

Symptomatic Axillary Seroma after Sentinel Lymph Node Biopsy: Incidence and Treatment

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ABSTRACT

Background. Postoperative seroma is a nuisance for patients and surgeons. Few studies investigate predisposing factors for axillary seroma after sentinel lymph node biopsy (SLNB). We sought to quantitate the risk of symptomatic seroma and characterize interventions.

Methods. We performed a retrospective review of 667 women undergoing breast-conserving surgery and SLNB at our institution between July 2007 and January 2015. Surgeons dissected sharply or with standard electrocautery. We correlated patient and tumor characteristics with symptomatic seroma using logistic regression models for univariate and multivariate predictors. All statistical tests were two sided, with $p < 0.05$ considered significant.

Results. Overall, 127 (19 %) of 667 women had axillary seromas and 98 (77 %) of 127 required further intervention for symptom relief. Seroma patients were similar in age, BMI, race, tumor type, T and N stage, and number of nodes removed as those without (all $p > 0.07$). Seroma rates did not vary according to surgeon, nodal mapping technique, or axillary closure technique ($p = 0.8789$). Multivariate analysis identified diabetes, smoking, and SSI as predictors of symptomatic axillary seroma with odds ratio of 1.97, 1.98, and 37.19 (all $p < 0.017$), respectively. Among the 98 of 127 patients with seroma, most (81 of 98, 83 %) resolved with a mean of 1.3 aspirations. The remainder resolved after axillary drain (13 of 98, 13 %) or additional surgery (4 of 98, 4 %).

Conclusions. Symptomatic axillary seroma occurs in 14 % patients undergoing breast-conserving surgery with

SLNB and is not influenced by tumor, nodal mapping, or surgeon characteristics. Management infrequently requires more than simple aspiration. Drain placement at initial surgery may be considered in smokers or patients with diabetes.

Complications after breast-conserving surgery (BCS) include cellulitis, abscess, and most commonly seroma formation.^{1,2} Seroma formation after breast surgery is a nuisance for surgeons and patients alike. The incidence of seroma after breast and axillary surgery is highly variable, ranging from 3 to 85 %.³ Despite their relatively common occurrence, the exact pathophysiology of how or why seromas form remains unclear.⁴ Some authors hypothesize this fluid is derived from an accumulation of afferent lymph.^{5,6} Others argue that this serous fluid represents an inflammatory process.⁷ Although the origin remains unclear, the high incidence and potential related complications of delayed wound healing, infection, and patient discomfort not to mention additional patient distress or phone calls are clear.⁸

Most existing studies evaluate the incidence of seroma after a larger dissection in the breast, axillae or both.^{3,7,9–12} It has been shown that the incidence of seroma is less when comparing BCS to mastectomy and SLNB to axillary lymph node dissection, respectively. However, these studies do not differentiate to whether the seroma was in the axilla or the breast; nor do they address whether these seromas were symptomatic.^{3,12} Some studies have evaluated closure of the dead space, placement of drains, and alternative cautery devices (bipolar, harmonic scalpel) as adjunctive methods to prevent seroma formation with varying rates of success.^{8,13–17} While seromas after BCS are expected, they usually reabsorb when small and can be minimized by oncoplastic techniques.¹⁸ Fewer data are

available regarding the rates of axillary seroma after sentinel lymph node biopsy (SLNB), patient symptoms and if intervention is needed for resolution. Therefore, we sought to identify clinical and pathologic predictors for axillary seroma after SLNB, evaluate frequency of symptomatic axillary seroma, and quantify interventions needed for resolution.

METHODS

After receipt of institutional review board approval we retrospectively reviewed the charts of 1002 women undergoing unilateral BCS and SLNB at our institution between July 2007 and January 2015. We excluded 335 patients who had prior axillary surgery, converted to axillary node dissection (defined as the intentional removal of levels I/II \pm level III axillary nodes), or those ultimately converting to mastectomy due to positive margins leaving a study cohort of 667 women. Technetium sulfur colloid was used routinely for sentinel node mapping while blue dye was used at the surgeon's discretion. SLNB was defined as the removal of all hot, blue, and palpable lymph nodes. Axillary drains were never placed at the time of initial surgery. One dose of preoperative antibiotics was given just before incision per institutional protocol and all patients were sent home without postoperative antibiotics. Three surgeons performed all surgeries in the cohort but varied in their technique used. Two surgeons (B and C) used blue dye selectively in addition to technetium sulfur colloid for mapping, performed axillary surgery with electrocautery, rarely used clips, and never closed the deep axillary spaces after SLNB. The third surgeon (A) used blue dye and technetium routinely, performed axillary surgery with a combination of sharp and blunt dissection as opposed to electrocautery, judiciously used ties and clips, and always closed the deep axillary space with 1–2 deep interrupted Vicryl sutures. Advanced electrocautery devices like the Harmonic Scalpel, Ligasure, or bipolar cautery were not used by any of the surgeons. Postoperatively, all patients are instructed to use their arms as normal without lifting or activity restrictions immediately after surgery. All patients were seen back in the office for a postoperative visit between 7 and 21 days for evaluation then thereafter as needed.

Recognizing that most patients develop some fluid in the axillary nodal basin, we considered axillary seromas to be symptomatic if the patient complained about its presence visually, noted it was markedly enlarged, infected, or painful. Although in general we did not have a standardized protocol prioritizing interventions, but all patients were cared for by the same Physician Assistant postoperatively. Interventions were discussed on an individual basis

with affected patients and our preference is for aspiration as the first line therapy. If initial aspiration was needed, patients were told to call after aspiration and return if the fluid reaccumulated and became symptomatic again. Return visit was not otherwise mandated. When needed, all aspirations were performed in the office by the breast surgeon or physician assistant with selective use of ultrasound guidance. We sought drain placement when the patient had persistent symptomatic seroma after two office aspirations or in select settings of patient preference. When drain placement was deemed necessary, these were always placed by interventional radiology under ultrasound guidance.

We gathered clinical, demographic, and pathologic data on all patients in addition to data on interventions including number of aspirations, drain placement, length of time drain was present, need for additional surgery, and infections. As the analysis was performed retrospectively, no data on fluid volume that was aspirated or drained was recorded.

Descriptive statistics for categorical variables are reported as frequency and percentage while continuous variables are reported as mean (standard deviation) and median (range). Categorical variables were compared between patients with and without seroma using Chi-squared test or Fisher's exact test and continuous variables were compared by a two-sample *t* test or the Wilcoxon rank sum test where appropriate. Logistic regression models were used to find the univariate and multivariate predictors of seroma after breast surgery. The multivariable model included variables with $p < 0.1$ in univariate analysis selection. All statistical tests were two sided, with the alpha level set at 0.05 for statistical significance.

RESULTS

Overall, 127 (19 %) of 667 of women had clinically detected axillary seromas. Patients having seroma were similar in age, BMI, race, tumor type, T and N stage, and number of nodes removed as those without seroma (all $p > 0.07$) (Table 1). Overall, the median number of nodes removed was 2. Seroma rates did not vary according to surgeon or nodal mapping technique and were not affected by deep suture closure of the axillary cavity ($p = 0.88$) (Table 1). Active smokers, diabetics, and those patients developing postoperative surgical site infections of the breast or axilla were more likely to have symptomatic axillary seromas (Table 1).

Axillary seromas tended to develop within the first two postoperative weeks with a median time to formation of 12 days (Table 2). Among the 127 of 667 patients developing symptomatic seromas, 29 were managed

TABLE 1 Patient characteristics and operation data

Characteristic	No seroma (<i>n</i> = 540)	Seroma (<i>n</i> = 127)	Total (<i>n</i> = 667)	<i>p</i>
Age at surgery, years				0.1948
Mean (SD)	64.5 (11.3)	66.0 (12.5)	64.8 (11.5)	
Median	65.0	64.0	65.0	
Range	(32.0–93.0)	(34.0–92.0)	(32.0–93.0)	
Diagnosis				0.8208
IDC/IDC + DCIS/other	494 (81.1 %)	115 (18.9 %)	609 (91.3 %)	
DCIS	15 (83.3 %)	3 (16.7 %)	18 (2.7 %)	
ILC	31 (77.5 %)	9 (22.5 %)	40 (6.0 %)	
T status				0.8507
Tis	15 (83.3 %)	3 (16.7 %)	18 (2.7 %)	
T1	416 (80.2 %)	103 (19.8 %)	519 (77.8 %)	
T2	99 (82.5 %)	21 (17.5 %)	120 (18.0 %)	
T3,4	4 (100.0 %)	0 (0.0 %)	4 (0.6 %)	
Tx	6 (100.0 %)	0 (0.0 %)	6 (0.9 %)	
N status				0.2007
Missing	1	0	1	
N0/N0i+	512 (81.4 %)	117 (18.6 %)	629 (94.4 %)	
N1mic/N1	27 (73.0 %)	10 (27.0 %)	37 (5.6 %)	
BMI, kg/m ²				0.0735
Mean (SD)	33.2 (111.0)	27.2 (5.5)	32.1 (99.9)	
Median	27.0	26.6	26.9	
Diabetes ^a				0.0504
No	484 (82.0 %)	106 (18.0 %)	590 (88.5 %)	
Yes	56 (72.7 %)	21 (27.3 %)	77 (11.5 %)	
Smoker				0.0012
No	371 (84.5 %)	68 (15.5 %)	439 (65.8 %)	
Yes	169 (74.1 %)	59 (25.9 %)	228 (34.2 %)	
Surgical site infection				<0.0001
No	538 (82.6 %)	113 (17.4 %)	651 (97.6 %)	
Yes	2 (12.5 %)	14 (87.5 %)	16 (2.4 %)	
No. of LN removed				0.3341
Missing	1	0	1	
1	141 (84.4 %)	26 (15.6 %)	167 (25.1 %)	
2–3	315 (80.4 %)	77 (19.6 %)	392 (58.9 %)	
≥4	83 (77.6 %)	24 (22.4 %)	107 (16.1 %)	
No. of LN positive				0.0647
Missing	1	0	1	
0	510 (81.7 %)	114 (18.3 %)	624 (93.7 %)	
1–2	29 (69.0 %)	13 (31.0 %)	42 (6.3 %)	
Surgeon				0.8789
A	63 (82.9 %)	13 (17.1 %)	76 (11.4 %)	
B	465 (80.7 %)	111 (19.3 %)	576 (86.4 %)	
C	12 (80.0 %)	3 (20.0 %)	15 (2.2 %)	

IDC invasive ductal carcinoma, DCIS ductal carcinoma-in-situ, ILC infiltrating lobular carcinoma, BMI body mass index, LN lymph node

Row percentages are displayed to show incidence rate of seroma by categorical variable

^a Diabetes was defined as any patient receiving insulin or oral antihyperglycemic medications, or with hemoglobin A1c >8

TABLE 2 Outcome/treatment data of 127 seroma patients

Characteristic	Value
Postoperative day, days	
Mean (SD)	17.2 (24.7)
Median (range)	12.0 (5.0–199.0)
No. of aspirations	
NA, no aspiration	31 (24.4 %)
1	66 (52.0 %)
≥2	30 (23.6 %)
Drain	
Yes	16 (12.6 %)
Drain LOS, days	
1–10	10 (7.9 %)
≥11	6 (4.4 %)
Median (range)	10.0 (7.0–54.0)
Return to OR	
Yes	4 (3.1 %)

NA not applicable, LOS length of stay, OR operating room

conservatively with no intervention while the remaining 98 (77 %) of 127 needed intervention. The flow chart in Fig. 1 outlines interventions. Notably, 85 patients resolved with a single ($n = 66$) or 2 ($n = 19$) aspirations with the median number of aspirations needed as 1.3 per axillary seroma. In total, 16 patients ultimately required a drain, either at initial presentation ($n = 2$) [due to overlying erythema ($n = 1$) and to patient choice after informed discussion ($n = 1$)] or a drain placed by interventional radiology after failing a course of in-office aspiration(s) ($n = 14$). Among those having drains placed, the seroma satisfactorily resolved in 13 patients. The median number of days the drains

remained in place was 10 (range 7–54 days). Overall, 4 (0.006 %) of 667 patients had persistent symptomatic axillary seromas requiring operative intervention for excision of seroma cavity, quilting of the axillary cavity with multiple interrupted absorbable sutures placed at sequential depths and in repetitive rows to eliminate the dead space within the cavity, and closure over closed suction drain. Three of these four patients had a drain before operative intervention (Fig. 1), the fourth had persistent seroma after two aspirations and chose surgery over drain, and three of the four patients were smokers. In each case, the seroma resolved after operative intervention.

Univariate and multivariate analyses were performed using logistic regression techniques and identified diabetes, smoking, and SSI as the only predictors of symptomatic axillary seroma with odds ratio of 1.97, 1.98, and 37.19 (all $p < 0.017$), respectively (Tables 3, 4). While univariate analysis showed number of nodes positive to be significant for seroma formation ($p = 0.046$), this difference was not seen after adjusting for other variables in the multivariate model ($p = 0.142$). Interestingly, number of nodes removed and patient BMI at the time of surgery did not influence axillary seroma formation.

DISCUSSION

Seroma rates are highly variable in the literature, ranging from 15 to 81 %.¹⁶ However, few studies are explicit about the location of the seromas leaving the reader to question if the reported rates refer to seromas forming in the breast, axillary basin or both. Early assessment of axillary seroma after SLNB in the ACOSOG Z011 trial

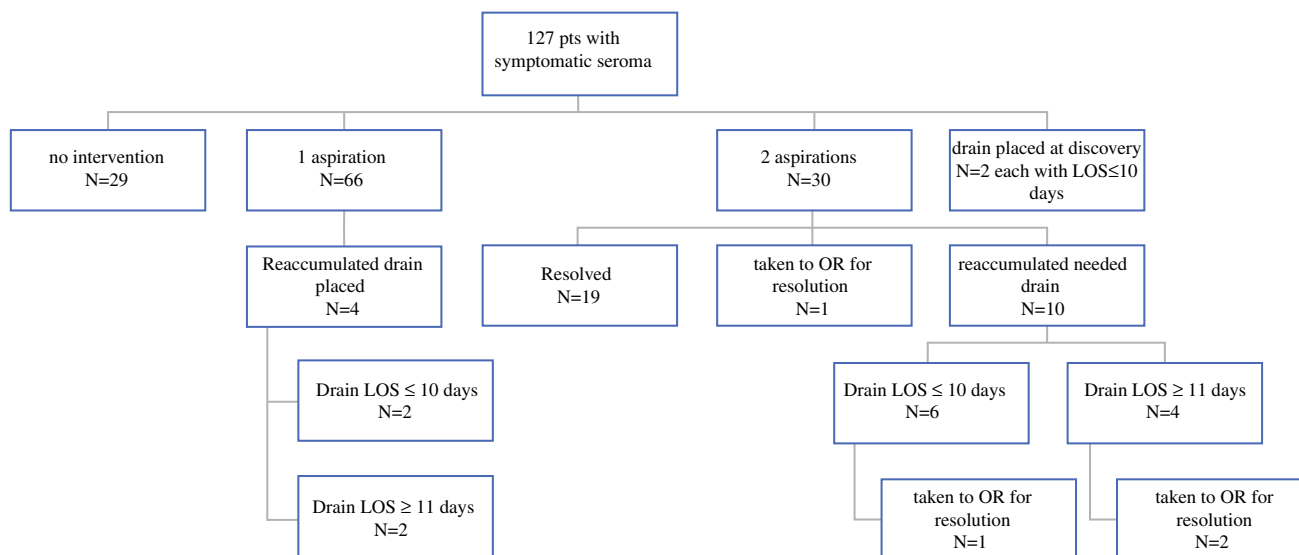
**FIG. 1** Flow diagram demonstrating interventions for axillary seromas in 127 symptomatic patients

TABLE 3 Univariate logistic regression models predicting seroma

Variable	Class value	OR (95 % CI)	<i>p</i>
Age at surgery, years		1.01 (0.99, 1.03)	0.195
BMI	26–30 kg/m ²	0.73 (0.46, 1.15)	0.172
	>30 kg/m ²	0.69 (0.42, 1.11)	0.127
T status	Tis/T1	0.81 (0.23, 2.84)	0.739
	T2	0.86 (0.51, 1.44)	0.558
	T3,4	0 (0, NA)	NA
	Tx	0 (0, NA)	NA
Diabetes	Yes	1.71 (0.99, 2.95)	0.053
Smoker	Yes	1.90 (1.29, 2.82)	0.001
SSI	Yes	33.33 (7.47, 148.77)	<0.001
No. of LN removed	2–3	1.33 (0.81, 2.16)	0.257
	≥4	1.57 (0.85, 2.91)	0.153
No. of LN positive	1–2	2.01 (1.01, 3.98)	0.046

OR odds ratio, CI confidence interval, BMI body mass index, LN lymph node

For categorical predictors, the reference level has an OR of 1 and is not shown

TABLE 4 Multivariate model predicting seroma

Variable	Class value	OR (95 % CI)	<i>p</i>
Diabetes	Yes	1.97 (1.13, 3.44)	0.017
Smoker	Yes	1.98 (1.31, 3)	0.001
SSI	Yes	37.19 (8.19, 168.9)	<0.001
LN positive	1–2	1.75 (0.83, 3.69)	0.142

OR odds ratio, CI confidence interval, SSI surgical site infection, LN lymph node

For categorical predictors, the reference level has an OR of 1 and is not shown

found axillary seromas to occur in 7 % of patients; however, the authors did not define how they categorized axillary seroma or if intervention was needed.¹⁹ Our rate of axillary seroma formation is higher than we anticipated and higher than was initially reported in early Z011 data but similar to other studies detailed above.^{2,3,9,20} In our patients, we find that seromas required intervention in 14 % of cases but typically this was with aspiration only and poses nominal risks to patients.

The use of closed suction drainage was introduced in 1947. Since that time, drains have been used in multiple surgical settings for seroma prevention, including in the breast and axillae. Drains have been shown to significantly decrease the incidence of immediate seroma formation in modified radical mastectomy and axillary lymph node dissection, although there is still controversy as to the appropriate timing of drain removal.^{6,14,21} The development of seroma is accepted in breast conservation and SLNB surgery as a normal consequence of surgery. Typically these do not require drainage but are left to natural means to reabsorb. As a result, it is accepted that routine

drain placement at the time of SLNB is not necessary. This conclusion is supported by the fact that 86 % of our patients had no symptoms or required no intervention for small seromas.

A number of variables have been previously cited as risk factors for seroma: patient's age, body mass index, extent of procedure, and hypertension.^{11,21} Interestingly, we found none of these variables to be significant but instead noted diabetes and smoking to be associated with an increased rate of seroma formation (odds ratio 1.97 and 1.98, respectively). Given these additive risks, perhaps drain placement at the time of the initial operation could be considered in this select population. While surgical site infection (SSI) was also a significant risk factor for symptomatic seroma in our population, this cannot be predicted and therefore cannot be treated prophylactically with drain placement at the time of operation. However, when patients return with SSI, seroma aspiration is needed to treat symptoms and exclude abscess as the offending cause. Interestingly, the number of lymph nodes positive was found to be significant in univariate analysis; however, this difference did not persist after adjusting for other variables. The role of lymph node positivity on seroma formation is not previously reported and its influence is unclear.

From our data, it appears surgical technique does not influence seroma formation. However, other studies have clearly demonstrated that obliteration of dead space by mechanical and chemical means could reduce the incidence of seroma. Several studies found that a combination of quilting and drains, as well as minimizing electrocautery, reduced the incidence and volumes of seroma.^{13,14} Currently, the use of fibrin sealant is considered experimental,

while other chemical sealants like doxycycline and erythromycin have been shown to be too painful to be practical.^{15,21–23} Similarly, data is mixed on the influence of standard electrocautery over sharp dissection and seroma formation.^{16–18} Some recent studies have shown a decrease in drain volume and time to removal when using energy devices such as the Valleylab LigaSure and harmonic scalpel. Huang et al. found that the use of harmonic scalpel significantly reduced the rates of seroma in the breast when compared to standard electrocautery.¹³ Bohm and colleagues showed that the Harmonic Focus reduced the rate of axillary seroma by 70%.^{14,21,22,24,25} However, the routine adoption of these devices for SLNB surgery may be impaired by their relatively high cost and the unknown cost benefit ratio of number of seromas prevented and subjective improvements in patient discomfort. Quilting the cavity closed has been shown to reduce breast seroma formation after mastectomy and may also therefore work in the axilla though fewer data exist to support this hypothesis.^{15,26} Similarly, oncoplastic techniques offer both cosmesis and good oncologic results in the breast with the clear intent of eliminating dead space, though it is unclear if they can reduce seroma rates.¹⁸ Savalia and Silverstein demonstrated that by utilizing volume displacing techniques, breast conservation can be offered to more women; this could have the additional benefit of reducing rates of seroma.²⁷ Oncoplastic techniques do not exist in practice for the axilla in as they do in the breast; however, the concept of closing the deep axillary spaces could be considered a technique with a similar long term goal. Unfortunately, routine closure of the axillary dead space did not translate into a reduction in seroma rates in our data.

Our study has many strengths and limitations. We included an overall large number of patients treated at a single institution by the same provider postoperatively. Although we did not standardize intervention, we did standardize patient instructions and uniformly did not require activity restrictions. Our focus was specifically regarding axillary seromas only, reducing the confounding effects of breast or axillary location. Certainly our data is limited by its retrospective nature and lack of standardized intervention approach. However, we sought to characterize our population in order to standardize intervention and understand the efficacy of the intervention options available. Admittedly, our practice variations were part of the prompt to undertake this study and utilize the results as a way to standardize our practice. It is unclear as to why 29 patients did not need aspiration or intervention otherwise, it is likely they had relatively smaller seromas or had borderline or marginal symptoms in comparison to those requiring intervention. Based on these data, we have discussed preemptive drain placement at the initial operation in patients who are both diabetic and active smokers. This

is reviewed with this small subset of patients at their preoperative visits. When patients present postoperatively with symptomatic axillary seromas, our standardized approach is to proceed with aspiration if needed two times as this resulted in resolution in 82 % of patients with symptomatic seromas. If the seroma remains persistent then we will proceed to IR drain placement.

CONCLUSIONS

Although the incidence of axillary seroma is decreased with BCS and SLNB when compared to modified radical mastectomy and axillary lymph node dissection, it remains a common postsurgical complication. Other complications include hematoma (1.4 %) and wound infection (1.0 %), but these are found less frequently.¹⁹ Axillary seroma in our study was not influenced by tumor characteristics, nodal mapping, or surgeon characteristics. Seroma results in frustration for the patient and surgeon alike but rarely requires aggressive operative intervention. Most commonly, symptomatic axillary seroma can be successfully treated with only one aspiration. However, even this simple treatment still results in patient discomfort, multiple clinic appointments, phone calls, anxiety, and increased cost in time and money. Patients who develop symptomatic seroma should be educated as to the anticipated course of treatment. Further research into prevention of seroma may be warranted given the cumulative costs and incidence.

DISCLOSURE The authors declare no conflict of interest.

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