Advances in Brachytherapy: New Approaches to Target Breast Cancer

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According to the American Cancer Society, an estimated 212,600 new cases of breast cancer are expected to occur among women in the United States during 2003 (Jemal et al., 2003). In the past decade, breast-conserving therapy (BCT) has become an accepted alternative to radical mastectomy in the management of patients with stage I or II breast cancer (Baglan et al., 2001). Recent advances in brachytherapy have led to the development of criteria for patient selection for limited breast irradiation. Patients who meet selected criteria have new options in radiation therapy treatment as part of their overall treatment plans. Two novel brachytherapy systems currently in use in North America and Europe are the Mammosite® Radiation Therapy System (RTS) (Proxima Therapeutics, Alpharetta, GA) and INTRABEAM® (Photoelectron Corporation, North Billerica, MA). Both use new technology to deliver radiation therapy directly to the tumor site and immediately surrounding tissue from inside the patient’s body. These new techniques greatly reduce postoperative radiation treatment time for women eligible for BCT. Several studies have shown that about 10%–40% of women eligible for BCT actually receive it (Dolan, Granchi, Miller, & Brunicardi, 1999; Farrow, Hunt, & Samet, 1992; Heimbach et al., 1999). The U.S. Food and Drug Administration (FDA) has cleared the use of Mammosite RTS and INTRABEAM for treatment of certain breast cancers. This may allow for widespread use of this new technology and could result in increased rates of BCT with radiation for patients with early-stage breast cancer.

History

In 1896, Madame Curie reportedly first used breast brachytherapy to treat a patient. By 1915, the use of interstitial radium needles was a common technique for treating patients with primary breast cancer. Sir Geoffrey Keynes, MD, reported the first published series of such cases in the 1920s (Keynes, 1937, 1981).

In the 1960s and 1970s, breast brachytherapy gained new footing, predominantly as a boost after whole breast irradiation. Long-term survival results and cosmetic outcomes were quite favorable and reported in a number of scientific publications.

In the 20th century, breast cancer therapy, in terms of radiation, was based on the premise that treatment of the entire breast is necessary for local control and disease-free survival. However, the vast majority of local recurrences occur in the vicinity of the surgical incision, regardless of whether the breast is irradiated (Baglan et al., 2001; Fisher & Anderson, 1994; Gage et al., 1995; Liljegren et al., 1994; Veronesi et al., 1990). As a result, a paradigm shift has led to the concept that limited breast irradiation confined to the lumpectomy cavity and a small surrounding margin should be sufficient to obtain a similar degree of local control when compared to whole breast irradiation.

Breast brachytherapy traditionally is delivered using interstitial catheters inserted either freehand or with the assistance of a template in at least two planes to incorporate the lumpectomy cavity and a margin surrounding the cavity. Recently, advances in technology involving the placement of a double-lumen catheter...