Radioguided occult lesion localization (ROLL) in breast cancer: maximizing efficacy, minimizing mutilation

We began investigating radioguided sentinel node biopsy for breast cancer in 1995, following pioneering publications by Giuliano et al. [1] with blue dye mapping, and Krag et al. [2] with radioguided excision. We adopted serial lymphoscintigraphy to follow the movement of radiotracer from the injection site through the lymphatic ducts to the sentinel node [3].

Early problems included which tracer compound to use, and where exactly should it be injected? Lacking data, we initially hypothesized that injecting radiotracer directly into the tumor would provide the best chance of revealing the true sentinel node. To verify this, we injected patients either subdermally (over the tumor), peritumorally or intratumorally, and studied them by serial lymphoscintigraphy [4]. Intratumoral injection turned out to be poor at revealing the sentinel node as the tracer tended not to move. However, when tracer was injected subdermally or peritumorally the sentinel node was identified in 98–99% of cases, in part because of the abundance of lymphatic vessels at these sites.

Our ensuing success with the sentinel node technique generated considerable enthusiasm, which often manifested as coffee-room banter. In one exchange, a surgeon challenged a nuclear medicine physician to solve (with his “high-tech methods”) the problem of the preoperative localization of occult breast lesions. At that time nonpalpable breast lesions were a cause of concern. They were being found with increasing frequency (as microcalcifications, opacities or parenchymal distortions), but the methods used to locate them were not particularly reliable or precise, and in some cases the patient had to undergo a second operation. The immediate and not entirely serious rejoinder to the challenge was, “Simple! Inject a drop of radioactive material into the centre of the lesion and use the gamma probe to locate it and remove it, as you do with the sentinel node.” The suggestion was taken seriously and within a few days a study protocol had been drawn up in collaboration with the Radiology Unit. It was decided to use large-size colloid particles (such as those used in lung scintigraphy) to be sure that the radiotracer would not move from the injection site. The first nonpalpable breast lesion was injected under stereotactic guidance in May 1996 and the lesion was removed surgically the following day. The gamma probe proved very effective in assisting intraoperative localization and removal, just as in sentinel node biopsy.

Thus was radioguided occult lesion localization (ROLL) born [5]. The original Italian term for the technique was *centratura radioisotopica* (CRI), which translated as radio-isotopic targeting (RIT). However RIT was already an established abbreviation for radioimmunotherapy, and the ROLL acronym emerged from a later brainstorming session.

Our next priority was to move rapidly to a clinical validation study and publish the results [6]. It did not occur to us that it might have been worthwhile patenting the name and the technique.

We have now used ROLL routinely for a number of years and apply it to an ever increasing number of patients. Its purpose is to ensure the complete removal of occult lesions, while keeping within tight limits the amount of healthy breast tissue removed, and its *sine qua non* is efficient interdisciplinary cooperation. The latter is part of the operating philosophy of our Institute. We are convinced that the best results in breast cancer treatment are obtained by tailoring the treatment to the needs of the individual, and this is facilitated by systematically involving all relevant personnel (surgeons, nuclear medicine physicians, oncologists, pathologists, radiologists, radiotherapists, etc.) in treatment definition and execution.

Following the mammographic or ultrasonic identification of a suspicious breast lesion, typically as a cluster of microcalcifications, opaque spot or parenchymal distortion, use of ROLL facilitates the diagnostic process, which continues as follows:

1. Precise preoperative localization of the lesion.
2. Complete removal of the lesion plus a sufficient margin of healthy tissue, with the lesion at the centre of the removed specimen.
3. Accurate intraoperative histological examination, to identify any early invasive component, particularly in the context of intraductal carcinoma.

Another aspect of the operating philosophy of our Institute can be encapsulated as *maximum treatment, minimum mutilation*. ROLL is a characteristic development of this attitude, as it minimizes the amount of healthy breast tissue removed, thereby maximizing patients’ acceptance of lesion removal, while improving its accuracy. Sentinel node biopsy was inspired by the same sentiment, as was the new technique of full-dose intraoperative radiotherapy with electrons (ELIOT) [7], now moving to the clinical trial phase, whose aim is to achieve the same efficacy as conventional radiotherapy while reducing the radiation dose to healthy breast tissue.

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