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Radioguided occult lesion localization plus sentinel node biopsy (SNOLL) versus wire-guided localization plus sentinel node detection: A case control study of 129 unifocal pure invasive non-palpable breast cancers

P.L. Giacalone [a,*], A. Bourdon [b], P.D. Trinh [a], P. Taourel [c], G. Rathat [a], M. Sainmont [b], H. Perocchia [d], M. Rossi [b], C. Rouleau [d]

[a] *Oncology Unit, Department of Obstetrics and Gynecology, Hôpital Arnaud de Villeneuve, 371 rue du Doyen Gaston Giraud, 34295 Montpellier Cedex 5, France*
[b] *Department of Nuclear Medicine, Hôpital Arnaud de Villeneuve, 371 rue du Doyen Gaston Giraud, 34295 Montpellier Cedex 5, France*
[c] *Senology Department, Hôpital Arnaud de Villeneuve, 371 rue du Doyen Gaston Giraud, 34295 Montpellier Cedex 5, France*
[d] *Department of Pathology, Hôpital Lapeyronie, 371 rue du Doyen Gaston Giraud, 34295 Montpellier Cedex 5, France*

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Abstract

Aims: We compared histological patterns after lumpectomy for non-palpable breast cancers preoperatively localized by radioguided occult lesion localization plus sentinel node localization (SNOLL) versus wire-guided localization.
Methods: To ensure a homogeneously treated cohort and rigorous comparisons, only patients with invasive cancer and measurable opacity by imaging were included. Exclusion criteria were one or more parameters that could interfere with localization and/or the surgical procedure. Forty-three SNOLL were compared with 86 WGL plus sentinel node (SN) localization. Cancer localization effectiveness was based on careful assessment of histological data from only the first resected glandular specimen, as any additional resection specimens were guided by intraoperative histological examination.
Results: Reexcisions to ensure free tissue margins were performed during the same procedure in 13.9% of SNOLL versus 31.3% of WGL; $p = 0.02$. Significantly more women in SNOLL (53.4%) also had free nearest margins of >9 mm after the first procedure compared with WGL (33.7%); $p = 0.03$. The median centricity ratio after the first procedure was better in SNOLL (2.8, range 1.3–14) than WGL (5, range 1–50); $p = 0.008$. The median number of SN detected by lymphoscintigraphy was the same in SNOLL and WGL (1, range 0–9, vs. 1, range 0–8). Intraoperative SN detection by blue dye and/or gamma probe was successful for 97.6% of SNOLL versus 93% of WGL.
Conclusion: In this study, SNOLL was effective and safe, and this procedure significantly improved the rate of negative margins in the first specimen and the rate of reexcision for positive margins compared with WGL.

Keywords: Non-palpable breast cancers; SNOLL; Radioguided surgery; Wire-guided localization; Lumpectomy; Sentinel node biopsy

Introduction

Approximately 25–35% of breast cancers are non-palpable at diagnosis.[1,2] Consequently, The main problem is obtaining accurate preoperative localization to facilitate complete excision with free margins while avoiding excessive removal of healthy tissue. Wire-guided localization (WGL) has long been the standard technique.[2,3]

Radioguided localization (RGL) of non-palpable tumors was first described by Luini et al. in 1998.[4] A liquid radioactive tracer (Tc-99) is injected into the tumor just prior to surgery under stereotactic or ultrasound guidance, and a handheld gamma probe guides intraoperative identification and surgical resection. This technique was termed "radioguided occult lesion localization" (ROLL). In 2001, Feggi et al.[5] proposed a single nanocolloidal tracer injected into the tumor for simultaneous performance of ROLL and sentinel node (SN) identification and, in 2007, this technique became known as SNOLL in a publication from the European Institute of Oncology.[6]

* Corresponding author. Tel.: +33 467 336 521; fax: +33 467 336 468.
E-mail address: pl.giacalone@cegetel.net (P.L. Giacalone).

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Many publications have reported improved positive margin rates, decreased reoperation rates and smaller volumes of surgical excision using SNOLL. Tumor centering with the handheld gamma probe under radioactive guidance helps the surgeon to remove the lesion with an adequate uniform margin of healthy tissue.[3,7] Yet, despite the preliminary encouraging results, the benefits of this technique are still under investigation.

The aim of our study was to assess the accuracy and effectiveness of the SNOLL procedure in comparison with our routine WGL technique plus SN detection. To do so as accurately as possible, we evaluated only pure invasive cancers with tumor size determined before surgery by precise radiological measurement.

Patients and methods

Since January 2006, 349 consecutive patients underwent lymphatic mapping and SN biopsy in the Department of Gynecological Surgery of Arnaud de Villeneuve Teaching Hospital, University of Montpellier, France. All presented with non-palpable breast cancer and were candidates for breast-conserving therapy. WGL was used until May 2009, but since June 2009 ROLL and SNOLL procedures have been used.

Study design

This retrospective analysis included women with histologically proven non-palpable invasive breast cancer and an indication for conservative surgical treatment with preoperative localization and SN biopsy. Patients with invasive cancer and measurable opacity by imaging (i.e., ultrasound, X-ray or MRI)] were included. To ensure a homogeneously treated cohort and rigorous comparison of the two localization techniques, patients were excluded from the study if they presented one or more parameters that could interfere with the surgical surgical margins after lumpectomy[8–10]: microcalcifications, multifocal disease, ductal carcinoma in situ (DCIS), or invasive cancers associated with extensive DCIS diagnosed during pre- or postoperative pathological examination (Fig. 1).

Technique of occult lesion localization

Both types of localization were performed preferentially under ultrasound guidance (Acuson S2000, Siemens) at 18 MHz, or mammography (Selenia, Hologic) with a stereotactic system (Lorad, Hologic) if the lesion was not sonographically visible.

WGL was performed by the radiologist on the day before surgery using a standard hook wire. Accurate wire localization was confirmed on additional mammographic images or with real-time ultrasound imaging. Sentinel nodes were detected after periareolar injection of radiocolloid. On the day before surgery, 80 MBq of a ^{99m}Tc-colloid radiopharmaceutical (Nanocis®, Cis-Bio International) was injected subdermally by the nuclear medicine expert into the periareolar site in the quadrant of the tumor (total volume: 0.2 ml).

The SNOLL procedure was also performed the day prior to surgery as follows: a single intratumoral radiotracer injection was used for both localization of non-palpable lesions and SN biopsy. Tumor localization was performed by the radiologist while radiotracer was injected by the nuclear medicine doctor. The injection consisted of 120 MBq of a ^{99m}Tc-colloid radiopharmaceutical (Nanocis®, Cis-Bio International) in a volume of 0.2 ml, followed by injection of 0.2 ml of sterile saline solution. The maximum volume injected never exceeded 0.5 ml.

Preoperative scintigraphy with a hybrid SPECT-CT dual-head gamma camera equipped with a low-energy, high-resolution collimator (Infinia Hawkeye 4, GE Healthcare, Chalfont St. Giles, UK) was performed in both groups at least 2 h after radiotracer injection. Static images (3 min) in anterior and lateral projections were obtained. In cases where SN localization proved difficult, SPECT/CT was performed as follows: parameters for SPECT: 3° per step, 20-s acquisition per step, zoom 1 and 128 × 128; parameters for low-dose CT scan: 140 kV, 2.5 mA, 2.6 revolutions per minute for gantry rotation speeds, 512 × 512 (pixel size: 1.47 mm), and 5-mm slice thicknesses. All acquisitions were reconstructed on a Xeleris workstation (GE Healthcare, Chalfont St. Giles, UK). Surgery was performed 18–24 h after radiotracer injection.

Surgical procedure

A standard conservative surgical procedure for breast cancer was initiated with the patient under general anesthesia. At least 5 min prior to incision, 1 ml of patent blue dye was injected periareolarly (Bleu Patente; Laboratoire Geuerbet, Aulnay-sous-Bois, France). The decision regarding the location of the lumpectomy incision depended on the patient's age, the degree of breast ptosis, the breast shape, the quadrant that was to be resected and the breast tissue density assessed radiologically using the Breast Imaging Reporting and Data System (BIRADS). The excision was performed with the aim of incorporating at least a 1-cm macroscopic ideal margin (IM) of normal tissue around the tumor bed. All resection specimens involved the full thickness of the breast tissue, from the subcutaneous layer to the pectoralis muscle fascia. For WGL patients, the wire was used intraoperatively to guide tissue dissection up to the point at which the hook ends were located. For SNOLL patients, a handheld gamma probe was used with a high threshold setting such that the probe produced a signal only when directly over the hotspot, showingthe center of the tumor.

In all cases, SN biopsy was attempted during the same procedure through a separate incision over the axillary region. The SN was identified with the same gamma probe