

# EARLY POST-OP SWELLING AND ITS ASSOCIATION WITH LYMPHOEDEMA

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## Abstract

**Background:** Arm lymphoedema is a commonly recognised complication of breast cancer treatment and can cause major physical and psychological morbidity. Accurate assessment is important and it has been shown that early treatment can minimise the severity of chronic lymphoedema. **Aims:** This study investigates the incidence of arm oedema in 133 women who had been treated for breast cancer and the correlation between arm swelling two weeks postoperatively and the development of lymphoedema. **Methods:** Excess arm volume and previously recognised risk factors, such as seroma, wound infection, body mass index (BMI), cording and restricted arm movement were recorded preoperatively; two weeks, three, six, 12 and 18 months postoperatively. The extent of surgery, the number of positive lymph nodes and any postoperative treatments were also noted. A null hypothesis was used to analyse the data. **Results:** The incidence of arm lymphoedema was 18.8% at 12 months. No new cases were found at 18 months. The only single significant factor associated with an increase in the incidence of arm lymphoedema was two-week postoperative swelling ( $p < 0.01$ ). **Conclusions:** If two-week postoperative swelling indicates a significantly increased risk of subsequent lymphoedema, early referral of patients may help to reduce the development of long-term chronic conditions. **Declaration of interest:** None.

## Key words

Postoperative swelling  
Arm lymphoedema  
Breast cancer  
Defining lymphoedema

Swelling of the upper limb is a major cause of both physical and psychological morbidity following breast cancer treatment (Pain and Purushotham, 2000). A degree of arm swelling is common in the postoperative period for women who have received early treatment for breast cancer; which may settle spontaneously within weeks (Mortimer, 1998). However, there is

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no clear universal definition of what degree of swelling signifies lymphoedema and when postoperative swelling ends and lymphoedema begins. Several risk factors have been associated with the development of lymphoedema: radiotherapy and surgery (Pain and Purushotham, 2000), seroma, obesity, postoperative infection, non-accidental skin puncture (Mozes et al, 1982), and cording (Stanton et al, 1996). Cording has been described as the development of tender cord-like structures either on the chest wall, in the axilla or down the inner aspect of the arm, possibly due to lymphangitis or lymphatic thrombosis (Keeley, 2000). However, whether early postoperative arm swelling can be included as a risk factor has not been established.

Early detection of breast cancer-related oedema is important, as early treatment can minimise further swelling and can prevent the development of chronic lymphoedema and infection (Stanton et al, 2006). The fact that the diagnosis is often missed by patients and healthcare professionals highlights the problem of early detection (Stanton, 2006; Geller et al, 2003).

Traditionally, the extent of arm lymphoedema has been gauged by comparing the measurements of the affected arm to those of the contralateral arm after surgery. The most commonly used method involves taking circumferential measurements at 4cm intervals along the affected limb using the normal limb as a control. The excess limb volume is then calculated from the total limb volume using the formula for a cylinder or a frustum (Kuhnke, 1976). However, there is an increasing body of evidence that emphasises the importance of establishing the preoperative difference between both arms as a baseline reference point (Armer, 2005; Armer and Steward, 2005). Stanton et al (2006) found the arm volume difference between 34 healthy women varied between -4.5% and +8.5%. He also found that the non-dominant arm was larger in 38% of cases.

The diagnosis of lymphoedema has been defined as the affected arm being 10% larger than the contralateral arm (Swedborg, 1977). A pilot study by the researchers on 50 healthy women volunteers from a wide range of occupations revealed a natural difference

of -5% to +11% between both arms. This population had an average 5% difference in the volume of their arms. For this reason, a 5% difference from the preoperative reference measurements was used to diagnose lymphoedema in this study. This equates to a 10% arm volume difference when preoperative measurements are unknown.

### Aims of the study

- ▶▶ To establish the incidence of arm lymphoedema in three breast units in Hertfordshire
- ▶▶ To examine the correlation between early postoperative arm swelling and arm lymphoedema
- ▶▶ To determine whether patients or researchers noticed arm swelling
- ▶▶ To establish whether preoperative baseline reference measurements are important when establishing the incidence of arm lymphoedema.

### Methods

Researchers (breast care nurses from three hospital sites and the lymphoedema specialist treating patients from two hospital sites and a statistician) invited patients diagnosed and treated for primary breast cancer at three hospital sites in Hertfordshire between March 2003 and April 2004 to participate in the study. 133 patients consented to be recruited. Patients with metastatic disease and bilateral breast cancer were excluded from the study. Ethical approval was obtained from West Hertfordshire Hospitals ethical committee and the patients' GPs were informed. Patient confidentiality was maintained through the use of study numbers rather than individual names. All researchers were trained by the lymphoedema specialist assigned to the study to ensure that reproducible measurements were obtained across all three sites.

Of the patients involved in the study, 94% had level II–III axillary clearance. Level I node clearance had been performed up to the lateral border of the pectoralis minor; level II clearance to the medial border of the pectoralis minor and level III clearance had involved nodes removed up to the apex of the axilla. No patients had been given sentinel node biopsy and no patients had had radiotherapy to the axilla.

The following factors were assessed on six occasions (preoperatively, two weeks, three, six, 12 and 18 months postoperatively):

- ▶▶ Bilateral arm measurements at 4cm intervals
- ▶▶ Body mass index (BMI)
- ▶▶ Presence of seroma (accumulation of fluid close to the surgical wound)
- ▶▶ Presence of wound infection
- ▶▶ Presence of an inflammatory episode in the arm or breast
- ▶▶ Self-reported inflammatory episode in the arm or breast since last assessment
- ▶▶ Presence of cording
- ▶▶ Range of shoulder and arm movement using the British Lymphology Society (BLS) form
- ▶▶ Report of subjective arm swelling noticed by researcher or patient
- ▶▶ Type and extent of surgery
- ▶▶ Number of lymph nodes removed and number of lymph nodes positive to metastatic disease
- ▶▶ Radiotherapy
- ▶▶ Chemotherapy.

Distal and proximal excess limb volumes were calculated from the 4cm interval measures using a preprogrammed calculator —LymCalc® (Colibri Systems Software, Wrexham). For the purpose of this study, lymphoedema was defined as a palpable swelling with a >5% increase in arm volume from preoperative reference using the total limb measurement which persisted for more than three months (excluding two-week postoperative measurements, as these were defined as postoperative swelling rather than lymphoedema). Further reasons for selecting a 5% excess arm volume measurement rather than the historic 10% value were three-fold:

- ▶▶ The use of preoperative measurements as a reference baseline allowed a more accurate assessment of excess arm volume
- ▶▶ The researchers' experience indicated that patients frequently had noticeable swelling when the total excess arm volume measurement was calculated at less than 10%
- ▶▶ Experience has also indicated that swelling was often localised to a small section of the arm (often around the elbow, or from wrist to mid-

forearm), whereas the calculation for excess arm volume took the average measurement over the whole of the limb. Modi et al (2005) also reported false negative assessment of lymphoedema because of uneven distribution of swelling.

All patients included in the study who were found to have a noticeable swelling or a difference of >5% total volume present for three months were referred to the lymphoedema service.

### Statistical analysis

The data were analysed using the chi-squared test to determine if the observed numbers of patients with arm lymphoedema in each potential risk factor group were significantly different from expected numbers. The Yates correction was applied to any chi-squared test where there was only one degree of freedom in the analysis.

The number of patients with arm oedema in the whole study sample was 18.8% (Table 1). Therefore, we would expect 18.8% of patients to have lymphoedema in each risk group. The null hypothesis is that any risk factor will not significantly affect the incidence of arm lymphoedema.

### Results

#### Incidence of lymphoedema

The incidence of arm lymphoedema (defined as >5% excess arm volume compared with the baseline measurement persisting for more than three months, excluding two-week postoperative measurement) was 18.8% (25 out of 133 patients in the study group), across all three independent sites. Early (two-week) postoperative swelling occurred in 27/133 (20.3%) patients in the study.

The numbers of patients with arm lymphoedema was not significantly different across the three sites involved in the study ( $p>0.2$ ) (Table 1). However, when lymphoedema was calculated with a 10% difference there was a significant difference between the sites. Site A had 2.8% of patients with a 10% difference, whereas site C had 7.9% (Table 1). There were no obvious differences in breast cancer treatment between the

sites, but the treatment offered by the lymphoedema specialist differed. The lymphoedema specialist of site A treated early lymphoedema with swelling of >5% persisting for three months, while the lymphoedema specialist of site B was reluctant to treat early arm swelling.

**Risk factors and occurrence of arm oedema**

The majority of arm lymphoedema (68%) occurred within three months (Table 2). No new cases were observed at 18 months. The only single risk factor in this study that significantly affected the incidence of arm lymphoedema was postoperative arm swelling two weeks post surgery ( $p < 0.01$ ). 40.7% of patients with early (two-week) postoperative swelling subsequently developed arm lymphoedema, whereas 18.8% would be the predicted percentage from the study group as a whole. The percentage incidence of arm lymphoedema was twice as high in patients who had postoperative arm swelling two weeks after surgery.

An increase in the number of positive lymph nodes tended to increase the percentage of patients with arm lymphoedema, but the sample size was

too small to be able to perform any statistical analysis.

BMI was not found to relate to arm lymphoedema in this study ( $p = 0.0861$ ). However, because the p value was so close to 0.05, this might have become significant if there had been a larger number of lymphoedema cases in the study group. Seroma ( $p > 0.2$ ), cording ( $p > 0.2$ ) and restricted arm movement ( $p > 0.2$ ) were also not found to be risk factors.

**Did patients or researchers notice early arm oedema?**

Arm lymphoedema was noticed by 52% of patients and 56% of the researchers, with some cases being recorded by both. However, 36% of cases went unnoticed by both parties and only by calculating the excess arm volume and comparing with the preoperative baseline measurement was it apparent that there was a greater than 5% difference in limb volume. These figures varied across the three sites — at site C 100% of the cases were noticed, whereas at site B none of the swellings were noticed (Table 3).

**Are preoperative reference measures important?**

The preoperative natural difference

between right and left arm measurements varied from 0–14%. In 57% of cases the dominant arm was larger; in 32% the non-dominant arm was larger and in only 11% both arms were equal in size. If no preoperative reference measurements are used as a baseline, the assumption is that preoperative right and left arm measurements are the same. This leads to inevitable inaccuracies when calculating volume changes. This was highlighted in this study as the set and number of patients identified as having limb lymphoedema varied depending on whether a preoperative excess arm volume measurement was used as a reference or not. The number of cases was twice as high when not using a reference measurement to calculate the number of lymphoedema cases defined as a 10% excess arm volume (Table 3).

**Limitations of the study**

The main limitation of this study is the sample size. Only 25 patients developed lymphoedema out of a cohort of 133. One reason for the small sample size was time pressures on the researchers when taking preoperative measurements. A larger sample size may have shown other risk factors, such as whether positive axillary lymph nodes and high BMI increase the risk of lymphoedema.

Using a tape measure may have caused inaccuracies in measurement by different researchers. This was minimised by training given by a lymphoedema specialist with 15 years' clinical experience and by using weighted tape measures.

Whether the patient or researcher noticed lymphoedema was answered by a yes/no question. No specific training was given. There was a great discrepancy in different sites; one site noticed 100% of swelling and another noticed none. Training might have improved this area.

**Discussion**

Traditionally, lymphoedema was diagnosed with a 10% difference in arm volume (Swedborg, 1977). In the majority of studies no preoperative arm volume difference is known. This 10% figure would include the natural fluctuation between arm volumes. In our longitudinal study we established the preoperative arm

**Table 1**

**Incidence of lymphoedema defined by both 5% excess volume or 10% excess volume compared with a preoperative reference measurement**

	Site A	Site B	Site C	All
Lymphoedema defined as 5% excess arm volume on two or more occasions	18.1% (n=13/72)	21.7% (n=5/23)	18.4% (n=7/38)	18.8% (n=25/133)
Lymphoedema defined as 10% excess arm volume on two or more occasions	2.8% (n=2/72)	4.3% (n=1/23)	7.9% (n=3/38)	4.5% (n=6/133)

**Table 2**

**New arm lymphoedema cases and when they presented**

Initial time of occurrence post surgery	Initial time of occurrence post surgery			
	3 months	6 months	12 months	18 months
	12.7% (17/133) (68% of all cases)	3.75% (5/133) (20% of all cases)	2.25% (3/133) (12% of all cases)	18.8% (25/133) (100% of all cases)

volume difference and added 5%, e.g. if the preoperative difference was +6%, lymphoedema was diagnosed when the arm volume difference was 11% or more on two occasions. We felt that this was comparable to the traditional 10% volume difference often found in the literature.

In this study 18.8% of patients developed lymphoedema of the arm, 94% had level II–III axillary clearance, and 6% had axillary sampling (less than five lymph nodes removed). This figure is in line with other studies such as Stanton et al (2006) and Box et al (2002), who reported an incidence of 21% in patients who had axillary clearance. Studies using self-reporting questionnaires demonstrate a much lower incidence of lymphoedema. Rampaul et al (2003) found an incidence of only 0.04% of lymphoedema after axillary sampling with a self-reporting questionnaire. The accuracy of self-reported lymphoedema may be questioned, as from our study only 52% of swellings were noticed by patients. Stanton et al (2006) reported that one out of seven patients (14%) noticed their lymphoedema and Geller et al (2003) found 34% of patients self-reported their lymphoedema. This suggests that a large number of patients do not notice and therefore do not report their arm swelling.

We found the incidence of lymphoedema with excess volume of more than 10% was only 2.8% when treatment was prompt, compared with 7.9% when treatment was delayed. One lymphoedema service accepted and treated patients when referred with oedema of 5% or more, persisting for three months. The other lymphoedema service, although it initially agreed to treat patients with a 5% or more difference, no longer offered this service after a change in staff and it was not considered a priority to treat early arm swelling. When the patients were eventually treated they had a larger excess volume difference. The practice of early treatment should be encouraged, as, in the long-term, it may reduce workload, treatment costs and psychological morbidity. Martlew (2005) found that patients required fewer consultations if treated early and were discharged sooner because they were able to self-manage their mild condition.

This study suggests that comparing preoperative and postoperative measurements can lead to early diagnosis of lymphoedema. However, Stanton et al (2006) found that using pre- and postoperative arm measurements underestimates the incidence of mild lymphoedema. He says that objective clinical examination using four points of observation, in addition to arm measurements, is a better method of diagnosing early lymphoedema. With this method lymphoedema was diagnosed in cases where no changes in measurement were detected. Armer et al (2003) suggest using symptom assessment such as self-reported heaviness of the limb and whether swelling was present, combined with limb volume measurement pre- and postoperatively, as the best method to diagnose early lymphoedema. It may also be that a 5% difference may be too small to be detected by either patients or researchers.

Postoperative arm swelling has been frequently reported and is expected to be a problem that will resolve itself over

time (Mortimer, 1998). The researchers' expectation, based on anecdotal comments from surgeons, was that all patients would experience some degree of postoperative swelling. However, it was noted that only one in five patients ( $n=27$ ; 20.3%) had arm swelling two weeks after surgery. The link between early postoperative swelling and lymphoedema has not previously been established. This study showed a significant link, with 40.7% of patients with early (two-week) postoperative swelling developing lymphoedema, as opposed to the expected 18.8%. These results suggest that swelling at the two-week postoperative visit can be used to predict patients who may experience chronic oedema. Whether treating early postoperative swelling would decrease the incidence of lymphoedema needs further investigation. Box et al (2002) found that randomly assigning 65 patients to a treatment group and control group reduced the incidence of lymphoedema in the treatment group to 11, compared with the control group who had an incidence of 30. The treatment consisted of risk minimisation and early management of

**Table 3**

**Percentage of lymphoedema cases noticed by patient or researcher without the aid of objective measurement**

Site	Patient noticed	Researcher noticed	Unnoticed
Site A	7/13 (54%)	8/13 (62%)	4/13 (31%)
Site B	0/5 (0%)	0/5 (0%)	5/5 (100%)
Site C	6/7 (86%)	6/7 (86%)	0/7 (0%)
All	13/25 (52%)	14/25 (56%)	9/25 (36%)

**Table 4**

**A comparison of the percentage of patients identified as having lymphoedema defined as either >5% or >10% excess volume both with and without a preoperative reference measurement**

Arm lymphoedema	Comparing arm size using a preoperative reference measurement	Comparing arm size without using a preoperative reference measurement
>5% excess arm volume for more than three months	25/133 (18.8%)	31/133 (23.3%)
>10% excess arm volume for more than three months	6/133 (4.5%)	11/133 (8.3%)

the condition when it was identified. Early management (advice on skin care, exercise, provision of hosiery for wear as required and simple lymphatic drainage) of mild lymphoedema may be the gold standard treatment and minimise the extent of chronic lymphoedema (Martlew, 2005; Campisi et al, 2006).

This study demonstrates the importance of bilateral preoperative arm measurements at 4cm intervals for the detection of differences in arm volume following surgery and/or treatment. It is important to know whether volume changes have occurred in the affected limb alone or in both limbs. The difference between preoperative measurements and longitudinal follow-up measurements allows accurate comparison, which is essential for the detection of lymphoedema. The population identified as having lymphoedema would have been different if reference measurements had not been used.

Other studies also comment on the importance of reference measurements, which lead to more accurate assessment of swelling and more meaningful study comparisons (Armer et al 2004; Armer, 2005; Armer and Steward, 2005; Stanton et al, 2006). Pain et al (2003) argued that functional disability is more important than the degree of lymphoedema. However, early detection and treatment of lymphoedema in the absence of functional disability may prevent worsening of the condition and disability in the long-term (Box et al, 2003). It is also important to consider that people with breast cancer are often anxious about their risk of lymphoedema and prefer to have clear guidance and early treatment if swelling develops (Clark et al, 2005).

As found in other studies, the majority of patients who developed arm oedema first presented with symptoms between 3–6 months post surgery (Campisi et al, 2006). BMI was not found to be a risk factor in this study, however, this may have become significant with more participants, as the p value was close.

This study suggests that early postoperative swelling (measured at two weeks) is a significant risk factor in

the development of arm lymphoedema. Further studies are needed to corroborate these findings and to determine whether the treatment of early swelling would reduce the incidence of lymphoedema. **JL**

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#### Key points

- ▶▶ The incidence of arm lymphoedema was found to be twice as high in patients who had postoperative arm swelling two weeks after surgery in a group of 133 women who had treatment for breast cancer.
- ▶▶ Preoperative reference arm measurements detailing the natural difference between arms prior to surgery are important when diagnosing lymphoedema. In this study, if the reference measurement was not considered, the incidence of lymphoedema cases, as defined by volume differences between contralateral arm measurements, was nearly twice as high.
- ▶▶ Subjective assessment of lymphoedema by patients and/or researchers appears to be unreliable; 36% of lymphoedema cases were only detected by calculating excess arm volume.