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Axillary "Exclusion"—A Successful Technique for Reducing Seroma Formation after Mastectomy and Axillary Dissection

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ABSTRACT

Introduction: A seroma is the commonest complication of breast cancer surgery, and although its consequences most often cause no more than discomfort and anxiety, more important sequelae include flap necrosis and wound breakdown. Infection developing within seroma increases morbidity and often results in the need for re-admission, re-imaging, drainage and antibiotic usage. Numerous methods to reduce post-mastectomy seroma formation have been tried with no consistent success. **Methods:** 24 consecutive patients undergoing mastectomy and axillary clearance were recruited before and after a departmental change in practice. At the point of skin closure, patients either underwent "axillary exclusion" or not. Total drain outputs were recorded by community district nursing staff for all patients. At the first post-operative visit, the presence and severity of seroma was recorded. **Results:** 24 patients were included (study group 14, control group 10). Age, size of tumour, and number of positive lymph nodes and laterality were comparable between groups. Mean drain output for the entire group was 471 ml (3 - 1030 ml) over 5.21 days. The control group had a drain output of 763.5 ml (95%CI 674.2 - 852.8) while the study group had a mean drainage of 262.2 ml (95%CI 161.9 - 362.5), a reduction of over 65%, $p < 0.001$. 15 (62.5%) out of 24 patients developed seroma. 42.9% of the study group and 90% of the control group developed seroma, $p < 0.01$. **Conclusion:** Seromas are a common complication following mastectomy and axillary clearance. Our technique of axillary exclusion has resulted in significantly reduced drainage volumes and fewer seromas.

Keywords: Breast Cancer; Lymphocele; Seroma; Mastectomy; Axilla

1. Introduction

Seromas represent the most common complication of breast cancer surgery [1], the aetiology of which remains obscure. Many surgeons view seromas as a necessary evil rather than a serious complication.

The commonest consequences of post-operative fluid collections are patient discomfort and anxiety, however more important consequences that can arise as secondary complications include flap necrosis and wound breakdown. Infection developing within seroma increases morbidity and often results in the need for re-admission, re-imaging, drainage and antibiotic usage [2-4].

The significance of post-operative seroma in breast surgery lies in its frequency. The incidence is thought to be somewhere between 25% - 60% for mastectomy and axillary clearance [5,6], but has been reported as high as 85% [7] depending on it's definition and the techniques employed to detect them.

Theories of aetiology are important in determining the most likely surgical technique for prevention. Various techniques have been studied in an attempt to minimise post-mastectomy drainage volumes and the incidence of seroma. None however, have been found to be consistently successful and consequently none are used in common practice. If it is believed that the disrupted lymphatics in the axillary fossa are central to aetiology, it follows that obliterating this space will minimise fluid collection. We introduce a novel technique of axillary exclusion, and present results of a series of 24 patients.

2. Patients and Methods

Patients undergoing mastectomy and axillary (level II/III) clearance at Southampton General Hospital and Princess Anne Hospital, Southampton were examined into the study. Over the period March to July 2008, 24 patients operated on by a single surgeon were investigated pros-

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pectively, before and after a departmental change in technique. After mastectomy, at the point of skin closure, patients either underwent axillary "exclusion" or not.

The technique involved suturing the superior mastectomy skin flap down to the free edge of pectoralis major and the lateral chest wall using a continuous 2/0 vicryl stitch (**Figures 1(a)-(c)**), and then placing 4 - 6 interrupted sutures between pectoralis major and minor to reliably exclude the axillary fossa from the remainder of the mastectomy cavity (**Figure 1(d)**).

A pressure dressing was applied to all wounds. 10F Handy Vac® suction drains were placed at surgery in all patients with the tip placed within the mastectomy cavity, and total drain outputs were recorded by community district nursing staff for all patients prior to drain removal. Chi-squared analysis was used to determine difference between drain outputs in each group.

At the two-week first post-operative visit, the presence and severity of seroma was recorded. This was graded mild (asymptomatic), moderate (symptomatic but not requiring intervention, or severe (symptomaic requiring intervention). Unpaired t-test was used to determine significance in seroma incidence between groups.

3. Results

24 consecutive patients were included. Of these, the study group contained 14 and the control group 10 patients. Age, size of tumour, number of positive lymph nodes and laterality were comparable between groups (**Table 1**).

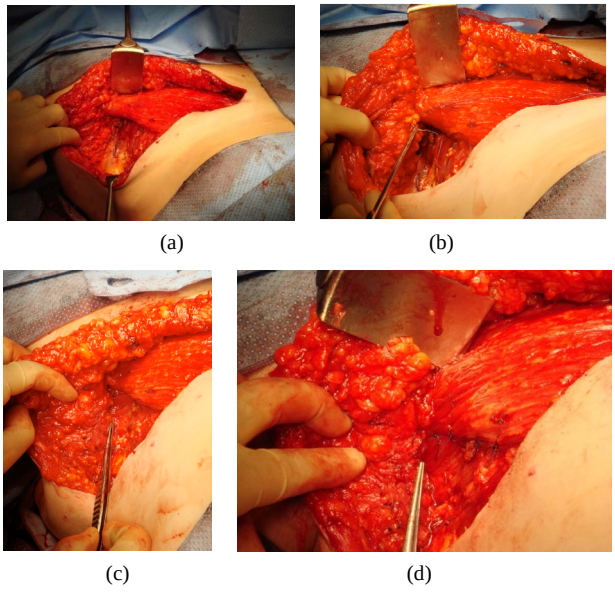

Figure 1. Intra-operative photographs showing axillary exclusion technique: (a) Axillary fossa potential dead space after mastectomy and axillary clearance; (b) Suturing of superior mastectomy flap to pectoralis major; (c) Superior mastectomy flap sutured to free edge of pectoralis major and lateral chest wall; (d) Interrupted sutures to appose pectoralis major and minor, providing reliable axillary fossa exlusion.

The median age of patients was 62 years (36 - 82 years). The laterality of operations was 10 (41.7%) left and 14 (58.3%) right. Types of pathology included invasive ductal carcinoma, ductal carcinoma *in situ*, and mixed invasive ductal/lobular carcinoma. 20 patients (83.3%) had invasive tumours (80% IDC, 20% mixed IDC/ILC). Sizes of tumour ranged from 3 - 82 mm (mean 29.8 mm).

Drains remained in situ for 4 - 7 days at the discretion of the community district nurse. At drain removal, total drain output was measured and recorded. Mean drain output for the entire group was 471 ml (range 3 - 1030 ml) over a mean of 5.21 days.

The control group had a drain output of 763.5 ml (95%CI 674.2 - 852.8) while the study group had a mean drainage of 262.2 ml (95%CI 161.9 - 362.5), a reduction of over 65%, $p < 0.001$ (**Figures 2** and **3**). 15 out of 24 patients developed seroma (rate 62.5%). 42.9% of the study group and 90.0% of the control group developed seroma. This difference is significant ($p < 0.01$). Seroma

Table 1. Comparison of results between study group and control group.

Variable	Study group	Control group
Mean age	62 (36 - 71)	61 (37 - 82)
Size of tumour (mm)	29 (3 - 71)	35.2 (13 - 82)
No. lymph nodes removed	10.8 (6 - 25)	10.6 (5 - 16)
No. positive lymph nodes	1.8 (0 - 7)	2.3 (0 - 10)
Laterality (% Right)	57.1%	50.0%
Length of drain placement (days)	4.9 (4 - 7)	5.6 (5 - 7)
G1/G2/G3	5/7/2	4/4/2

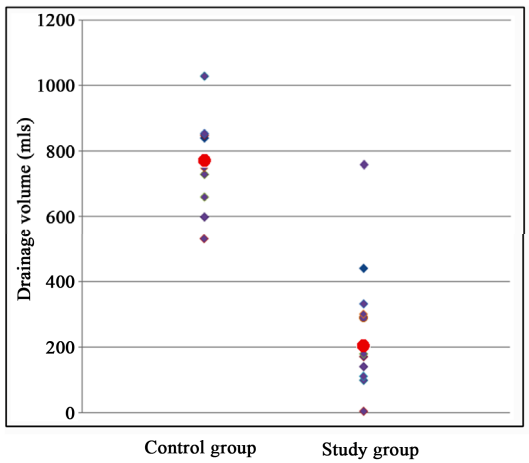

Figure 2. Drain outputs for control and study groups (red dots indicate median value).

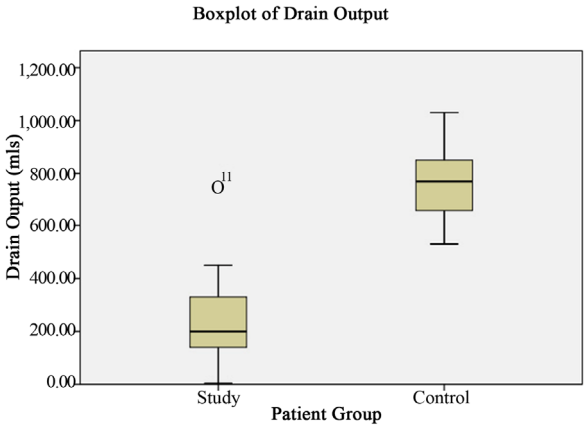

Figure 3. Boxplot showing drain output volumes in study and control groups.

formation was not significantly related to number of lymph nodes obtained, nodal involvement, tumour size or grade.

4. Discussion

A seroma is an accumulation of serous fluid that develops following the formation of skin flaps during mastectomy or in the axillary dead space in the post-operative period [8]. The most likely cause for the formation of seroma is the disruption of lymphatic channels in the axilla [9-11]. However, laboratory studies have shown conflicting evidence, some determining the fluid to be lymph-like in quality [2,12], and others showing an inflammatory exudate [13,14].

A large number of risk factors for seroma formation that have been looked into include age, type of surgery, tumour size, number of positive lymph nodes, and patient's BMI. Unfortunately, results of these studies are inconsistent, and in any case, the majority of these risk factors are unmodifiable. The challenge is to find a means to reduce the rate of seroma without significantly increasing operative time, blood loss, or other morbidity.

Only the age of the patient [15] and type of surgery performed [5,16] have been consistently shown to affect the rate of formation of seroma (**Table 2**).

Various studies have attempted to reduce seroma formation in order to improve outcome and reduce morbidity. Techniques that have been advocated over the years include shoulder immobilization [19,20], prolonged suction drainage [21] perioperative tranexamic acid [22], choice of surgical instrument [18,23], and obliteration of dead space [4,6,9,24-28].

Electrocautery has been described as possibly increasing the frequency of seroma. Contrary to popular belief, a study has shown that the length of time drains are left in place does not affect seroma rate. Few results have shown consistent benefit (**Table 3**).

Table 2. Studies of predictive factors of seroma formation following breast surgery.

Authors	n	Non-significant results	Significant results
Unalp *et al.* (2007) [17]	119	Type of surgery Tumour size Neoadjuvant chemotherapy Surgical instrument Pressure dressing Positive nodes Drainage duration Buttress suture	Flow rate > 50 ml/day at 48 hr
Gonzalez *et al.* (2003) [5]	359	Age Positive nodes Tumour size Patient weight Neoadjuvant chemo	Type of surgery
Loo & Chow (2007) [15]	119	Diabetes Menstrual status Blood loss Operative time Grade of surgeon	Age > 45 yrs Hypertension
Hashemi *et al.* (2004) [16]	158	Age Tumour size Nodal involvement Neoadjuvant chemo Surgical instrument Pressure dressing Duration of drainage	Type of surgery
Lumachi *et al.* (2004) [18]	92	Age Type of surgery Operating time	BMI Size of tumour Nodal involvement

Table 3. Studies examining interventions to reduce post-operative drainage following breast surgery (NS = non-significant result).

Author	n	Intervention	Result
Browse *et al.*, 1996 [29]	67	Shoulder immobilization	31% vs. 43% (NS)
Chen *et al.*, 1998 [30]	41	Pressure dressing	2.4% overall (NS)
Zavotsky *et al.*, 1998 [31]	115	Drain vs. no drain	8% vs. 50% ($p < 0.05$)
Rice *et al.*, 2000 [32]	62	Topical tetracycline sclerotherapy	53% vs. 22% (NS)
Gupta *et al.*, 2001 [33]	121	Length of suction drainage	48% vs. 28% (NS)
Barwell *et al.*, 1997 [34]	63		51% vs. 49% (NS)
Porter *et al.*, 1998 [23]	80	Electrocautery vs. scalpel.	38% vs. 13% ($p < 0.05$)
Lumachi *et al.*, 2004 [18]	92	Ultrasound scissors	20% vs. 40% (NS)
Anand *et al.*, 2002 [35]	36	Daily aspiration	NS

Time of initiation of arm movement has also been studied on the basis that chest wall motion and shoulder

use create shearing forces that delay flap adherence, and that postoperative arm use acts as a pump forcing lymph into the empty axillary fossa. However, studies have shown no significant difference when delaying rehabilitation [29], and in fact the consequences of shoulder stiffness can be far greater than that of simple seroma.

Several studies have looked into tacking skin flaps to underlying muscle in an attempt to minimise dead space (**Table 4**). Halsted first described flap fixation in 1913 [3] and since, others have described individual methods to secure flaps and thereby close dead space. Some authors have used external sutures passing through the flap from the underlying muscle, but of course these may predispose to wound infection or local skin necrosis. Coveney *et al.* [4] as well as O'Dwyer [36] demonstrated that drainage volumes and seroma formation were significantly reduced when dead space was obliterated by suturing flaps to muscle down the skin closure suture line. Chilson *et al.* [37] advocated a similar tacking procedure, but tacked down the entire flap area using interrupted sutures.

In a similar vein, various authors including Lindsey *et al.* [38] have used topical fibrin glue in the operative site. Moore *et al.* [39] found good results using virally inactivated fibrin sealant, quoting a 30% reduction in median time to drain removal, and 23% reduction in cumulative drainage over 4 days, however, seroma formation was not examined as an outcome.

If it is believed that the largest potential dead space is the empty axillary apex after axillary dissection or indeed that seroma formation is contributed significantly to by disruption of axillary lymphatics, it follows that closure of this space may prove useful. A few studies introduced the concept of axillary padding to reduce drainage volumes after axillary surgery. The axillae were padded with nearby tissue, and outcomes in terms of seroma formation were excellent. However, both main studies [24,25] carried out a limited axillary dissection, and were carried out on patients undergoing breast conservation.

Table 4. Studies examining techniques to obliterate dead space to reduce post-operative drainage following breast surgery.

Author	n	Intervention	Result
Burak *et al.*, 1997 [9]	101	Bovine thrombin	37% vs. 40% (NS)
Berger *et al.*, 2001 [26]	60	Fibrin glue	39% vs. 42% (NS)
Coveney *et al.*, 1993 [4] O'Dwyer, 1991 [36]	40 33	Suturing to muscle at skin closure line	25% vs. 85% ($p < 0.001$) 8% overall
Chilson *et al.*, 2002 [27] Purushotham *et al.*, 2002 [28]	375	Closing dead space by quilting	$p < 0.05$ NS
Garnier *et al.*, 1993 [24] Classe *et al.*, 2002 [25]	100 207	Axillary padding (BCS only)	0% overall 22% overall
Benjasirichai *et al.*, 2007 [6]	18	Axillary closure	NS

We found only one other study looking at closing off the axillary space in patients undergoing mastectomy to reduce postoperative seroma. This was carried out in Thailand [6] involving 18 patients. The technique involved suturing the skin flap to underlying muscle at 3 points in the mid-axillary line, and found no significant difference of seroma thickness at the axilla measured ultrasonographically at two weeks.

We believe that post-operative fluid collections following mastectomy and axillary clearance arise from disrupted axillary lymphatics to a greater extent than serous fluid formation from mastectomy flaps. We have shown that reliably excluding the axillary fossa from the remainder of the mastectomy wound can considerably reduce post-operative drainage volume in this small group of patients. More importantly, this technique significantly reduces clinically apparent seromas after drain removal, thereby reducing the consequences of patient anxiety, discomfort and added morbidity.

5. Conclusion

Seromas are a common complication following mastectomy and axillary dissection. Many means of reduceing postoperative drainage volume and seroma rate have been studied, however results are inconsistent. Our technique of axillary exclusion has resulted in significantly reduced drainage volumes and fewer seromas.

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