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Wound drainage following radical mastectomy: the effect of restriction of shoulder movement

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SUMMARY

A randomized prospective clinical trial has been performed to determine the effect of temporary immobilization of the shoulder on wound drainage following radical mastectomy. In 64 patients admitted to the trial the mean volume of drainage was reduced by 40 per cent in those who had shoulder movement restricted for the first 7 days after operation when compared with the group in whom early arm exercises were encouraged. The mean drainage time was reduced by 29 per cent. Shoulder immobilization did not result in increased shoulder stiffness, although there was an increased incidence of mild lymphoedema of the arm.

SUBCUTANEOUS fluid collections may complicate any operation in which large skin flaps are raised. They are frequently encountered in the postoperative care of mastectomy patients, especially after the radical operation.

The traditional practice used to be to allow the fluid to escape via one or more open drains into a thick layer of dressings held in place by careful strapping or bandaging. Compression was used to inhibit the further formation of fluid and attempts were sometimes made to obliterate the dead space and to hold the flaps still by means of sutures. Orr (1951) used tension sutures tied over rubber tubing to hold the flaps against the chest wall, Keyes et al. (1953) tried multiple silk sutures together with drains, while Larsen and Hugan (1955) stitched down the flaps with up to fifty subcutaneous cotton sutures and advised extensive early shoulder movement. These methods were not without complication and were abandoned with the introduction of continuous closed suction drainage. Here, suction is usually maintained for several days until the drainage has almost ceased and the potential dead space is obliterated by adherence of the skin flaps to the deeper structures. Murphey (1947) was the first to describe suction drainage after radical mastectomy, and its superiority over open drainage was shown by Morris (1973) and by Bourke et al. (1976). In particular, the frequency of dressings and length of time until the removal of drains are reduced, and in Morris's series there was reduction in delayed wound healing and in the length of stay in hospital.

Large skin flaps would be expected to become more rapidly adherent to the underlying structures if they were held relatively immobile rather than subject to repeated movement, with consequent reduction in fluid formation. Nevertheless, there is no conclusive evidence that this is so. Riddell (1948) advocated discouragement of all movements at the shoulder joint following radical mastectomy because 'too early movement has caused separation of the skin edges of the flaps and increased the liability to serum collection, without any compensating advantage in the ultimate range of movement at the shoulder joint'. The majority of surgeons, however, probably recommend early arm movements because of the potential risk of developing shoulder stiffness. This procedure was standard in this unit, but considerable problems arose because of persistent wound drainage continuing sometimes two or more weeks after operation.

This controlled clinical trial was carried out to determine the effect of temporary restriction of shoulder movement on the volume and duration of wound drainage following radical mastectomy. An assessment was also made of the effect of this regimen on the incidence of shoulder stiffness and lymphoedema of the arm.

Patients and methods

During 8 months in 1973, 64 consecutive patients undergoing radical mastectomy for early breast cancer were admitted to the trial. All patients were nursed in the same ward of the Guy's Breast Unit at New Cross Hospital. The operations were all modified Halsted radical mastectomies performed to a standard technique by six surgeons. Diagnosis was confirmed histologically by open biopsy, either as a separate procedure or by frozen section as a preliminary to mastectomy. Elliptical skin incisions were marked out in ink and the skin flaps infiltrated subcutaneously with a solution of 1 : 400 000 adrenaline in saline to reduce haemorrhage. The flaps were cut to include some subcutaneous fat, and mastectomy performed with complete axillary node clearance together with *en bloc* removal of pectoralis minor, and a proportion of the sternal head of pectoralis major depending on the site of the tumour. Haemostasis was achieved by diathermy, with occasional catgut ligatures. The wound was then irrigated with hot (48 °C) sterile distilled water, with the objective of lysing any seeded malignant cells. Three Redivac drains were introduced with a trocar through the lower flap, one passing beneath each flap and one into the axilla, and sutured loosely in place to the chest wall with 2/0 catgut. The wound was sutured with interrupted silk by the method of 'halving' to match the flaps equally, sprayed with Nobecutane and covered with a light gauze and wool dressing held in place with Netelast. Skin grafting was not performed. The three drainage tubes were connected to vacuumed bottles, and after release of the clamps the flaps were gently massaged to evacuate any blood which had collected before the patient left the operating table.

At this stage the patient was randomly allocated to the trial by drawing an envelope from a box. On return to the ward, those patients who drew the 'fixed' option had the shoulder on the side of operation held relatively immobile by a triangular bandage. The bandage enclosed the upper arm and was tied around the waist. This prevented abduction at the shoulder whilst allowing a certain amount of internal and external rotation but, by leaving the forearm free, did not greatly inconvenience the patient. For those who drew the 'free' option the arm was left unrestricted, and arm movements commenced under the guidance of a physiotherapist from the second postoperative day. On the seventh day the triangular bandage was removed from the patients in the 'fixed' group and the same programme of arm movements was begun under supervision.

In both groups the wool was removed from beneath the Netelast on the third postoperative day, leaving a light gauze dressing covering the wound. Provided wound healing was satisfactory, one-third of the sutures were removed on the

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tenth day, one-third the next day and the remainder on the twelfth day. The drainage bottles were changed as often as necessary, and the volume of fluid in each was measured daily. Each drain was removed when it had produced 20 ml or less on 3 consecutive days. At subsequent inspection if a seroma had collected beneath the flaps it was aspirated by means of a needle and vacuumed tube (Vacutainer). This was repeated as required on an in- or outpatient basis until the reaccumulation of fluid had ceased. The total volume of drainage, the length of time until the removal of the last drain and the number and volume of aspirations were recorded.

All patients were assessed preoperatively, 2 weeks postoperatively and again as outpatients 1 month and 4 months after discharge from hospital. The wounds were inspected at least every 3 days until discharge from hospital, and if not then healed they were checked again weekly until healing was complete.

The following data were recorded:

Shoulder movements

1. Abduction and elevation (0–180°).
2. Internal and external rotation with the upper arm abducted to horizontal and the elbow flexed to 90°.

A note was also made of subjective shoulder stiffness and of any additional physiotherapy required following discharge from hospital.

Lymphoedema

The circumference of both arms was measured at points 20 cm above and 10 cm below the olecranon.

Wound healing

1. Delay in healing: (*a*) breakdown of the wound, defined as separation of the wound edge over any length; (*b*) necrosis of the flaps, judged as any area of sloughing greater than 5 mm in diameter at 14 days; (*c*) delay in removal of sutures beyond 12 days.
2. Wound infection, defined as purulent discharge from the wound, pus that could be aspirated, or cellulitis of the skin flaps associated with a pyrexia greater than 38 °C.
3. Wound haematoma, defined as a collection of fluid beneath the flaps which, when aspirated, appeared to be frank blood.

Clinically apparent postoperative chest infection and deep vein thrombosis were also recorded, as were any other significant complications.

The majority of patients received postoperative radiotherapy. Those with clinically uninvolved axillary nodes were part of another trial then in progress to compare radical mastectomy with wide excision of the lump in the treatment of 'early' breast cancer, and all received radiotherapy. Radiotherapy was only given to those with clinically malignant nodes if involvement was confirmed histologically. After the wound was fully healed, treatment was given to the axilla, supraclavicular triangle and internal mammary chain, in a dose of 3000–3300 rad given over 3 weeks. The percentage of patients who received radiotherapy was similar in the two groups (*Table I*), and all had completed treatment by the time of their follow-up examination at 4 months.

Results

Sixty-four patients were admitted to the trial. In the group with the arm unrestricted ('free') there were 29 patients whose age range was 28–77 years (mean 53·5 years). In the group with shoulder restriction ('fixed') there were 35 patients whose age range was 27–72 years (mean 51·4 years). *Table I* shows that the two groups were similar with respect to tumour size, lymph node involvement, radiotherapy and subsequent recurrence, thus excluding bias. The results were assessed statistically using Student's t test and the χ^2 test with Yates's correction.

Wound drainage (*Table II*)

In the 'free' group mean drainage volume was 1203·1 ml and mean total drainage time (including aspirations) 16·4 days, compared with 725·4 ml and 11·7 days respectively in the 'fixed' group of patients. These reductions in drainage volume and duration are significant ($P<0·01$ and $P<0·05$ respectiveely). Time postoperatively until the removal of the last drain was reduced from a mean of 13·7 days in the 'free' group to a mean of 11·2 days in the 'fixed' group, and there was a small reduction in the length of stay in hospital, but these differences are not statistically significant.

One patient in each group had a pocket of fluid aspirated before removal of the last drain. Following removal of all drains, 7 patients in the 'free' group had a total of 33 aspirations up to 60 days postoperatively, compared with only 2 patients requiring a total of 4 aspirations up to 18 days postoperatively in the 'fixed' group.

Shoulder stiffness (*Table III*)

One patient in the 'free' group died from metastatic disease just before her 4-month assessment was due and is therefore not included in the follow-up. No patient had restricted shoulder movement before mastectomy. There was no postoperative limitation

Table I: COMPARISON OF TRIAL GROUPS

	Fixed	Free
No. of patients	29	35
Age (yr)		
Mean	53·5	51·4
Range	28–77	27–72
Involved axillary nodes		
No. of patients	13 (44·8%)	15 (42·9%)
Mean no. of nodes	2·5	1·9
Postoperative radiotherapy		
No. of patients	21 (72·4%)	24 (68·6%)
Tumour recurrence at March 1978 (4½–5 yr)		
Recurrence	10 (34·5%)	12 (34·3%)
Died	6 (20·7%	8 (22·9%)

Table II: WOUND DRAINAGE

	Fixed ($n=29$)		Free ($n=35$)	
Drainage volume (ml, mean±s.e.)	725·4±77·3		1203·1±137·7†	
Drainage time (d)				
Total* (range and mean)	4–21	11·69±0·93	6–60	16·40±1·79‡
Until removal of all drains (range and mean)	4–21	11·17±0·92	6–31	13·66±0·93§
Aspirations				
No. of patients	2		7§	
No. of aspirations	4		33‖	
Hospital stay (d, mean±s.e.)	14·66±0·66		16·03±0·75§	

* Including aspirations.
Significance: † $t=2·862$; $P<0·01$. ‡ $t=2·195$; $P<0·05$.
§ n.s. ‖ $t=1·791$; $P<0·1$.

Table III: SHOULDER ABDUCTION AT 4 MONTHS

Group	Shoulder abduction: Limitation>30° (no. of patients)	Shoulder abduction: Mean limitation (degrees±s.e.)
Fixed ($n=29$)	8	19·8±3·3
Free ($n=34$)	13	21·2±3·6

The differences are not significant.

Table IV: LYMPHOEDEMA AT 4 MONTHS

	Fixed ($n = 29$)	Free ($n = 34$)
No. of patients with lymphoedema*		
1·0–2·5 cm	15	7†
2·5–4·5 cm	3	3‡
>4·5 cm	1	0‡
Lymphoedema (cm)		
20 cm above olecranon	0·88±0·23	0·57±0·19‡
10 cm below olecranon	0·83±0·25	0·22±0·21§

* Maximum of measurements above and below the olecranon.
Significance: † $\chi^2 = 5{\cdot}377$; $P<0{\cdot}02$. ‡ n.s. § $t = 1{\cdot}852$; $P<0{\cdot}1$.

Table V: OTHER COMPLICATIONS

	Shoulder restriction	
	Fixed ($n = 29$)	Free ($n = 35$)
Delayed discharge from hospital (beyond 12 d)	16	24
Delayed wound healing	8	12
Wound sepsis	5	4
Haematoma	1	2
Chest infection	1	1
Deep vein thrombosis	0	1*
Thrombophlebitis of arm	1	0
Late physiotherapy required	0	1

No significant differences.
* Patient died with metastases 4 months post-mastectomy.

of internal or external rotation at the shoulder in any patient at 4 months. Early in the postoperative phase there was considerable impairment in arm abduction in the 'fixed' group, but at 4 months there was no significant difference between the two groups. Only 1 patient, who had not had her arm restrained, had stiffness of the shoulder sufficient to require physiotherapy as an outpatient.

Lymphoedema (Table IV)
At 4 months there was mild lymphoedema (1·0–2·5 cm) in 15 patients in the 'fixed' group, compared with only 7 in the 'free' group ($P<0{\cdot}02$). There were 3 patients in each group at this time with moderate swelling (2·5–4·5 cm) and only 1 patient had severe lymphoedema (>4·5 cm). This patient, from the 'fixed' group, had only mild swelling of the upper arm, but had a 5·1-cm increase in forearm circumference. Overall, there was a mean increase in forearm circumference of 0·83 (±0·25) cm in the 'fixed' group compared with a mean increase at the same site in the 'free' group of 0·22 (±0·21) cm at 4 months ($P<0{\cdot}1$).

Other complications (Table V)
There was no significant difference in the rate of delayed wound healing beyond 12 days in the group that commenced arm exercise early, and no patient had suture removal delayed. The rates for other complications were similar, but the numbers were small.

Discussion

This trial has demonstrated that by limiting shoulder movement for 7 days postoperatively the amount of fluid drained from a radical mastectomy wound can be reduced by an average of 40 per cent, while the length of time until fluid formation ceases is reduced by about 29 per cent. As well as being a consequence of stabilization of the skin flaps, this is probably also due in part to a lessening of drainage from severed axillary lymphatics.

The results also suggest that an increase in the incidence of lymphoedema might be anticipated from routinely employing this method of postoperative care. The incidence of post-mastectomy lymphoedema varies in different series from 8 to 80 per cent (El-Kharadly and Enein, 1965) and is principally affected by the extent of surgery, the type and dose of radiotherapy and the incidence of infection. Atkins et al. (1972), in a series of 90 patients also treated at Guy's Breast Unit, reported an incidence of 81 per cent 3 months after radical mastectomy, 71 per cent being classed as mild (0–2·5 cm), 6 per cent as moderate (2·5–4·5 cm) and 4 per cent as severe (more than 4·5 cm). All their patients had postoperative radiotherapy and were given active arm exercises the day after mastectomy. The results of the present trial are of the same order, but suggest that there is a significant increase in lymphoedema, at least to a slight degree, as a result of restriction of arm movement for 1 week postoperatively. Four months after discharge from hospital there was a mean increase of 3 mm in circumference of the upper arm and of 6 mm in the forearm. The reason for this is obscure, though reduced arm movements may lead to interference with the pumping action of the muscle on venous and lymph flow, and may promote axillary vein thrombosis. Guthrie and Gagnon (1946) advocated mobilization of the arm to prevent post-mastectomy lymphoedema, and noted a high incidence of swelling in those with poor function, but did not show which was cause and which effect.

With regard to shoulder mobility, it is generally advised that movements should be commenced early to prevent stiffness. Healey (1971), in a prospective study of 271 patients, found that 34 per cent had some limitation of shoulder movement 1–4 years after radical mastectomy, 8 per cent being unable to abduct to 90°. Some of them had performed early exercises under the supervision of a physiotherapist, others had had no formal instructions. Moreover, Pollard et al. (1976), in a study of 192 patients having both radical and simple mastectomy, found that early physiotherapy resulted in significantly better shoulder movements than were obtained in those patients advised not to move the arm until suture removal at 7–10 days. These patients, however, were not randomly allocated to the two treatment options. The present trial does not confirm that any increased shoulder stiffness results from limiting shoulder movement after operation.

It is concluded that active shoulder movement immediately after mastectomy should not be advised. Drainage is increased in volume and duration, without affecting eventual shoulder mobility. The liability to lymphoedema may be increased but is limited in extent.

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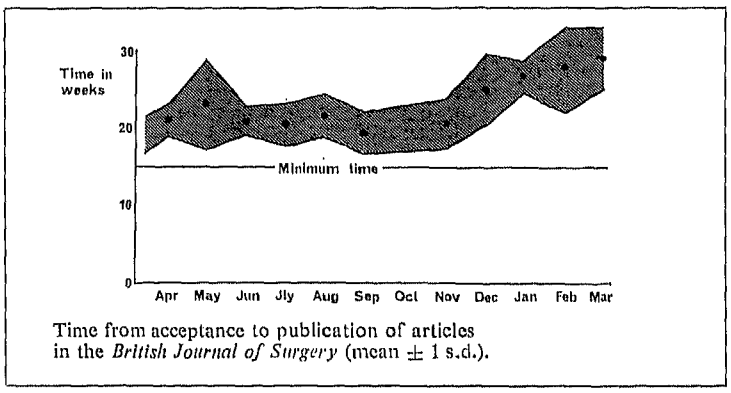

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