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Original article

ESTRO-ACROP guideline: Interstitial multi-catheter breast brachytherapy as Accelerated Partial Breast Irradiation alone or as boost – GEC-ESTRO Breast Cancer Working Group practical recommendations

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ABSTRACT

Purpose: This consensus statement from the Breast Cancer Working Group of Groupe Européen de Curiethérapie of European Society for Radiotherapy and Oncology (GEC-ESTRO) aims at generating practical guidelines for multi-catheter image-guided brachytherapy in the conservative management of breast cancer patients used for either Accelerated Partial Breast Irradiation (APBI) or for a breast boost.
Methods: Recent advances in techniques of multi-catheter brachytherapy were summarized and all the relevant literature was reviewed by a panel of experts. Panel members of the GEC-ESTRO experts participated in a series of conferences, supplemented their clinical experience, were surveyed to determine their current practices and patterns, performed a literature review, and formulated recommendations for implementing APBI with multi-catheter brachytherapy, focusing on treatment planning issues, catheter insertion, dosimetry and quality assurance. This document was reviewed and approved by the full panel, the GEC-ESTRO executive board and by the ACROP (Advisory Committee on Radiation Oncology Practice).
Results: Three-dimensional (3D) treatment planning, catheter insertion techniques, dosimetry and methods of quality assurance for APBI and boost with multi-catheter image-guided brachytherapy after breast conserving surgery are described. Detailed recommendations for daily practice including dose constraints are given.
Conclusions: Recent standards and guidelines for the use of APBI with different multi-catheter image-guided brachytherapy techniques have been defined. Different techniques are used to insert the catheters. Guidelines are mandatory to assure precise catheter insertion for coverage of the target volume and to guarantee high-quality dosimetry. The same rules apply for brachytherapy based boost irradiation for breast cancer after whole breast irradiation as well as for partial breast re-irradiation.

Interstitial multi-catheter brachytherapy in the context of breast conserving therapy (BCT) represents one of the most highly published irradiation techniques for Accelerated Partial Breast Irradiation (APBI) alone, Salvage-APBI and Boost after whole breast irradiation (WBI) [1–4]. Generally, this technique delivers a high-dose to a precise, strictly limited in-breast target volume, avoiding to the greatest possible extent, exposure of adjacent organs at risk (OARs) thus resulting in excellent local control with low rates of side effects [1,5–12]. To date, APBI using multi-catheter brachytherapy is the only method of breast irradiation with a treatment duration of merely 4–5 days with level 1 evidence showing it to be a valid treatment alternative to WBI after breast conserving surgery (BCS) for low-risk breast cancer patients which is used in clinical routine [1,4,9–12]. Sole APBI based on multi-catheter brachytherapy is intended first to shorten treatment duration compared with the WBI regimen (40–50 Gy over 3–6 weeks) and second to reduce late side effects to OARs such as the heart,

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lung and skin while achieving similar rates of local control, disease-free survival and overall survival. As a consequence, sole APBI with multi-catheter brachytherapy is also a unique treatment technique for re-irradiation after re-excision (Salvage-APBI, Accelerated Partial Breast Re-Irradiation – APBrI) after previous BCS and WBI with an exceptionally low rate of side effects and with local recurrence rates comparable to salvage mastectomy alone [2].

Recently, guidelines for patient selection and target definition for APBI after both breast conserving closed and open cavity surgery as well as dose recommendations according to risk factors were provided by the Breast Cancer Working Group of GEC-ESTRO [13–15]. Similar guidelines for patient selection were also published by numerous USA societies [16–18]. Guidelines for treatment planning using different techniques for APBI were provided by the National Surgical Adjuvant Breast and Bowel Project (NSABP) B-39/Radiation Therapy Oncology Group (RTOG) 0413 Protocol [19]. The NSABP B-39 protocol included criteria for target coverage as well as for sparing OARs.

The aim of this consensus statement of the GEC-ESTRO Breast Cancer Working Group is to generate detailed practical guidelines for APBI, boost after WBI or APBrI with multi-catheter image-guided brachytherapy for the conservative management of breast cancer patients in daily practice.

Methods

The authors evaluated the relevant literature, identified established and controversial topics via working conferences, circular emails, meetings, conference calls and supplemented this information with their clinical experience to formulate the current guidelines. A consensus decision was made to incorporate strategies using 3D image guidance for interstitial brachytherapy based APBI. Specific commercial equipment, instruments, and materials are described only when necessary. Such identification does not imply recommendation or endorsement by the presenter nor imply that the identified material or equipment is necessarily the best available for these purposes.

This report document was reviewed and approved by the full panel, the GEC-ESTRO executive board and by ACROP.

Results

Technical recommendations

General issues related to multi-catheter HDR-/PDR-brachytherapy

We recommend that APBI with image-guided multi-catheter brachytherapy after breast conserving surgery (BCS) should be completed preferably in less than 12 weeks and no longer than 20 weeks, as better local tumour control and survival can probably be expected than with a longer time frame [20–27]. Nevertheless a recent analysis illustrated that starting of radiation therapy shortly after BCS seems not to be associated with a better long-term outcome [28]. In Europe, the most common HDR-brachytherapy regimen used for APBI prescribes 2 fractions per day for a total of 7–10 fractions.

Patient selection for APBI alone after BCS in patients with early breast cancer should be performed according to the GEC-ESTRO- or the ASTRO guidelines [13,29]. The GEC-ESTRO panel of members holds the view that until the results of the NSABP B-39/RTOG 0413 APBI trial are available, GEC-ESTRO selection criteria should remain unchanged, particularly because current published data of phase 3 trials [1,11,30–33] so far do not allow one to analyse corresponding subgroups of interest. As far as patient selection criteria for APBrI, we suggest using the criteria as published by Hannoun-Levi et al. [2]. Furthermore we advise using criteria as analysed and described previously for patient selection for boost [34–38].

Furthermore we advise defining the target in accordance with current published guidelines [14,15].

Treatment planning and catheter insertion

Pre-implant treatment planning may be performed either in a separate procedure as in a pre-plan approach, or on the day of the procedure in the operating room as intra-operative preplanning. Whatever the pre-implant treatment planning and mode of catheter insertion as listed below, the following information must be available at the time of preplanning and at the time of catheter insertion: surgical report, pathological report including size of resection margins in 6 directions, knowledge about number and position of surgical clips, images of preoperative mammography, ultrasound and, if necessary, magnetic resonance imaging (MRI).

The standard procedure for catheter insertion is to use a transcutaneous approach usually in week 4 to 12–20 after BCS under computed tomography (CT) or ultrasound (US) or X-ray monitoring and template guidance (if needed). According to the Paris System, a square or triangular arrangement is reasonable [39]. Boost brachytherapy should follow WBI as soon as possible within 4 weeks depending on the extent and grade of skin inflammation after WBI. Patient positioning should coincide with the pre-implant planning study as closely as possible when a preplan approach is used. If US equipment is used a high-resolution system is recommended. When the surgeon leaves the cavity open, the seroma can easily be identified during needle insertion [40], and thus the needles cover the shape of the cavity (Image-guided Brachytherapy). After closed cavity surgery, a pre-implant CT with radiopaque marks on the skin scar and nipple is useful in order to locate the surgical scar and/or the clips. If no clips are in place and a surgical scar cannot be identified, a CTV is difficult to define so an APBI or boost cannot be easily and securely performed. Fluoroscopy (as X-ray based guidance) as a complementary imaging modality can only be used if surgical clips are present.

CT-based pre-implant treatment planning and insertion of catheters after open cavity surgery

According to timing and number of CT imaging, various policies exist, but the catheter positions are always determined using the 3D rendering of the target volume and patient anatomy. Planning the catheter positions can be done using a plastic template on the breast during pre-implant CT imaging [41,42]. Then, using 3D rendering of patient anatomy and virtual simulation the appropriate catheter positions can be defined. A few needles (e.g. in deep plane – close to the thoracic wall) can be inserted freehand, and the remainder with a template. The template is made of plastic; it has two plates with holes arranged in regular geometry with a triangular pattern. The distance between the holes is between 12 and 20 mm (Fig. 1). Ideally, two CT image series (pre-implant and post-implant) are used for the implantation and treatment planning [41,42]. First, one day before implantation a CT-compatible plastic template is placed over the breast skin taking into account the scar position on the skin and other relevant clinical information about the tumour location. Distance between the template plates is recorded and their positions are marked on the skin. Pre-implant CT imaging is performed, the cavity is outlined in axial slices, and the target volume is created according to the contouring protocol. Using 3D rendering in the treatment planning system, the patient's image data are then rotated to the "needle's eye view", i.e. viewing in the direction of the needles, and the target volume is projected on to the rendered template with the holes (Fig. 2). By visual inspection the holes covering the target volume are identified, and their coordinates are recorded. On the following day, another more rigid template,

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