5.1 Brachycurietherapy in Breast Cancer

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1 Introduction

Interstitial (radium) implants were used experimentally to treat “inoperable” breast cancers in the early 1920s (KEYNES 1929). The routine use of interstitial brachytherapy in conservative breast cancer management became possible with the development of iridium-192 after-loading methods during the 1950s and 1960s (PIERQUIN et al. 1987b). While presently endocurietherapy methods are used less frequently than telebeam techniques to irradiate cancerous breast lesions, it is our opinion that interstitial brachytherapy can be particularly useful and effective in the conservative management of breast cancer when used in association with telebeam techniques, surgery, and systemic treatment.

2 Materials and Methods

Iridium-192 sources have proved to be the most practical for temporary interstitial implants. Continuous, think, flexible wires are available and may be used with afterloading techniques, causing little mechanical damage to surrounding tissues. The wires may be cut to any desired length. I use this radionuclide exclusively with a mean linear activity of 1 mRh⁻¹m²cm⁻¹ (range 0.8–1.3)

Both plastic tubes and stainless steel guide needles are available as inert guide systems for breast implants. The use of guide needles makes it possible to obtain a more perfect parallelism between lines. Plastic tubes cause less tissue damage and follow anatomic curves better. Since I use a method of dose calculation which does not require that the sources be placed absolutely parallel to each other, I prefer to use a plastic tube guide system.

The spacing between radioactive lines may be maintained by plexiglass retaining plates or soft perforated plastic tubes. I prefer the less rigid immobilization of the plastic tube spacers. In addition, if the implant consists of two or more planes, spacers are used only between lines of the same plane. Interplanar separation is not maintained by spacers between planes. This causes less damage to breast tissue, particularly at the plastic tubes’ entry and exit points. I use silicone plates to hold plastic tubes for plesiocurietherapy of superficial recurrent disease. This device maintains a plane of radioactive lines 0.5 cm from the skin surface.

Prior to implantation of the guide system the initial primary tumor volume is defined, and the radioactive source lengths necessary to cover this volume are drawn on the skin. The sources are not inserted until after the implant procedure was completed, the patient returned to her room, dosimetry performed, and the duration of application calculated. This makes it possible to control the time of source removal and to insure greater radiation protection of the recovery room personal.

The implantation of the guide system is performed under general anesthesia. Local anes-
The plastic tubes are generally inserted horizontally to decrease the risk of displacement of the guide system and of the radioactive sources within the guides. The entry and exit points are placed 1 cm from the extremities of the radioactive sources; thus, the length of the plastic tube inserted into the breast should be 2 cm longer than the radioactive source lengths. To facilitate surveillance the plastic guide tubes are cut 4 cm beyond the entry and exit points. Nylon wires are inserted into each end of the plastic tubes to block the radioactive sources in place. The length of each nylon wire is equal to one-half the length of the radioactive sources subtracted from one-half the total length of the plastic tubes.

2.1 Target Volume and Forecast Dosimetry

The volume to be treated (target volume) includes the tumor plus a 1-cm safety margin in all directions. If previous treatment has modified the tumor’s size and shape, determination of the treatment volume is based on the initial tumor dimensions. It is preferable that the radiotherapist examine the patient before surgery or systemic treatment to determine the initial tumor size and location. When this is not possible and the exact tumor size and location before surgery and/or chemotherapy is uncertain, one systematically adds 2 cm to the tumor dimensions noted in the patient’s records.

In practice, the patient work-up before beginning conservative treatment for breast cancer includes a frontal view photograph of the chest with the patient in a sitting position (this facilitates later evaluation of cosmetic results); and determination of the tumor location and size with the patient in treatment position, that is, lying supine. The tumor is outlined with a felt pen and a frontal photograph of the chest is taken from above. In addition, the tumor dimensions and situation in relation to the nipple are noted on a diagram. The initial mammograms are reviewed. Exceptionally, an atypical extension of the tumor is noted on the mammograms, making it necessary to enlarge the tumor volume.

The active lengths and number of implant planes used are determined by the dosimetric system adopted. The Paris system (DUTRUIX et al. 1982) is often used in France. Two plane implants are routinely required, and the spacing between the sources and the planes must be chosen so that the sources are equidistant and arranged as the apices of equilateral triangles. An elementary basal dose rate may be determined for each equilateral triangle at the intersection of perpendicular bisector lines projected from the sides of the triangles (formed by the intersection of the line sources with the central plane). The arithmetic mean of those elementary basal dose rates is termed the basal dose rate. The dose along the isodose surface which has been chosen as 85% the basal dose rate is termed the reference isodose. I use a modified Paris system requiring less rigid adherence to certain basic principles. This new system was presented in 1979 at the Journées Nationales de Radiologie in Paris. It is well adapted to the protocols developed in this treatment center for the conservative management of breast cancer (BAILLET et al. 1988; MAYLIN et al. 1988). It does not require that the triangular arrangement of the sources be absolutely equilateral. An optimal isodose is sought for by referring to the isodose surface which is 85% the minimum dose rate inside (MDI) the radioactive application (Fig. 1). The isodose chosen as the reference isodose must cover the target volume as defined above and must not result in hyperdose sleeves around the wires of greater than 1 cm. A hyperdose sleeve refers to the tissue immediately surrounding the radioactive line which is included in the isodose surface corresponding to twice the value of the reference isodose. When this modified system is used and an equilateral triangular source arrangement is obtained at implanta-

![Fig. 1. Dosimetry in the reference plan.](image-url)