



## Original research

## Prevention of postoperative seromas with dead space obliteration: A case-control study



Johnathon M. Aho, Terry P. Nickerson, Cornelius A. Thiels, Michel Saint-Cyr, David R. Farley\*

Department of Surgery, Mayo Clinic, Rochester, MN, USA

## HIGHLIGHTS

- Soft tissue resection is a common procedure in general surgical practice.
- Seroma, a complication of soft tissue resection, affects a significant population.
- The risk of seroma formation can be significantly reduced with dead space closure.

## ARTICLE INFO

## Article history:

Received 14 September 2015

Received in revised form

2 March 2016

Accepted 5 March 2016

Available online 8 March 2016

## Keywords:

Closure

Dead space

Lipoma

Seroma

Soft tissue

Wound

## ABSTRACT

**Introduction:** Excision of soft tissue masses in the subcutaneous space is a common surgical procedure. Postoperative seromas may occur and often result in additional visits, procedures, and impaired wound healing.

**Methods:** A retrospective chart review (2001–2011) identified patients who underwent resection of a soft tissue mass in the subcutaneous tissues. Patients undergoing breast surgery, head and neck surgery, and lymph node dissections were excluded. Patients ( $n = 100$ ) with seromas were identified. These patients were matched to patients not having postoperative seroma ( $n = 100$ ).

**Results:** We identified 100 patients with seroma and 100 controls without seroma after soft tissue resection. Patients had no difference in wound characteristics. Patients with a dead space obliterating stitch were less likely to have a postoperative seroma (26% vs 74%,  $P < 0.001$ ).

**Conclusions:** Dead space closure was associated with a decreased rate of postoperative seroma in subcutaneous resections. Postoperative seroma was associated with increased cost and provider visits.

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## 1. Introduction

Resections of skin and subcutaneous masses of the extremity and trunk are commonly performed in a surgical practice. Complications such as seroma may lead to additional office visits, imaging studies, and procedures and can impair the cosmetic result. There is little literature regarding seroma complications and factors that affect seroma formation. In the literature on breast surgery involving axillary dissection, the seroma incidence is estimated to be 14% [1]. In light of the paucity of data, there is little on which to base the management of resections of extremity and trunk soft tissue masses to prevent seroma formation. Seromas are common

after breast excision, abdominoplasty, and lymph node basin dissections; however, incidence outside these settings is unclear. Various techniques have been proposed and tested to eliminate seroma formation, such as decreased undermining and use of fibrin glue and drains; none have eliminated seroma [2–7].

While the pathogenesis of seroma is unresolved, the following may be theorized from known data. In the immediate postoperative period the potential space generated by surgical trauma allows collection of exudative fluid. Given the interruption of lymphatic channels this fluid remains in situ and accumulates. This is plausible as it has been shown that degree of lymphatic interruption increases rate of seroma formation [3]. Further potential to reduce seroma formation, or at least clinically detectable seroma may be possible from obliteration of the potential space and minimization of tissue dissection [6,7].

The purpose of our study was to determine which preoperative

\* Corresponding author. Department of Surgery, Mayo Clinic, 200 First St SW, Rochester, MN, 55905, USA.

E-mail address: [farley.david@mayo.edu](mailto:farley.david@mayo.edu) (D.R. Farley).

and operative factors affect seroma formation in soft tissue excisions outside of breast and head and neck operations, lymph node dissections, and abdominal reconstructive operations.

## 2. Methods

A retrospective case-control study approved by the Institutional Review Board was done of all soft tissue mass excisions performed from 2001 to 2011 across all surgical departments and divisions. Patients were assessed for location of tumor and whether there was true subcutaneous involvement only. Patients undergoing breast, axillary, abdominoplasty, and head and neck surgery were excluded, as were those with lymph node dissections, fascial resection, or concomitant major operations. True subcutaneous excisions were defined as lack of involvement of the deep fascia of the trunk or extremity on the basis of preoperative imaging (e.g. sarcoma patients) operative reports, and pathologic descriptions of the specimen as containing no fascia. No melanomas with in transit disease were included. Patients with seromas detected clinically or with imaging were assigned to the category “seroma” ( $n = 100$ ), and those without were assigned to the category “no seroma” ( $n = 100$ ). Patients without seroma were then matched for age, sex, and body mass index. Wound volume, placement of a surgical drain, use of dead space closure, and follow-up data were collected from pathology reports with detailed description of specimen size measured by caliper and pathologist, operative reports and clinic visits respectively. Dead space closure use included quilting sutures to pexy the subcutaneous tissue to the deep fascia or simple subcutaneous closure of the wound in layers in either a continuous or interrupted fashion. All dead space closure techniques involved absorbable suture. Treatment interventions were assigned a cost equivalent to a 40-min visit (to quantify opportunity cost of equivalent time that would be spent on seeing a new patient consultation) based on the time it took to perform the procedure. This method was used because billing data regarding true cost were unable to be obtained for these visits; they are not billable because they result from a complication of the operative procedure. Only visits that were directly related to treatment of the seroma were recorded, not routine postoperative wound assessments. Results were analyzed using  $\chi^2$  and Wilcoxon rank sum tests, and  $P < 0.05$  was considered statistically significant.

## 3. Results

One hundred patients (63 lipoma, 24 melanoma, 10 lipomatous sarcomas, and 3 other [spindle cell sarcoma, malignant fibrous histiocytoma, and pleomorphic sarcoma]) with a postoperative seroma after soft tissue resection were identified and matched with 100 patients (76 lipoma and 24 melanoma) without seroma as controls. Twelve patients were excluded due to limited follow up for a total of 188 patients. The locations of the tumors are listed in

**Table 1**  
Location of tumors in patients with and without seroma.

Tumor location	Seroma (n = 99), No.	No seroma, (n = 89), No.
Upper aspect of arm	4	7
Forearm	4	10
Shoulder	13	16
Chest	5	8
Back	45	27
Abdomen	4	6
Buttock	2	3
Thigh	21	10
Lower aspect of leg	1	2

**Table 1.** Patients with a seroma and those without were similar: diabetes (11% vs 13%,  $P = .47$ ), immunosuppression (3% vs 3%,  $P = 0.89$ ), personal history of smoking (36% vs 36%,  $P = 0.56$ ), or active tobacco use (12% vs 7%,  $P = 0.33$ ) (Table 2). Wound characteristics were similar: area (34 cm<sup>2</sup> vs 26 cm<sup>2</sup>,  $P = 0.09$ ) and volume (73 cm<sup>3</sup> vs 49 cm<sup>3</sup>,  $P = 0.11$ ) (Table 3). Patients with a documented dead space obliterating stitch (quilting, progressive tension, or a dedicated subcutaneous stitch) were less likely to have a symptomatic postoperative seroma (26% vs 74%,  $P < 0.001$ ). Placement of a surgical drain did not affect the rate of seroma formation (25% vs 19%,  $P = 0.39$ ). Median duration of follow-up was 1033 days (range, 10–4410). Seroma resulted in additional patient interventions and provider visits (2.53 [range, 0–13] vs 0.24 [range, 0–4],  $P < 0.001$ ) and additional cost (\$268.6 [0–1299] vs \$17.5 [0–292],  $P < 0.001$ ) (Table 4). The procedure performed (i.e. aspiration or incision) was at the discretion of the operating surgeon. Patients who required aspiration ( $n = 35$ ) had an average of 50 mL removed (range, 4–1000 mL). Patients who had a seroma underwent multiple treatment interventions (Table 5). Patients with seroma developed cellulitis and were prescribed antibiotics at a higher rate (21% vs 2%,  $P < 0.001$ ). Thirty two patients were treated by observation alone; this was based on patient and surgeon assessment and did not incur any additional cost beyond follow up visits.

## 4. Discussion

Although seroma after soft tissue resections is typically not life-threatening, it remains a frustrating problem, leading to increased cost and additional procedures. Our case series is the first, to our knowledge, to evaluate whether use of a drain and dead space obliteration affect seroma formation during short and long-term follow-up after subcutaneous resection. Our data suggest closing subcutaneous wounds carefully with dead space obliteration is important. Several different techniques of dead space obliteration were performed, owing to the fact that multiple different surgeons with varied practices perform these operations; however, all dead space obliteration procedures were performed with absorbable suture.

The surgical literature has shown that dead space obliteration with quilting or progressive tension sutures decreases the risk of seroma formation, especially in the latissimus dorsi donor flap site, abdominoplasty, and breast surgery with axillary dissection [2,8–13]. Our data support that dead space obliteration with such techniques leads to lower risk of seroma formation. Although negative-pressure wound therapy was not used in our study patients, the risk of infection does seem to be decreased with this therapy; however, the subsequent risk of seroma formation is unclear [14].

Studies that have assessed fibrin glue in an attempt to weld tissue flaps to wound bases have had conflicting results [3–6]. In our case series, fibrin glue was not used. Our study is supportive of the practice of dead space closure using a combination of progressive tension sutures, quilting sutures, or a dedicated subcutaneous stitch. Drain use did not have a significant effect on late seroma formation in our study, a finding similar to that reported in the plastic and gynecologic surgery literature [15–17]. At our institution, surgeons typically use electrocautery rather than ultrasonic dissection, and this approach remains controversial in regard to the rates of seroma formation [18,19].

Risk factors for seroma formation have been studied outside of subcutaneous resection in the breast and abdominoplasty literature; there is a suggestion that risk factors for seroma include increased body weight, obesity, and hypertension [20,21]. These factors were unimportant in our study. Additionally, our study corroborates previous literature reporting a lack of association of

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