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BRACHYTHERAPY

Brachytherapy ■ (2017) ■

Review Article

American Brachytherapy Society consensus report for accelerated partial breast irradiation using interstitial multicatheter brachytherapy

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ABSTRACT

PURPOSE: To develop a consensus report for the quality practice of accelerated partial breast irradiation (APBI) using interstitial multicatheter brachytherapy (IMB).

METHODS AND MATERIALS: The American Brachytherapy Society Board appointed an expert panel with clinical and research experience with breast brachytherapy to provide guidance for the current practice of IMB. This report is based on a comprehensive literature review with emphasis on randomized data and expertise of the panel.

RESULTS: Randomized trials have demonstrated equivalent efficacy of APBI using IMB compared with whole breast irradiation for select patients with early-stage breast cancer. Several techniques for placement of interstitial catheters are described, and importance of three-dimensional planning with appropriate optimization is reviewed. Optimal target definition is outlined. Commonly used dosing schemas include 50 Gy delivered in pulses of 0.6−0.8 Gy/h using pulsed-dose-rate technique and 34 Gy in 10 fractions, 32 Gy in eight fractions, or 30 Gy in seven fractions using high-dose-rate technique. Potential toxicities and strategies for toxicity avoidance are described in detail. Dosimetric constraints include limiting whole breast volume that receives ≥50% of prescription dose to <60%, skin dose to ≤100% of prescription dose (≤60−70% preferred), chest wall dose to ≤125% of prescription dose, Dose Homogeneity Index to >0.75 (>0.85 preferred), V_{150} < 45 cc, and V_{200} < 14 cc. Using an optimal implant technique coupled with optimal planning and appropriate dose constraints, a low rate of toxicity and a good-to-excellent cosmetic outcome of ≥90% is expected.

CONCLUSIONS: IMB is an effective technique to deliver APBI for appropriately selected women with early-stage breast cancer. This consensus report has been created to assist clinicians in the appropriate practice of APBI using IMB.

Keywords: Interstitial multicatheter brachytherapy; Accelerated partial breast irradiation; Breast brachytherapy; Breast cancer

Introduction

The concept of accelerated partial breast irradiation (APBI) is firmly rooted in pathologic data and patterns of failure showing that residual disease and clinical recurrences are largely confined to the tissues surrounding the lumpectomy cavity for patients with early-stage breast cancer (1−8). The interstitial multicatheter brachytherapy (IMB) technique was one of the early

Received 31 January 2017; received in revised form 11 May 2017; accepted 28 May 2017.

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1538-4721/$ - see front matter
http://dx.doi.org/10.1016/j.brachy.2017.05.012

Table 1
Studies evaluating APBI using interstitial multicatheter brachytherapy

Study	Study design	Number of patients	Median followup	IBTR[a] %
GEC-ESTRO (10)	Randomized	1118	6.6 years	1.4
NIO, Hungary (11)	Randomized	258	10 years	5.9 (10 years)
William Beaumont Hospital (12)	Matched pair	199	11 years	5 (12 years)
RTOG 9517 (13)	Multi-institutional case series	99	12 years	5.2 (10 years)
PROMIS (14)	Multi-institutional case series	1356	7 years	7.6 (10 years)
Germany/Austria (15)	Multi-institutional case series	274	5 years	2.3
NIO, Hungary (16)	Case series	45	11 years	9.3 (12 years)
Harvard University (17)	Case series	50	11 years	15 (12 years)
Orebro Medical Centre, Sweden (18)	Case series	50	7 years	4 (7 years)
London Regional CC, Canada (19)	Case series	33	7 years	16.2
Tufts University (20)	Case series	32	7 years	6.1
Ochsner Clinic (21)	Case series	304	6 years	2
Washington University (22)	Case series	202	5 years	3
Tata Memorial Hospital, India (23)	Case series	140	5 years	3
University of Perugia, Italy (24)	Case series	100	5 years	2.3
University of Nice-Sophia, France (25)	Case series	70	5 years	2.4
Florence Hospital., Italy (26)	Case series	115	4 years	6 (crude rate)
University of Wisconsin (27)	Case series	247	4 years	2.2 (low risk) 6.4 (high risk)
University of Kansas (28)	Case series	24	4 years	0
Soonchunhyang University, Korea (29)	Case series	48	4 years	4.6
VCU (30)	Case series	44	3.5 years	0

APBI = accelerated partial breast irradiation; GEC-ESTRO = Groupe Européen de Curiethérapie and the European Society for Radiotherapy and Oncology; NIO = National Institute of Oncology; RTOG = Radiation Therapy Oncology Group; PROMIS = Pooled Registry of Multicatheter Interstitial Sites; VCU = Virginia Commonwealth University.

[a] IBTR: ipsilateral breast tumor recurrence (5-year actuarial rate if not otherwise specified in parentheses).

approaches to explore the concept of APBI, and thus this technique has accumulated the most robust clinical data with the longest followup. The IMB technique, compared with other APBI techniques, is also the most versatile one allowing for conformal dose distribution across a variety of breast and tumor bed volumes and geometries (9). The IMB technique can be technically challenging. However, with appropriate knowledge and skill, IMB can result in a convenient and effective treatment, both in regards to tumor control and cosmetic outcomes. The American Brachytherapy Society (ABS) Board, therefore, presents this consensus report to assist clinicians in using the IMB technique.

Methods and materials

In 2016, The ABS Board of Directors appointed a group of practitioners with clinical and research experience with breast brachytherapy to provide guidance for the present practice of IMB. Consensus report development was initiated with a systemic literature review. A PubMed search performed using search terms interstitial, breast, and brachytherapy yielded 340 publications. This included reports on two randomized trials (10, 11), 1 case-controlled trial (12), and 18 nonrandomized studies (13–30). These are listed in Table 1. Recommendations were based on published literature with emphasis on randomized data when applicable and clinical experience of the expert panel. This final report was reviewed and approved by the ABS Board of Directors.

Summary of clinical outcomes

Early in the development of the IMB technique, it was commonly employed to deliver boost irradiation to the tumor bed as part of whole breast radiation therapy. IMB to deliver APBI and the concept of APBI itself was initially investigated in the United States at William Beaumont Hospital and the Ochsner Clinic and in Europe at the National Institute of Oncology (NIO) in Hungary (31–33). Patients were largely required to be $>$ 40 years old, with invasive ductal carcinoma, surgical margins $\geq$ 2 mm, and axillary lymph node dissection of Levels I and II with 0–1 lymph nodes positive, no extensive intraductal component, and no residual microcalcifications on postlumpectomy mammogram.

One of the first publications to compare IMB to whole breast irradiation (WBI) was a matched-pair analysis from William Beaumont Hospital. This study evaluated 199 patients receiving IMB and an equal number receiving WBI. At 12 years, no significant difference was noted in the rates of local recurrence (12). The first randomized trial comparing APBI to WBI was conducted by the NIO, in which 258 women with early-stage breast cancer were randomized to WBI or partial breast irradiation (with 69% of patients treated with IMB and 31% with electrons). Five-year and 10-year clinical outcomes were comparable, and no difference in local recurrence was noted (12, 34). Most recently, the Groupe Européen de Curiethérapie and the European Society for Radiotherapy and Oncology (GEC-ESTRO) conducted a randomized trial of 1184 patients.