Wire- and Ultrasound-Guided Localization: A Novel Technique for Excision of Nonpalpable Breast Tumors

Breast Cancer: Basic and Clinical Research
Volume 14: 1–4

DOI: 10.1177/1178223420938068

Siddhant Khare[1], Tulika Singh[1,2], Irrinki Santosh[1], Ishita Laroiya[1] and Gurpreet Singh[1]

[1]Department of Surgery, Post Graduate Institute of Medical Education & Research (PGIMER), Chandigarh, Chandigarh, India. [2]Department of Radiodiagnosis, Post Graduate Institute of Medical Education & Research (PGIMER), Chandigarh, Chandigarh, India.

ABSTRACT

BACKGROUND: Excision of nonpalpable breast lesions requires intraoperative guidance. Wire-guided localization and intraoperative ultrasounds have been used successfully but suffer from some disadvantages. We describe a new modification of the standard technique using a combination of preoperative ultrasound in conjunction with standard wire-guided localization.

METHODS: Wire and ultrasound-guided localization (WUGL) technique was used for the excision of nonpalpable breast lesions.

RESULTS: Sixty-nine patients with nonpalpable breast lesions were subjected to excision using WUGL, out of whom 63 patients had a preoperative diagnosis of invasive/noninvasive breast cancer. Six patients had a preoperative diagnosis of benign lesions, out of which 3 patients were converted to invasive breast cancer on final pathology. Only 1 patient had positive margin.

CONCLUSIONS: WUGL is a technique that uses a combination of well-accepted and easily available techniques. It has given good results and has the potential for widespread acceptance in resource-constrained situations.

KEYWORDS: Nonpalpable breast lesions, ultrasound, wire-guided localization

RECEIVED: May 13, 2020. **ACCEPTED:** May 18, 2020.

TYPE: Original Article

FUNDING: The author(s) received no financial support for the research, authorship, and/or publication of this article.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

CORRESPONDING AUTHOR: Siddhant Khare, Department of Surgery, Post Graduate Institute of Medical Education & Research (PGIMER), Chandigarh, Chandigarh 160012, India. Email: khare.siddhant@gmail.com

Introduction

Nonpalpable lesions of the breast present a dilemma to the surgeon. Intraoperative guidance is required for excision. The challenge lies in excising the lesion with negative margins while sparing as much normal tissue as possible. Wire-guided localization (WGL) is the oldest and most widely used method for excision of nonpalpable lesions. Although the process has evolved over a period of time, it is faced with many difficulties.[1] The localizing wire is usually placed under ultrasound guidance but may require stereotactic localization sometimes. This is usually done in the radiology suite and the wire fixed in a way to avoid migration/displacement during shifting of the patient to the operating suite. The entire procedure can be painful and demanding on the patient. Pneumothorax can be caused rarely during the procedure. The site of entry of the wire may interfere in the placement of the incision and removal of the lesion. Scheduling of the patient involves a close collaboration between the radiologist and the surgeon.[2,3]

As a result, alternative methods of intraoperative guidance have been developed, the commonest being the use of radioisotope (radioguided occult lesion localization—ROLL and radioactive seed localization—RSL), and intraoperative ultrasound (IOUS).[2,4,5] Although these techniques appear to be as effective as WGL, they require the acquisition of new equipment and new skills by the surgeons. A combination of techniques may be useful in overcoming problems associated with individual techniques. Standard WGL with ultrasound-guided localization of the wire tip has been described with good results.[6,7] Tattooing of the lesion with charcoal under ultrasound guidance as a visual aid to WGL has also been used.[8]

We describe an innovative technique combining WGL and ultrasound guidance and our initial experience using this method in patients with nonpalpable breast lesions.

Methods

After institutional review board approval, a retrospective review of female patients with nonpalpable breast lesions excised by a new modification of wire and ultrasound-guided localization (WUGL) was performed. Consecutive patients with nonpalpable lesions of the breast were operated using this technique from July 1, 2013 to December 31, 2018 in the Department of Surgery, PGIMER, Chandigarh, a tertiary health care center in North India. This included cases with biopsy-proven screen-detected lesions, both benign and malignant. This also included biopsy-proven cases of breast cancer which became nonpalpable after primary systemic chemotherapy. Patients receiving primary systemic therapy had ultrasound visible markers placed in the center of the tumor to aid subsequent localization by ultrasound. None of the patients had any contraindication to breast-conserving surgery (BCS).

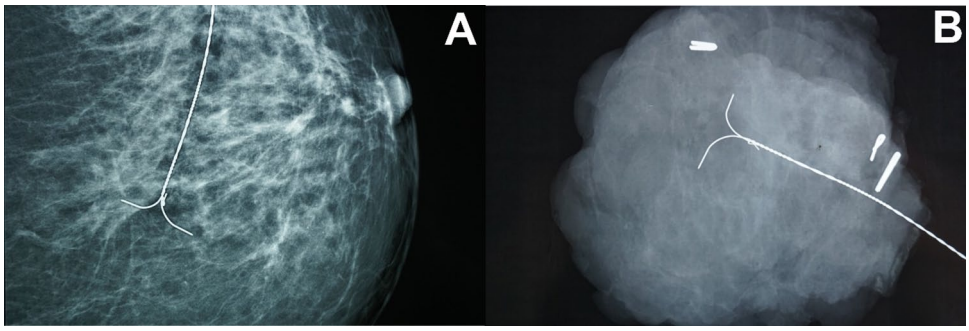

Figure 1. Preexcision and postexcision mammogram: (A) post-wire-guided localization mammogram showing wire tip beyond the breast marker, (B) post-excision specimen radiograph confirming the excision of the desired area. The marker is in the center of the excised specimen, well away from the resection margins.

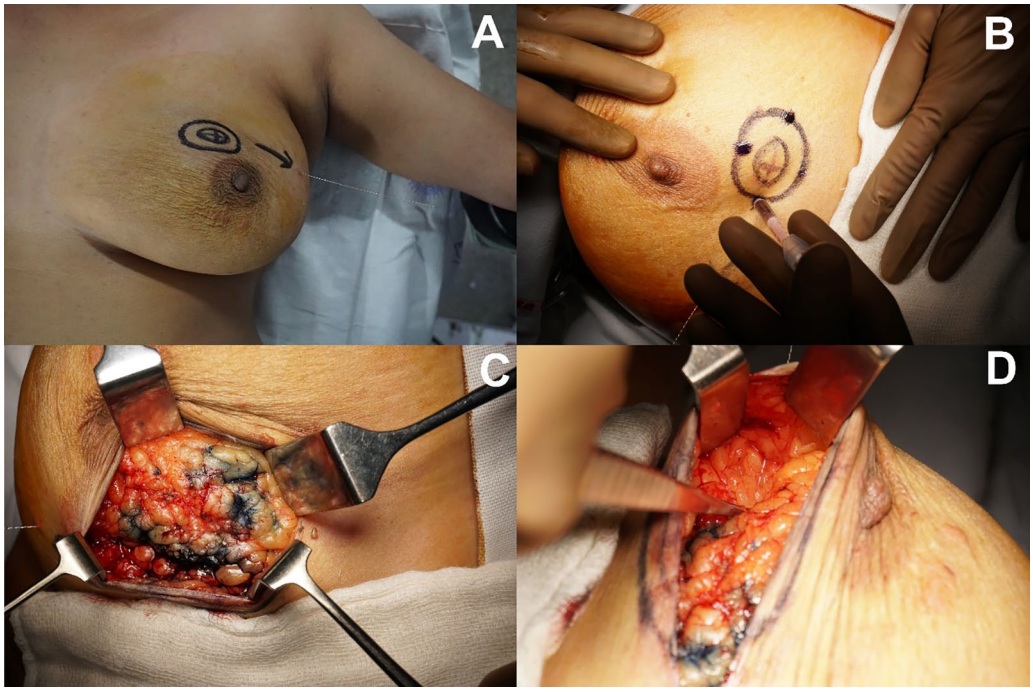

Figure 2. Operative technique: (A) preoperative marking of tumor. The wire is inserted lateral to the tumor (arrow). (B) Injection of methylene blue in progress. (C) Skin flaps elevated. Methylene blue marks out the area to be excised. (D) Wide dissection of flaps allows the entry point of the wire to be brought into view.

Technique

In the ultrasound suite

The patient is positioned supine and the ipsilateral arm abducted to 90° (identical to the position of the patient on the operating table). The lesion is localized by ultrasound (ACUSON 2000, Siemens) with a high resolution 5-12 MHz linear array transducer. The transducer is placed directly over the lesion and the guide wire is inserted from the side, approximately 4 cm away from the transducer to go parallel to the chest wall. The tip of the hook wire localization needle is passed through the mass and the hooks are deployed across the mass lesion (Figure 1A). A double J hook wire is used (DuaLok, Bard). The borders of the lesion are then delineated under ultrasound guidance and marked circumferentially on the skin using an indelible marker (inner ring). Another circumferential marking is made 1 cm away from the tumor border (outer ring) under ultrasound guidance (Figure 2A). The hook wire is fixed securely using adhesive tape and the patient transferred to the operating suite.

In the operating suite

Under general anesthesia, the patient is positioned supine on the operating table with the ipsilateral arm abducted to 90°. The tapes securing the hook wire are removed, and the patient painted and draped for excision. Sterile methylene blue (1 mL) is loaded in a tuberculin syringe and injected at 8 points along the outer ring into the breast tissue (Figure 2B). This is done to guide the extent surgical excision after the skin flaps are raised (Figure 2C). The incision is made over the tumor or away from it as planned for the surgical procedure. Skin flaps are elevated,

Table 1. Demographic and tumor characteristics of the patients.

	NO PST (N=23)	PST (N=46)	TOTAL (N=69)
Age (years)	50.4 ± 10.9	42.3 ± 9.6	45.3 ± 9.8
Laterality—Right	11 (47.8%)	20 (43.4%)	31 (44.9%)
Location			
Outer quadrants	13 (56.5%)	21 (45.7%)	34 (49.3%)
Inner quadrants	4 (17.4%)	14 (30.4%)	18 (26.1%)
Preoperative biopsy proven malignancy	17 (73.9%)	46 (100%)	63 (91.3%)
Postoperative biopsy proven malignancy	20 (87%)	46 (100%)	66 (95.7%)
Specimen weight (g) (median [range])	80.0 (33-150)	57 (20-100)	60.0 (33-150)
Tumor size on pathology (mm) (median [range])	15(5-50)	10.0 (0-54.0)	12.0 (0-54.0)
Positive margin	0 (0%)	1 (2.2%)	1 (1.5%)
*Closest margin (mm)—(median [range])	10 (0.5-10.0)	5 (0-10)	5 (1-10)

PST: primary systemic therapy.
*Patient with positive margins excluded.

as for a mastectomy, well away from the tumor margins as outlined. The flaps are elevated to bring the hook wire in the operative field (Figure 2D). The hook wire is divided at its point of entry and dissected to within the margin of excision as marked by the methylene blue injected earlier. A full thickness excision (from subcutaneous plane to the pectoral fascia) of the breast carrying the lesion is carried out. The methylene blue injected earlier guides the excision and ensures removal of the entire lesion with a 1 cm margin, as per the current recommendations for breast cancer.[9] Marker clips are placed at the margins. The breast tissue on both sides of the excision is then mobilized in a plane above the pectoralis major and the tissue advanced to close the defect. The skin is closed with a subcuticular suture. A specimen radiograph is done to confirm the removal of the marker (Figure 1B).

Results

A total of 69 consecutive patients with nonpalpable lesions of the breast were operated using this technique from July 1, 2013, to December 31, 2018.

Sixty-three patients had a diagnosis of malignancy (invasive duct carcinoma—57; tubular carcinoma—1; DCIS—5). Of the patients with invasive breast cancer, 42% received primary systemic chemotherapy with the aim of doing BCS. Out of all the patients operated, 46 (66.7%) were in the primary systemic therapy (PST) group (the group that had received primary systemic therapy to downsize the tumor), whereas 23 (33.3%) did not receive any PST. Out of the 23 patients in no PST group, 6 patients had a diagnosis of benign lesion (intraductal papilloma—4, atypical papilloma—1 and benign phyllodes tumor—1). However, since these were suspicious lesions on biopsy or had a radio-pathological discordance, the approach in such patients was to excise the lesion in the same way as one would excise a malignant lesion. This prevents a redo surgery in case the final biopsy unexpectedly comes as malignant. After excision, the final diagnosis was intracystic papillary carcinoma in 1 patient and atypical papilloma in 1 patient who had intraductal papilloma in their preoperative biopsy, and DCIS in 1 patient who had atypical papilloma in preoperative biopsy. All the other patients had concordance in the preoperative and postoperative biopsies.

The demographic and tumor characteristics are shown in Table 1.

Only 1 patient (1.5%) had tumor margins involved with DCIS. She underwent re-excision, but negative margins could not be achieved and she subsequently underwent total mastectomy. The mastectomy specimen showed presence of further DCIS.

Discussion

Breast cancer has become the number one cancer in women in urban India with an age-adjusted breast cancer rate of 37.5 per 100,000 in Chandigarh.[10] There is at present no national health policy on mammographic screening in India and as such, the number of screen-detected cancers is negligible. In contrast, locally advanced breast cancers still constitute more than 50% of the breast cancers seen in India.[11] In this scenario, most of the nonpalpable tumors seen by us are after primary systemic chemotherapy. Over a period of almost 4 years, we had only 17 patients with breast cancer who presented with a nonpalpable mass.

We follow the principles of level 1 oncoplasty for performing BCS. Wide biplanar mobilization, full thickness excision of the breast bearing the tumor with clear margins, closure of the defect by advancement of the local tissues and nipple areola complex mobilization are all essential components of this approach.[12]

We believe that our technique offers several distinct advantages and overcomes most of the deficiencies of WGL. The placement of the wire parallel to the chest wall minimized the risk of accidental pneumothorax. It allows the entry point of the hook wire to be well away from the tumor and allows the surgeon to place a well-planned incision independent of the wire hampering the planning. The marking performed by ultrasound allows us to put the tumor in the center of our excision. This allows complete excision of the tumor with negative margins. Wide mobilization of flaps brings the wire into the field of dissection even when it has been inserted well away from the tumor. The wire can then be divided and dissected till it comes within the area of excision.

The extent of excision (tumor with 1 cm margin) is marked on the skin by ultrasound guidance. The injection of methylene blue transfers this marking onto the breast tissue and guides the excision after the skin flaps have been elevated, thus minimizing the chances of having positive margins circumferentially. Full-thickness excision of the breast ensures that the anterior and posterior margins are not compromised.

The use of intraoperative ultrasound to guide tumor excision is associated with lower rates of positive margins and smaller volumes of tissue excised.[13-15] This requires the presence of the ultrasound equipment and the radiologist in the operating suite. The alternative is the acquisition of new equipment and skills by the surgeon. Our technique achieves ultrasound-guided excision of the tumor without having to face either alternative. The marking of the tumor and a 1 cm margin around it on the skin is done by the radiologist in the ultrasound suite. This marking helps in planning the incision and excision. Tumors in the outer quadrants can be dealt with by Lateral Oncoplastic Breast Surgery, a technique which we have described.[16] Tumors close to the inframammary crease can be excised through an incision in the inframammary crease. The surface marking is of no use once the skin flaps are raised. The injection of methylene blue transfers this marking on the breast tissue, effectively outlining the circumferential margin of the breast tissue to be excised. Oncoplasty techniques involve a complete antero-posterior excision of the breast tissue carrying the tumor. The circumferential marking thus ensures that all margins are negative.

The standard definition of negative margins is no tumor on ink on microscopy.[17] Clear margins obtained with WGL are reported to be 70.8% to 87.4%.[18] We were able to achieve negative margins in 98.5% of our patients.

The learning curve is small since both the radiologists and the surgeons are already familiar with the use of WGL. The early results show this technique to be at par if not better when compared to the use of IOUS. This technique is more ergonomically suited and is extremely beneficial in resource limited and time constrained centers.

Conclusion

The present technique is a combined use of WUGL for excision of nonpalpable breast tumors. The technique uses methods that are familiar to the surgeon and does not involve the acquisition of new equipment or skills. Margin positivity is at very acceptable rates. It provides an effective alternative to surgeons working in resource-constrained situations.

Author Contributions

SK contributed to data collection, data analysis, and review of manuscript. T S, IS, and I L, contributed to review of manuscript. G S contributed to drafting of manuscript.

ORCID iD

Siddhant Khare https://orcid.org/0000-0001-9142-1115

REFERENCES

1. Hall FM, Kopans DB, Sadowsky NL, Homer MJ. Development of wire localization for occult breast lesions: Boston remembrances. *Radiology*. 2013;268:622-627.
2. Sajid MS, Parampalli U, Haider Z, Bonomi R. Comparison of radio-guided occult lesion localization (ROLL) and wire localization for non-palpable breast cancers: a meta-analysis. *J Surg Oncol*. 2012;105:852-858.
3. Demiral G, Senol M, Bayraktar B, Ozturk H, Celik Y, Bolu S. Diagnostic value of hook wire localization technique for non-palpable breast lesions. *J Clin Med*. 2016;8:389-395.
4. Volders JH, Haloua MH, Krekel NM, Meijer S, van den Tol PM. Current status of ultrasound guided surgery in the treatment of breast cancer. *World J Clin Oncol*. 2016;7:44-53.
5. Chan BK, Wiseberg-Firtell JA, Jois RHS, Jensen K, Audisio RA. Localization techniques for guided surgical excision of non-palpable breast lesions. *Cochrane Database Syst Rev*. 2015;12:CD009206.
6. Benson SR, Harrison NJ, Lengyel J, Deacon C, Isgar B. Combined image guidance excision of non-palpable breast lesions. *Breast*. 2004;13:110-114.
7. Kolpattil S, Crotch-Harvey M. Improved accuracy of wire-guided breast surgery with supplementary ultrasound. *Eur J Radiol*. 2006;60:414-417.
8. Ko K, Han BK, Jang KM, et al. The value of ultrasound-guided tattooing localization of non-palpable breast lesions. *Korean J Radiol*. 2007;8:295-301.
9. Fischer J. *Fischer's Mastery of Surgery*. 7th ed. Philadelphia, PA: Wolters Kluwer; 2018.
10. Thakur JS, Budukh A, Kapoor R, et al. Urban-rural differences in cancer incidence and pattern in Punjab and Chandigarh: findings from four new population-based cancer registries in North India. *Int J Non-Commun Dis*. 2017;2:49-55.
11. Shankar A, Roy S, Rath GK, et al. Change in trend in various clinico-pathological factors and treatment profile of breast cancer patients: a tertiary cancer centre experience. *Asian Pac J Cancer Prev*. 2016;17:3897-3901.
12. Clough KB, Kaufman GJ, Nos C, Buccimazza I, Sarfati IM. Improving breast cancer surgery: a classification and quadrant per quadrant atlas for oncoplastic surgery. *Ann Surg Oncol*. 2010;17:1375-1391.
13. Pan H, Wu N, Ding H, et al. Intraoperative ultrasound guidance is associated with clear lumpectomy margins for breast cancer: a systematic review and meta-analysis. *PLoS ONE*. 2013;8:e74028.
14. Ahmed M, Douek M. Intra-operative ultrasound versus wire-guided localization in the surgical management of non-palpable breast cancers: systematic review and meta-analysis. *Breast Cancer Res Treat*. 2013;140:435-446.
15. Slijkhuis WA, Noorda EM, van der Zaag-Loonen H, et al. Ultrasound-guided breast-conserving surgery for early-stage palpable and nonpalpable invasive breast cancer: decreased excision volume at unchanged tumor-free resection margin. *Breast Cancer Res Treat*. 2016;158:535-541.
16. Singh G, Kohli PS, Bagaria D. Lateral oncoplastic breast surgery (LOBS): a new surgical technique and short term results. *Am J Surg*. 2018;216:1166-1170.
17. Moran MS, Schnitt SJ, Giuliano AE, et al. Society of Surgical Oncology/American Society for Radiation Oncology consensus guideline on margins for breast-conserving surgery with whole-breast irradiation in stages I and II invasive breast cancer. *Int J Radiat Oncol Biol Phys*. 2014;88:553-564.
18. Hayes MK. Update on preoperative breast localization. *Radiol Clin N Am*. 2017;55:591-603.