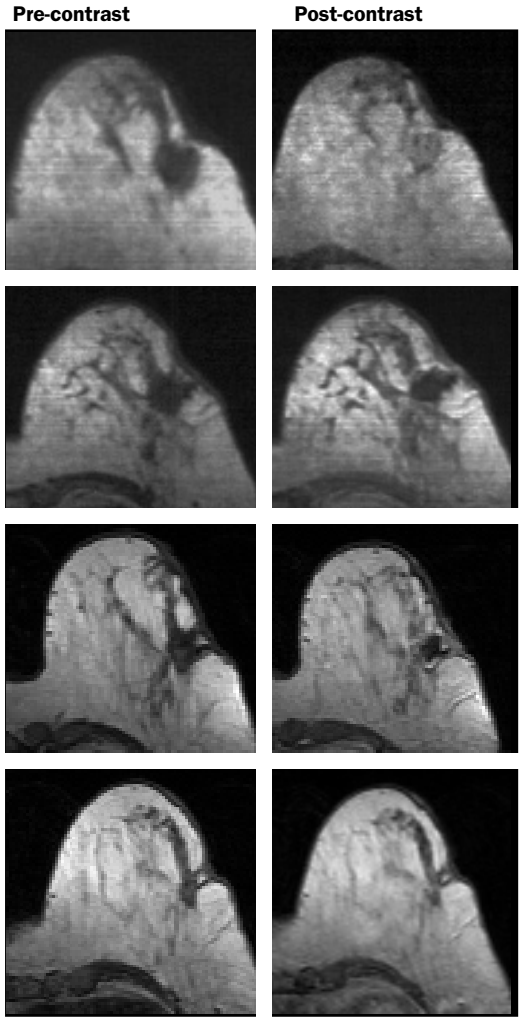

Figure 1. Contrast-enhanced MRI scans of the breast.

This novel approach uses a minimally invasive therapy which incorporates three converging technologies: (a) the Fisher Mammotest table for digital real-time tumour localisation, (b) the Mammotome vacuum biopsy system for large excision biopsy, and (c) the PRS400 (PeC Photoelectron Corporation) for localised portable radiotherapy. The patient lies prone on the Fisher stereotactic localisation table and the breast is suspended under the table between the image sensor and a small windowed compressing pad (figure 2). The Mammotome vacuum biopsy apparatus is targeted at the tumour through a tiny incision in the breast under local anaesthesia and a large-volume breast biopsy is taken.

The PRS400 is a portable (1·8 kg) electron-beam soft X-ray source that provides a point source of low energy X-rays (50kV) at the tip of a 3·2 mm diameter tube that can be positioned in the breast through the tract created by the Mammotome needle. Positioning of the X-ray tube is carried out under real-time stereotactic control on a prone table under local anaesthetic. The typical prescribed physical dose is 20 Gy (biological equivalent dose=286 Gy for an α/β ratio of 1·5) at the surface of the tumour. At the centre, the physical dose is approximately 130 Gy. The dosimetry is similar to interstitial brachytherapy but does not have the disadvantage of radioisotope handling and is less complex to calculate. The treatment is delivered in about 12 minutes in a routine X-ray room on an outpatient basis. Using this technique, the area of

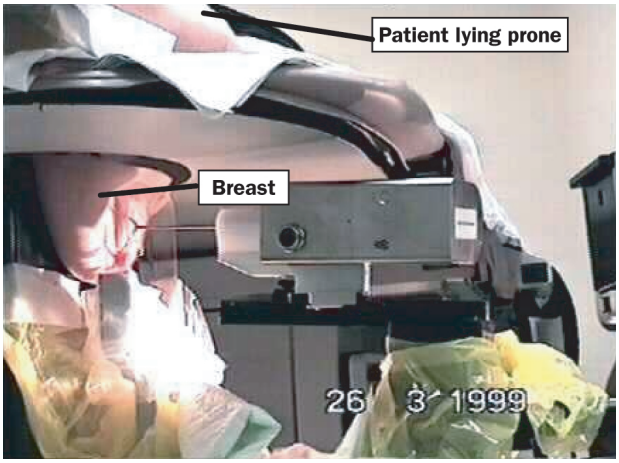

Figure 2. The tip of the PRS400 is positioned at the centre of the tumour under computer-aided sterotactic guidance.

maximum tissue anoxia—the most likely site of treatment failure—receives the highest dose, and the normal tissues receive the least.

The patient tolerated the treatment well and experienced no pain. To our surprise, contrast-enhanced MRI, just 6 days after the treatment, showed a substantial loss of tumour vascularity (apart from a thin rim of enhancement) compared with the pretreatment scan. The rim of enhancement disappeared in subsequent scans at 1, 3, and 6 months. Core biopsies at 1 week and at 1 month showed evidence of apoptosis, occluding blood vessels, and progressive fibrosis. The tumour was impalpable at 3 months and the patient remained disease free. Unfortunately, she died of motor neurone disease 13 months after the radiation treatment.

We have treated two further patients, aged 78 and 85 years, with stereotactic radiotherapy and similar responses to those described above have been seen. The tumour masses were impalpable by 3 months following treatment. The second patient is still disease free at 24 months, while the third patient died of ischaemic heart disease at 12 months.

Delivering a single large dose of radiotherapy intraoperatively, after wide local-excision of the tumour, is currently being tested in clinical trials as an alternative to 6 weeks of postoperative radiotherapy, and the early results are promising.[2,3,4] In the case reported here, the patient did not undergo surgery, and a high dose of radiotherapy, albeit concentrated over a small volume, was delivered directly to the tumour from the centre outwards. The real potential for this technique is its use in treating small screen-detected cancers in which standard surgery and radiotherapy often results in overtreatment. The Mammotome can biopsy up to 2 cm^3 of tissue and for small screen-detected malignancies this may achieve complete excision.[5] Combined with the Mammotome, this novel radiotherapy technique could offer patients an option of complete treatment (localisation, excision, and radiotherapy) in a single outpatient visit.

Conflict of interest

M Baum is on the scientific advisory committee of the Photoelectron Corporation and has share options. J S Vaidya was partly funded by a research grant from Photoelectron Corporation.

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