Sole conformal perioperative interstitial brachytherapy of early stage breast carcinoma using high-dose rate afterloading: longer-term results and toxicity

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Received: 10.09.2007
Accepted: 7.02.2008
Subject: original paper

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SUMMARY

AIMS AND BACKGROUND: This study of high-dose-rate brachytherapy to the lumpectomy site as the sole radiation presents longer-term results and toxicity of accelerated partial-breast irradiation, using three-dimensional treatment planning.

MATERIALS AND METHODS: From March 2002 to July 2004, 25 patients were prospectively included in this study. Six patients were excluded because of definitive histology of lobular carcinoma or positive margin. The median age at the time of treatment was 63.2 years (range 44–77 years). Median follow-up of all patients was 44 months (range 30–53 months) with a minimum follow-up of 30 months. Radiation was delivered using the high-dose-rate remote afterloader VariSource with ^{192}Ir source. The patients received radiation twice a day at least 6 hours apart for a total of 10 fractions over five days with a single dose of 3.4 Gy. The total dose was 34.0 Gy prescribed as a minimum peripheral dose to match or minimally exceed the volume defined by the surgical clips as seen on computed-tomography (CT) scans. Free-hand technique allows conformal placement of the catheters to the shape of the lumpectomy cavity. Side-effects and toxicity were scored using the EORTC/RTOG scale.

RESULTS: At a median follow-up of 44 months none of the women had developed in-field breast recurrences, one patient had out-of-field recurrences and one patient presented distant metastases. There were no regional nodal recurrences. In each woman, target volume size in cm3 (median 91.3 cm3), dose volume histogram (DVH), and dose homogeneity index (DHI) were calculated. Median DHI was 0.42. Median volume of breast tissue receiving 100% of the prescription dose, V_{100}, was 87%; and V_{150} 48.5%. We noticed two treatment complications: haematoma and abscess in the place of the tumour bed after extirpation. At last follow-up, all patients rated the overall cosmetic outcome as excellent or good.

CONCLUSIONS: This method is suitable only for patients with histologically confirmed small tumours (<3 cm in diameter) without negative prognostic factors for local recurrence. We observed low treatment-related morbidity and mild long-term toxicity with good treatment results.

KEY WORDS: breast cancer, radiotherapy, interstitial brachytherapy

BACKGROUND

Breast conserving therapy is an attractive alternative to mastectomy for patients with Stage I and II breast cancer and it is now considered to be an equivalent therapy to mastectomy. The current standard of care for breast-conserving therapy includes a post-lumpectomy course of whole-breast external beam radiotherapy (EBRT), which typically requires 5–7 weeks to complete. The purpose of radiotherapy (RT) is to prevent recurrence by eliminating residual foci of cancer that might remain in the surrounding breast tissue. This conservative approach still has the same radical intent as the destructive surgery first done by William Halstead over 100 years

ago. The main obstacle to wider acceptance of breast-conserving surgery is the dogma of 6-7 weeks of postoperative radiotherapy, which has several disadvantages: the long course of treatment and very often distant abode of patients from a department of radiotherapy are a substantial burden on women [1, 2]. It has been estimated from patterns of care study by the American College of Surgeons that only 50% of women in the United States who are eligible for breast-conserving surgery receive this form of treatment. Equally problematic, 15% of women who should receive radiation after conservative treatment do not [3].

Accelerated partial-breast irradiation (APBI) may be defined as any scheme that delivers radiotherapy to the tumour site and some surrounding tissue over a short overall period (5-8 days). Among the approaches described to date using brachytherapy to accomplish this are the following: low-dose rate (LDR) or high-dose rate (HDR) brachytherapy using interstitial implantation or a balloon catheter (MammoSite), and single-fraction intraoperative irradiation using 50 kV orthovoltage radiation (Intrabeam) or electrons 4–12 MeV (Mobetron, Novac-7) [2, 4]. Irradiation of the tumour bed only is being investigated in several clinical trials. The number of studies with median follow-up times of about 6 years using mainly interstitial high-dose rate APBI, 8–10 fractions, and total doses of 32 to 34 Gy have found low rates of breast recurrence and good cosmetic outcome. However, many centres do not have significant brachytherapy experience [5, 6, 7, 8, 9].

Long-term results of the use of three-dimensional conformal planning of perioperative interstitial sole brachytherapy of early stage breast carcinoma including late effects and morbidity are presented.

MATERIALS AND METHODS

Sole conformal perioperative interstitial brachytherapy was delivered to patients with early stage breast carcinoma. From March 2002 to July 2004, 25 patients were prospectively included in this study, which was approved by the Ethics Committee of Masaryk Memorial Cancer Institute. All patients gave informed consent. Six patients were excluded because of definitive histology of lobular carcinoma or positive margin. The median age at the time of treatment of the 19 women in this pilot study was 63.2 years (range: 44–77 years). Median follow-up of all patients was 44 months (range: 30-53 months).

Study objectives. The objective is to establish methods of perioperative brachytherapy in clinical practice, and evaluate treatment complications, cosmetic effect and local control. Eligibility criteria and diagnostic work-up. Patients with invasive lobular histology were excluded. Initially all patients were axillary node negative (only 3 patients had 1 to 3 axillary nodes positive). Eligibility criteria included histology of adenocarcinoma, clinical stage T1-T2 (tumour size <3 cm), and axillary node-negative breast cancer with microscopic resection margins negative for ductal carcinoma. Pretreatment work-up included clinical examination, mammography and breast and axillary ultrasonography with biopsy of breast tumour, chest X-ray, liver ultrasonography, gynaecological examination and bone scintigraphy, pretreatment CT of breast, serum CEA and Ca15-3 levels, and blood tests.

Patient population, follow-up. Patient characteristics are summarized in Table 1. The follow-up schedule included breast examination every 3 months. Mammography was done at 6 months after brachytherapy and then once a year together with ultrasonography. Cosmetic effect was assessed every 3 months.

Surgery and brachytherapy. In this group the patients underwent standard lumpectomy. During the surgery the needles were inserted into the tumour bed and nylon catheters were threaded through the needles (free-hand technique). The margins of the cavity were marked by clips. A very important, maybe the most important, aspect was the correct and accurate definition of the target volume. For this reason we used a combination of preoperative (preimplant) CT scans of 2–5 mm intervals and 2 mm thickness to identify the tumour with postoperative (postimplant) CT scans with the location of clips and applicators. Radiation was delivered using the high-dose rate remote afterloader VariSource with ^{192}Ir source and perioperative interstitial application of multicatheters. The patients received radiation twice a day at least 6 hours apart for a total of 10 fractions over five days with a single dose of 3.4 Gy. The total dose was 34.0 Gy prescribed as a minimum peripheral dose to match or