A Single-Institute Experience With Radioactive Seed Localization of Breast Lesions—A Retrospective Study

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Abstract

Objectives: To assess the benefits associated with radioactive seed localization (RSL) in comparison to conventional wire localization (WL) for nonpalpable breast lesions. Methods: Radioactive seed localization was initiated at our institution in July 2013. Retrospective review of all WL performed between June 2012 and July 2013 (2013) and all RSL performed during June 2015 and July 2016 (2016). Patients who received neoadjuvant therapy or did not undergo their planned surgeries and WL performed in 2016 were excluded. The following data were collected: final pathology, resection margins for malignant lesions, time to surgery, seed migration, and number of localized lumpectomies performed by each surgeon. Results: A total of 292 WL procedures (288 women) in 2013 and 194 RSL procedures (186 women) in 2016 were eligible for the study. All WLs were inserted the day of surgery. Mean time from RSL insertion to surgery was 4.0 ± 2.8 days (range: 1-17 days). There was no difference in specimen size for malignant lesions (6.8 ± 2.8 cm for WL and 6.9 ± 2.9 cm for RSL; P = .5). Specimen radiographs were obtained in 233 (80%) of 292 WL compared to 194 (100%) of 194 RSL (P < .001). For malignant lesions, positive margins were present in 34 (17.2%) of 198 with WL compared to 15 (10.3%) of 146 with RSL (P < .001). Close margins (≤1 mm) were present in 31 (15.6%) of 198 with WL compared to 1 (0.6%) of 146 with RSL (P < .001). The seed fell out of the specimen during surgery in 6 (3.1%) of 194. No seed loss was recorded. The surgeons (n = 4) who transitioned to RSL increased the number of surgeries per month from a mean of 4.4 ± 2.6 in 2013 to 6.9 ± 3.5 in 2016, equivalent to a 41% increase (P = .003). Conclusions: The use of RSL, as compared to conventional WL, resulted in a reduction in the number of pathologically involved surgical margins and was associated with an increased number of surgeries. Furthermore, RSL can be performed up to 14 days prior to surgery, which may improve scheduling flexibility in the radiology department.

Résumé

Objectifs: Évaluer les bénéfices associés à la localisation au grain radioactif (LGR) par rapport à la localisation au harpon (LH) conventionnelle des lésions mammaires non palpables. Méthodes: La technique de localisation au grain (ou bille) radioactif (LGR) a été lancée dans notre établissement en juillet 2013. Une analyse rétrospective de toutes les LH effectuées entre juin 2012 et juillet 2013 (2013) et de toutes les LGR effectuées entre juin 2015 et juillet 2016 (2016) a été réalisée. Les patients ayant bénéficié d’une thérapie néoadjuvante ou pour lesquels les chirurgies planifiées n’ont pas eu lieu et la LH a été effectuée en 2016 ont été exclus. Les données suivantes ont été collectées: pathologie finale, marges de résection pour les lésions malignes, délai avant chirurgie, migration du grain et nombre de lumpectomies localisées effectuées par chaque chirurgien. Résultats: Au total, 292 interventions de LH (288 femmes) en 2013 et 194 interventions de LGR (186 femmes) en 2016 étaient admissibles à l’étude. Toutes les LH ont été effectuées le jour de la chirurgie. Le délai moyen entre la réalisation de la LGR et la chirurgie était de 4.0 ± 2.8 jours (intervalle de 1-17 jours). La taille des échantillons ne présentait aucune différence (6.8 ± 2.8 cm pour les LH et 6.9 ± 2.9 cm pour les LGR; P = 0.5). Les radiographies des échantillons ont été obtenues pour 233 (80%) des 292 LH par rapport à 194 (100%) des 194 LGR (P < 0.001). Concernant les lésions malignes, des marges positives étaient présentes dans 34 (17.2%) des 198 LH par rapport à 15 (10.3%) des 146 LGR (P < 0.001). Des marges fermées (≤1 mm) étaient présentes dans 31 (15.6%) des 198 LH par rapport à 1 (0.6%) des 146 LGR (P < 0.001). Une chute peropératoire du grain de l’échantillon s’est produite pour 6 (3.1%) des 194 LGR. Aucune perte de grain n’a été enregistrée. Les chirurgiens (n = 4) ayant effectué la transition vers la LGR...
were reviewed. The following were recorded for each localization procedure: time from diagnosis to surgery, time from localization to surgery, resection margins, specimen size, seed loss, surgeon performing the resection, biopsy, and postoperative histology. Specimen radiographs were reviewed to assess for seed presence. Positive margins were defined as tumor at ink on the pathology specimen. Close margins were defined as less than or equal to 1 mm. Health Science Ethics Board of Western University approved the study, and informed consent from patient was waived.

The RSL was performed with seeds from Oncura Manufacturers (Buckinghamshire, UK, former unit of GE Healthcare) Model 6711 OncoSeed that was purchased loose and was sterilized using a cyclotron. The seeds were introduced as described by Goudreau et al.15

Statistical analysis was performed using SPSS, version 18.0 (SPSS, Inc, Chicago, Illinois). Normally distributed continuous variables were reported as means with standard deviations. The χ2 test was used to compare differences in proportions for categorical variables. The t-test was used to compare mean differences in normally distributed continuous variables between groups. A P value of <.05 was considered statistically significant.

Results

Time to Surgery

For malignant lesions, the mean time from diagnosis to surgery was 42.6 ± 18.8 days for WL patients and 39.0 ± 15.0 days for RSL patients (P = .06). All WLs were inserted the day of surgery. The mean time from RSL insertion to surgery was 4.0 ± 2.8 days (range: 1-17 days).

Specimen Radiograph

Specimen radiographs were obtained in 233 (80%) of 292 WL cases compared to 194 (100%) of 194 cases with RSL (P < .001).

Seed Loss

The seed fell out of the specimen during surgery in 6/194 (3.1%) cases. In one case, the seed was not harvested, as the patient was diagnosed with diffuse metastatic disease and her surgery was cancelled; she was excluded from the study. No seed loss was recorded.

Introduction

Breast cancers detected by screening mammography are quite often subclinical and surgeons rely on radiologists for preoperative localization. This is commonly accomplished with wires under either ultrasound or stereotactic guidance. Inherent drawbacks to this method include preoperative migration, inefficacy for superficial lesions, and patient discomfort. Another limitation to this method is the scheduling conflicts and inefficiencies as a result of necessitating insertion on the same day of a planned lumpectomy. Iodine-125 radioactive seed localization (RSL) is gaining popularity as a safe and reliable method of preoperative breast localization for non-palpable breast lesions.1-3 Recent studies point to its superiority over conventional wire localization (WL) with respect to accuracy of lesion localization and decreased need for re-excision4-9 and lower cost.10 Radioactive seed localization has also demonstrated improved patient satisfaction and comfort.2 However, recent reports have not found a significant difference between the 2 methods in terms of operative excision times,1,12 radiographical localization,11 margin status,12,13 and weight of surgical specimen.2,12,14 Since RSL can be inserted several days before surgery, we speculated that the potential scheduling flexibility could decrease the wait time for surgery, increase the number of surgeries per surgeon, and reduce specimen size. We present our experience comparing the last year we used exclusively WL, June 2012 to July (2013), to the first year, June 2015 to July (2016), when RSL became the standard method of localization by the majority of our surgeons.

Materials and Methods

This is a retrospective observational study at a single academic institution comparing all WL performed in 2013 to all RSL performed in 2016 (Figure 1). The electronic charts of all patients who received localization procedure in 2013 and 2016 were reviewed. Patients who received neoadjuvant therapy (n = 16) or did not undergo their planned surgeries (n = 1) as well as women who underwent WL in 2016 (n = 48) were excluded from the study analysis.

A total of 537 women underwent localization procedures (WL and RSL) in 2013 and 2016. A total of 292 WL (288 women) in 2013 and 194 RSL (186 women, 8 with bracketing technique) in 2016 were eligible for the study. Electronic patient records, pathology reports, and specimen radiographs were reviewed. The following were recorded for each localization procedure: time from diagnosis to surgery, time from localization to surgery, resection margins, specimen size, seed loss, surgeon performing the resection, biopsy, and postoperative histology. Specimen radiographs were reviewed to assess for seed presence. Positive margins were defined as tumor at ink on the pathology specimen. Close margins were defined as less than or equal to 1 mm. Health Science Ethics Board of Western University approved the study, and informed consent from patient was waived.

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For malignant lesions, the mean specimen size was $6.8 \pm 2.8$ cm for WL and $6.9 \pm 2.9$ cm for RSL ($P = .5$). For benign lesions, the mean specimen size was $4.6 \pm 1.7$ cm for WL and $5.4 \pm 2.7$ cm for RSL ($P = .03$).

Surgical Margins

Positive margins were present in 34 (17.2%) of 198 malignant lesions with WL and 15 (10.3%) of 146 malignant lesions with RSL ($P < .001$). Close margins ($\leq 1$ mm) were present in 31 (15.6%) of 198 with WL and 1 (0.7%) of 146 with RSL ($P < .001$).

Number of Surgeries

There were 6 surgeons in 2013 and 5 surgeons in 2016. Four surgeons who transitioned to RSL in 2016 demonstrated a mean increment in the number of surgeries per month from $4.4 \pm 2.6$ in 2013 to $6.9 \pm 3.5$ in 2016 ($P = .003$; 40.9% $\pm 6.9%$; Figure 2). The one surgeon who continued to use WL did not experience a similar increment (4.7 vs 4.5 per month).

Discussion

Our results concurs with previous reports demonstrating multifactorial superiority of RSL over conventional WL. While earlier studies and meta-analyses have suggested superior margin status with RSL, several recent studies have not found a significant difference. Our study identifies statistically significant fewer pathologically involved margins in the RSL group. Interestingly, Velazco et al found a trend toward positive margins as surgeons gained experience and became more comfortable with RSL. We did not observe this phenomenon as our surgeons had up to 3 years of experience with RSL prior to the period of data collection used in this study. Our center started the implantation of RSL in mid-2013. It took 2 years for this method to be adopted by most of the surgeons, expect one, who preferred to continue using WL. In 2013, 100% of women underwent WL when within 3 years; in 2016, only 25% underwent WL (Figure 1). It took 2 years to move from WL-only practice to RSL dominant practice mainly because of lack of familiarity with this technology.

This study did not look at any potential impact that intraoperative specimen radiograph and feedback from the radiologist could have had on final margin positivity rates, although it is not expected that this would differ between the WL and RSL cases. We did however observe a 25% increase in compliance with intraoperative specimen radiographs with RSL, presumably related to radiation safety concerns if the seed is not harvested. Rhee et al suggested improved assessment of the excision margins by both the surgeon and the radiologist due to the resolution and detail of specimen radiograph. An added benefit is the facilitated communication between radiologists and surgeons, providing a second “checkpoint” to ensure the lesion has adequately resected. To our knowledge, such observation regarding increased compliance of obtaining specimen radiographs is not yet reported.

A trend toward reduced specimen size has been reported previously with RSL, which other groups have attributed to point source guidance provided by the seed. We found no significant difference in specimen size between the WL and RSL groups. However, unlike prior studies, we have shown an associated difference in margin status despite similar specimen sizes between the WL and RSL groups.

There are no current Canadian regulations regarding the maximum number of days permitted between RSL and surgery. According to US regulations, RSL must performed at least 5 days prior to surgery. In our study, RSL was performed within a mean of $4 \pm 2.8$ days prior to surgery but ranged from 1 to 17 days; all seeds were harvested successfully. We...
presume that while performing WL is inherently limited to the morning of surgery and relies on the radiology department’s schedule, the ability to perform RSL days before the surgery allows scheduling the lumpectomy procedures early in the morning of surgery. This provides scheduling flexibility which in turn may increase the number of surgeries per day and is reflected by the mean number of procedures performed by the surgeons who transitioned completely to RSL, which had increased by 40.9% ± 6.9% in 2016 compared to 2013 (Figure 2). The slight reduction in total number of localized lumpectomies reported in 2016 compared to 2013 (294-280) likely attributed to the departure of one of the breast surgeons in 2016. We speculate that scheduling flexibility and the fact that no additional equipment or personnel required for RSL are the reasons why most of our surgeons had completely converted their localizations to RSL. Our data failed to show a statistically significantly (\(P = .06\)) shorter wait time from diagnosis to surgery in the RSL group compared to the WL group, in contrast to that was reported by Tran et al.\(^8\)

Limitations of our study include the retrospective nature of the analysis, and due to the nature of gradual transition from WL to RSL, nonconsecutive years of cases were analyzed. Although the time interval selected was according to the last year when we performed almost exclusively RSL and the last year when only WL was used, one might argue that a sampling bias impacted the results. Surgeon experience could also be a factor; however, we attempted to account for this by excluding transitional years between 2013 and 2015 of RSL in our analysis. Nonetheless, important and statistically significant differences between WL and RSL were identified which have clinical relevance to surgeons and radiologists involved in the management of nonpalpable breast lesions. Furthermore, we cannot comment on the potential impact of RSL on patient outcome in terms of need for revision or adjuvant therapy because the relevant data were not collected and deserve a separate future study.

Conclusions
Radioactive seed localization is superior to conventional WL. It is associated with a significant reduction in the number of pathologically involved surgical margins and increased number of localized lumpectomies. Furthermore, the ability to perform RSL up to 17 days prior to surgery may improve scheduling flexibility.

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.

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

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