Sonographic Hematoma-Guided vs Wire-Localized Lumpectomy for Breast Cancer

A Comparison of Margins and Volume of Resection

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**Hypothesis:** Sonographic hematoma-guided (SHG) lumpectomy achieves better margin clearance with a smaller volume of resection compared with wire-localized (WL) lumpectomy.

**Design:** Retrospective study.

**Setting:** University Comprehensive Breast Center.

**Patients:** Consecutive patients treated over 6 months at the breast center with stereotactic biopsy–proven cancers that were not visualized on ultrasonography. The SHG and WL techniques were compared.

**Main Outcome Measures:** The matching variables were age, mammographic abnormality, tumor size and type, and lymph node status. The outcome variables were the closest margin of resection, volume of resection, resection index (resection volume divided by tumor volume), and rate of margin revision.

**Results:** Twenty-nine patients had SHG lumpectomy and 34 had WL lumpectomy. The SHG and WL groups were similar in age, mammographic abnormality, tumor size and type, and lymph node status. The median (interquartile range) closest margin was 5.0 (5-8) mm in the SHG group vs 3.5 (1-7) mm in the WL group ($P = .01$). The median (interquartile range) resection volume was 85.0 (60-128) cm$^3$ in the SHG group vs 143.4 (54-229) cm$^3$ in the WL group ($P = .048$). The median (interquartile range) resection index was 77.1 (51-220) in the SHG group vs 315.9 (89-3025) in the WL group ($P = .003$). The margin was revised in 1 (3.4%) of the patients who underwent SHG lumpectomy vs 5 (14.7%) of the patients who underwent WL lumpectomy ($P = .20$).

**Conclusions:** Sonographic hematoma-guided lumpectomy is superior to WL lumpectomy in obtaining adequate margins while minimizing the volume of resection.

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**SCREENING MAMMOGRAPHY** and advanced imaging techniques have increased the rate of detection of nonpalpable cancers in the breast that are amenable to conservation therapy. The goal of breast conservation in the treatment of cancer is to achieve an oncologic resection with adequate margins while maintaining cosmesis. This poses significant challenges in the case of nonpalpable lesions and requires image-guided localization to effect resection. The current standard technique of operative guidance is preoperative wire localization (WL), which is associated with several limitations. First, the ideal entry site for the radiologist is often distant from the ideal incision site for the surgeon. Second, surgeons depend on 2-dimensional postlocalization radiographs to estimate the 3-dimensional position of the lesion in relation to the wire, which results in positive margins in up to 62% of patients.$^{1-3}$ Third, up to 10% of patients have vasovagal episodes during wire placement.$^{4}$ Fourth, complications such as wire transection$^5$ and displacement have been described.$^6,7$ Last but not least are the logistic issues that arise between surgical and radiological scheduling systems.

These disadvantages have led to the quest for better alternatives to WL. Intraoperative ultrasonography has proven to be superior to WL in all of the aforementioned aspects for lesions that are visible on ultrasonography.$^9-12$ Unfortunately, 60% to 70% of mammographic lesions are not visible on ultrasonography and the onus of acceptable oncoplastic resection continues to fall on WL.

Smith et al$^{13}$ described the use of the sonographically visible hematoma (induced iatrogenically by stereotactic biopsy) as a localizing device with intraoperative ultrasonography. Postbiopsy
Table 1. Comparison of Baseline Characteristics Between Wire-Localized and Sonographic Hematoma-Guided Lumpectomy Groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patients Who Underwent WL Lumpectomy (n = 34)</th>
<th>Patients Who Underwent SHG Lumpectomy (n = 29)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (interquartile range), y</td>
<td>56.5 (50-67)</td>
<td>58.0 (44-65)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Mammographic abnormality, No. (%)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Density</td>
<td>22 (64.7)</td>
<td>17 (58.6)</td>
<td></td>
</tr>
<tr>
<td>Microcalcifications</td>
<td>12 (35.2)</td>
<td>12 (41.4)</td>
<td>.80</td>
</tr>
<tr>
<td>Tumor characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size, median (interquartile range), cm</td>
<td>0.9 (0.5-1.4)</td>
<td>1.2 (1.1-1.5)</td>
<td>.08</td>
</tr>
<tr>
<td>Volume, median (interquartile range), cm³</td>
<td>0.3 (0.05-1.5)</td>
<td>1.1 (0.7-2.2)</td>
<td>.07</td>
</tr>
<tr>
<td>Type, No. (%)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ductal carcinoma in situ</td>
<td>14 (41.2)</td>
<td>13 (44.8)</td>
<td>.90</td>
</tr>
<tr>
<td>Infiltrating ductal carcinoma</td>
<td>19 (55.9)</td>
<td>15 (51.7)</td>
<td></td>
</tr>
<tr>
<td>Infiltrating lobular carcinoma</td>
<td>1 (2.9)</td>
<td>1 (3.5)</td>
<td></td>
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<tr>
<td>Lymph node status, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>11 (32.4)</td>
<td>7 (24.1)</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>18 (52.9)</td>
<td>17 (58.6)</td>
<td>.56</td>
</tr>
<tr>
<td>Positive</td>
<td>2 (5.9)</td>
<td>4 (13.8)</td>
<td></td>
</tr>
<tr>
<td>Positive, micrometastasis</td>
<td>3 (8.8)</td>
<td>1 (3.5)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: NA, not applicable; SHG, sonographic hematoma-guided; WL, wire-localized.

Hematoma is a naturally occurring localizing device that is visible on ultrasonography without the need for another invasive procedure. We hypothesized that sonographic hematoma-guided (SHG) lumpectomy for breast cancer effects better resection margins by providing all dimensions of the lesion and results in better cosmetic outcome by ensuring a lower volume of resection.

**METHODS**

**PATIENTS**

Sixty-three consecutive patients treated with breast conservation at the Comprehensive Breast Center between October 1, 2005, and March 31, 2006, for stereotactic biopsy–proven small unifocal cancers that were not visualized on ultrasonography were studied. Patients with extensive lesions requiring bracketing wires were excluded. UMass Memorial Health Center, Worcester, Mass, is a university-based practice that has a multispecialty-based Comprehensive Breast Center with 3 breast surgeons. Two surgeons (R.M.Q. and Anne Larkin, MD) use WL for lumpectomies and 1 surgeon (R.L.R.) performs SHG resection for breast cancer. The rest of the management protocols are similar across the entire practice.

**SHG EXCISION TECHNIQUE**

This technique involves using the iatrogenic hematoma as a localization device that is created during stereotactic biopsy of the mammographic lesion. Patients are evaluated in the office within 7 to 10 days of biopsy, where the sonographic visibility of the hematoma is documented by the surgeon with a focused ultrasonographic scan of the breast using triangulation based on the mammographic results. Surgery is performed ideally within 4 to 5 weeks of biopsy, lest the hematoma resolves. An intraoperative ultrasonographic scan of the documented area is performed by the surgeon, and skin markings are made at the site of the hematoma as well as at a 1-cm margin from the edge to affect ultrasonography-guided excision. Specimen ultrasonography is performed to document the presence of the hematoma with adequate margins. Suspected close margins can be revised as additional shaved margins during the same surgery. The specimen is oriented and submitted for pathological analysis.

**DATA COLLECTION**

Data were collected from the medical records regarding patient age, mammographic abnormality, tumor size and type, and lymph node status for matching between the 2 groups. The closest margin, the volume of resection, the need for reexcision, and the cosmetic outcome score by the patient using a visual analog scale of 0 to 10 were recorded as outcome variables.

**STATISTICAL ANALYSIS**

Microsoft Excel software (Microsoft Corp, Redmond, Wash) was used to record the data. The differences in age, mammographic abnormality, tumor type, and tumor size were computed for matching between the WL and SHG groups. The tumor volume and the volume of resection were calculated from the 3 dimensions of the tumor and the specimen described in all of the reports of the pathological analysis; the resection index was computed as a ratio of resection volume and tumor volume such that the lower the index is, the better the cosmetic resection is. SigmaStat software version 2.0 (SPSS, Inc, Chicago, Ill) was used for statistical significance.

Sixty-three patients were treated for stereotactically diagnosed nonpalpable breast cancer that was not visible on ultrasonography during the study period. Thirty-four patients (54.0%) underwent WL lumpectomy and 29 (46.0%) were subjected to SHG resection. The 2 groups were similar in age, mammographic abnormality, and tumor characteristics (Table 1). The tumor volume was larger in the SHG group with borderline statistical significance ($P = .07$). The comparison of outcome variables between the 2 groups is depicted in Table 2. The median (interquartile range) closest margin was 5.0 (5-8) mm in the SHG group vs 3.5 (1-7) mm in the WL group.
The volume of resection was significantly larger in the WL group (median, 143.4 cm³) despite the smaller volume of the tumor. The median (interquartile range) resection index was 77.1 (51-220) in the SHG group vs 315.9 (89-3025) in the WL group (P = .003). The median (interquartile range) cosmetic outcome score was 6 (5-8) for the patients in WL group vs 9 (7-9) for the patients in the SHG group (P = .03). Only 1 patient (3.4%) needed margin revision in the SHG group as compared with 5 patients (14.7%) in the WL group who needed margin revision; however, this difference was not statistically significant (P = .20).

**COMMENT**

The ideal localization procedure for nonpalpable breast cancers would provide precise identification of the site of the lesion with adequate intraoperative assessment of margins such that the rate of reexcision is limited and the cosmetic outcome is acceptable. In addition, it would be painless and convenient for patients and would not hamper the surgical scheduling. The current standard of WL falls short on these criteria1-5; hence, the pursuit to develop alternative methods continues. The SHG technique is an immense improvement over WL to meet the mentioned criteria.

First, the hematoma is a natural result of biopsy, thereby completely obviating the need for another localization procedure. This eliminates the patient’s inconvenience associated with an invasive procedure without anesthesia, pain, and vasovagal episodes. Second, the position of the hematoma within the breast is always at the site of the lesion compared with the wire, which is placed at an approximated close location. This issue is further complicated in situations where the original lesion is completely excised during the biopsy and the wire is placed using the clip as a guide. Clip migration occurs in about half of the cases,14,15 adding to the challenge of localization. These factors are probably responsible for the high rate of positive margins after WL lumpectomy. Our data show the positive margin rate in the WL group to be 15%, which is much lower than that reported in the literature.16 In this group, clip migration occurred in only 3 patients but was not associated with positive margins. Although in this study both techniques had comparable margin clearance, the volume of resection was significantly larger in the WL group, which in turn may have contributed to the lower cosmetic outcome score. It is established that cosmetic outcome worsens as the resection volume increases.17 Taylor et al18 found that the resection volume of 100 cm³ is associated with cosmetic compromise irrespective of breast size. Our data show that SHG lumpectomy achieved good margins with a much smaller volume of resection compared with WL (median resection volume, 85.0 cm³ vs 143.4 cm³, respectively). Third, sonographic assessment in the operating room provides appropriate assessment of all margins to plan excision, and specimen ultrasonography can guide immediately if a margin revision is indicated.11 In our study, 2 margins were revised intraoperatively based on specimen ultrasonography. Finally, from a logistic standpoint, SHG excision obviates the need for radiology scheduling; moreover, specimen ultrasonography is much faster than specimen radiography, thereby enhancing efficiency in the operating room. Admittedly, the SHG technique is not without problems. There is a learning curve involved in the use of ultrasonography technology by the surgeons. In addition, localization is not possible if the diagnosis is established by fine-needle aspiration and may be compromised if the biopsy is associated with significant hemorrhage causing a large hematoma or if multiple needle insertions are performed. However, it is becoming increasingly clear that ultrasonography has become an indispensable tool for the breast surgeon in the office and the operating room setting. Several studies have shown the accuracy and convenience of surgeon-based breast ultrasonography19; our study demonstrates the effect of surgeon-performed intraoperative ultrasonography on the quality of breast cancer treatment in terms of adequate excision, patient friendliness, and cosmetic superiority with an added value of obviating the logistics of scheduling.

Other techniques for nonpalpable lesions involve radioisotope-guided excision with technetium Tc 99m-labeled colloid injection20,21 or radioactive seed placement.22 Although both of these approaches achieve better margins and superior cosmetic outcome, they have certain shortcomings. First, an extra procedure is required for localization after the diagnosis of cancer or a high-risk lesion is established. Scheduling issues between 2 departments are curtailed but still exist. Shine-through radioactivity can potentially compromise the sentinel node procedure in the case of technetium Tc 99m use, and the Compton effect has to be considered with the use of radioactivity. Last but not least, exposure to radioactivity is eventually going to limit the use of the procedure. With the current Occupational Safety and Health Administration guidelines23 and radioactivity exposure to the surgeons by the sentinel node biopsy procedure,24 surgeons can perform about 100 procedures per year; adding another procedure with radioactivity exposure is likely

**Table 2. Comparison of Main Outcome Measures Between Wire-Localized and Sonographic Hematoma-Guided Lumpectomy Groups**

<table>
<thead>
<tr>
<th>Main Outcome Measure</th>
<th>Patients Who Underwent WL Lumpectomy (n = 34)</th>
<th>Patients Who Underwent SHG Lumpectomy (n = 29)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closest margin, median (interquartile range), mm</td>
<td>3.5 (1-7)</td>
<td>5.0 (5-8)</td>
<td>.01</td>
</tr>
<tr>
<td>Resection volume, median (interquartile range), cm³</td>
<td>143.4 (54-229)</td>
<td>85.0 (60-128)</td>
<td>.048</td>
</tr>
<tr>
<td>Resection index, median (interquartile range)</td>
<td>315.9 (89-3025)</td>
<td>77.1 (51-220)</td>
<td>.003</td>
</tr>
<tr>
<td>Patients with margin revision, No. (%)</td>
<td>5 (14.7)</td>
<td>1 (3.4)</td>
<td>.20</td>
</tr>
</tbody>
</table>

Abbreviations: SHG, sonographic hematoma-guided; WL, wire-localized.

*The resection index is calculated as the resection volume divided by the tumor volume.*
REFERENCES


DISCUSSION

Richard Wait, MD, Springfield, Mass: Would there be any advantage to doing an ultrasound-guided needle localization so that you have something solid in there when you are cutting down vs just making some lines on the skin, which may move around afterwards?

Dr Layeequr Rahman: I think it is a learning curve and comfort zone issue. Many surgeons would put a wire in to be able to feel something within the breast, but I think the wire is a thin structure so localization is good, but margins, still I would rely on staying 1 cm based on my image because the wire will not give me an idea about that.

Scott Kurtzman, MD, Waterbury, Conn: Do you use any oncoplastic techniques, because the difference in volume resected may not be important if you know how to put things back together again. Ultrasound in the OR [operating room] may be out of the reach of many surgeons.

Dr Layeequr Rahman: When we have to, if the volume of resection has to be high, we do employ oncoplastic techniques, but I think the idea would be you do not want to resect the tissue if you do not have to for a margin’s sake but yes, of course, if you are bound to from an oncologic standpoint, then you would employ techniques to do that.

David W. Butsch, MD, Montpelier, Vt: I enjoyed the paper. I wonder, is it the same surgeon doing a wire localization as is doing the hematoma localization?

Dr Layeequr Rahman: No.

Dr Butsch: That might influence the results, do you think?

Dr Layeequr Rahman: Yes. That is why I looked at some matching variables, but yes, that bias we cannot remove.

Dr Butsch: Dr Quinlan was doing the wire ones, wasn’t he?

Dr Layeequr Rahman: Yes.

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