THE EFFECT OF SUCTION DRAINS AFTER TOTAL HIP REPLACEMENT

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A prospective study of 120 consecutive total hip replacements showed that deep suction drains produced maximal drainage volumes in the first 24 hours. Their continued presence resulted in minimal further drainage, did not reduce the likelihood of haematoma formation and led in some cases to the spread of skin organisms into the wound.

Deep suction drainage of wounds following total hip replacement has become an established routine in orthopaedic practice, with the aim of preventing wound haematomas and thereby reducing infection. Some previous workers have demonstrated that closed suction drainage is effective and provides a less complicated postoperative course (Waugh and Stinchfield 1961). Others, however, have produced evidence of the migration of skin micro-organisms along drains to deep surgical wounds (Cerise, Pierce and Diamond 1970; Nora, Vanecko and Bransfield 1972). Magee et al. (1976) showed that in contaminated experimental wounds the presence of drains enhanced infection by damaging host tissue resistance.

In an attempt to clarify the role of closed deep suction drains following total hip replacement, we decided to study a series of cases prospectively.

PATIENTS AND METHODS

One hundred and twenty patients who had undergone total hip replacement with a Charnley or Stanmore cemented prosthesis were studied. They were divided into three groups A, B and C depending on the time of removal of their "Redivac" suction drains at 24, 48 or 72 hours after operation. A primary arthroplasty was performed in 106 cases and a revision procedure in 14. The total volume of fluid drained at 12, 24, 48 and 72

hours after operation was recorded in each case. The antibiotic regime was comparable in all cases: 1G of Amoxycillin and 1G of Flucloxacillin two hours before operation and 0-5G of both antibiotics at six and 12 hours after operation.

Standard proprietary polyvinyl chloride (PVC) suction drains with an external diameter of 3 mm were used. These were attached by a closed system to pre-vacuumed glass bottles. Bottle changes were only made if the bottle became full or if the suction pressure fell below the recommended level (50 mm Hg). The suction tubing was clamped during bottle changes.

All the observations were made by the authors and they themselves removed all the drains. The drain tubing was removed at the bedside using a sterile technique. The exit site was exposed and a wet swab taken from the surrounding skin for culture. The drain was then extracted in one movement without contamination. The fluid content of the proximal portion of the drain (termed the deep aspirate) was cultured. A swab was taken from the surface of the proximal 4 cm of drain which had been in contact with the subcutaneous drain track; this also was cultured. Finally a fourth culture was taken with a sterile inoculating wire loop introduced (using a sterile funnel) into the drain track and scraped along the walls.

All culture samples were immediately plated out at the bedside onto aerobic and anaerobic blood agar, and cystine lactose electrolyte deficient media. They were then incubated for 48 to 72 hours. Any plate which showed a positive culture at this time for any site other than skin was then subjected to further identification and testing, and compared to the organism grown from the skin swab of that patient. The tests used to compare organisms were the antibiotic sensitivities screen and the Analytical Profile Index (API) system.

In the postoperative period all patients were observed for the presence of wound infection and the development of haematomas. A haematoma was graded "minor" if it delayed discharge from hospital but subsided spontaneously, or "major" if it was larger and required aspiration.

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Table I. Results of drainage

	12 hours n = 120	24 hours n = 120	48 hours n = 87	72 hours n = 28	12-hour loss (per cent) n = 120	24-hour loss (per cent) n = 87
Mean volume in <i>ml</i>	372	445	509	604	79	91
Range in <i>ml</i>	50 to 1090	60 to 1265	70 to 2150	295 to 2425	34 to 100	58 to 100

Table II. Mean drainage characteristics

Postoperative period	Number of cases	Mean volume in <i>ml</i>	Fraction of total loss (per cent)	Cases with no drainage
0 to 24 hours	120	445	90.9	0
24 to 48 hours	87	44.2	8.5	16
48 to 72 hours	28	23	3.8	14

RESULTS

Drainage

The results are given in Tables I and II. These may be summarised as follows:

All 120 cases. Within the first 12 hours from operation 79% (range 31 to 100%) of the total drainage occurred. The mean loss was 372 ml (range 40 to 1090 ml). Within the first 24 hours 91% (range 58 to 100%) of the total drainage occurred. The mean loss was 445 ml (range 50 to 1265 ml). Between 24 and 48 hours the mean loss in 87 cases was 44 ml (maximum 300 ml) and in 16 of these it was zero. Between 48 and 72 hours the mean loss in 28 cases was 23 ml (maximum 275 ml) and in 14 of these it was zero.

The 14 revision cases. In these, 69% of the total drainage occurred in 12 hours and 84% in 24 hours from operation. The volumes were 27 to 31% greater than in primary replacements (Table III).

Complications

Wound haematoma. Clinically a haematoma complicated recovery in 11 cases: two minor haematomas occurred in Group A (24 hour removal), seven in Group B (48 hour removal) and two in Group C (72 hour removal). Three of the seven in Group B and one of the two in Group C were major haematomas requiring aspiration. Of these nine cases, five recorded no drainage in the 24 to 48 hour postoperative period, prior to drain removal.

Wound infection. Superficial wound sepsis as indicated by redness, swelling and increased local temperature complicated five cases; one was in Group A, two in Group B and two in Group C. In no case was an organism isolated from the wound and all resolved with systemic antibiotics within ten days. In two of the five

cases positive cultures were obtained from the deep aspirate at the time of drain removal. In only one case was wound sepsis found in a patient with a haematoma; this was a minor haematoma in Group B and no positive culture was obtained at drain removal.

Positive cultures. In seven of the 120 cases a positive culture was obtained from a site other than the skin. In four of these cases the organisms were coagulase-negative staphylococci obtained from the deep aspirate; in two of these the same organisms were also grown from the surface of the drain. On API testing and antibiotic sensitivities, each of the four organisms were identical to coagulase-negative staphylococci grown from the skin swab from that individual (see Table IV). In three further cases pure cultures of organisms were obtained from the deep aspirate, the drain surface, the drain track and the skin: these were aerobic spore-bearing gram-positive rods, diphtheroid bacilli and *Escherichia coli* respectively.

DISCUSSION

In recent decades closed suction drainage systems have replaced simple conduit drains with claimed advantages of decreased infection and haematoma rates (Cruse and Foord 1973; Morris 1973). This supports the work of Waugh and Stinchfield (1961) who, in a prospective study, compared the postoperative complications of 100 various orthopaedic procedures using closed suction drainage with a similar number of undrained matched controls. Other workers, however, (Browett et al. 1978; Reilly et al. 1986) have shown no difference in the wound complication rate or postoperative morbidity of patients undergoing meniscectomy or total knee arthroplasty with or without suction drainage.

Table III. Results of drainage in the 14 revisions

	12 hours	24 hours	48 hours	72 hours	12-hour loss (per cent)	24-hour loss (per cent)
Mean volume in <i>ml</i>	471	585	702	876	69	84.4
Range in <i>ml</i>	100 to 750	275 to 1250	295 to 2150	295 to 2425	34 to 93	58 to 100

Table IV. Details of the positive cultures in seven patients

Case	Skin	Deep aspirate	Drain surface	Drain track	API testing and antibiotic sensitivity
1	Coag - ve staph. ASB Micrococcus	Coag - ve staph. ASB Micrococcus	No growth	No growth	Identical
2	Coag - ve staph. Gram + ve coccus	Coag - ve staph.	No growth	No growth	Identical
3	Coag - ve staph. Gram + ve coccus	Coag - ve staph.	Coag - ve staph.	No growth	Identical
4	Gram + ve rods ASB Staph.	ASB	ASB	ASB	Not applicable
5	Diphtheroid sp.	Diphtheroid sp.	No growth	Diphtheroid sp.	Not applicable
6	Gram - ve staph.	Gram - ve staph.	Gram - ve staph.	No growth	Identical
7	Coliform bacilli	Coliform bacilli	Coliform bacilli	Coliform bacilli	Not applicable

ASB, aerobic spore-bearing Gram positive rod.

Substantial evidence exists of the migration of skin micro-organisms into a wound along a drain. Following laboratory experiments Casey (1971) postulated the retrograde spread of organisms in static serum columns in polyethylene drainage tubing. This was demonstrated by Cerise et al. (1970) *in vivo*; they demonstrated the migration of skin organisms down a peritoneal drain in splenectomised rabbits, with subsequent infection of the dissection bed. Nora et al. (1972) re-affirmed this concept. More recently Raves, Slifkin and Diamond (1984) have shown convincingly that, with simple conduit drains, retrograde migration of bacteria occurs by 72 hours with relatively high frequency (75 to 90%); with closed suction drainage the frequency is much lower (20%). Thus it appears that there are advantages in using drains, but these advantages must be balanced against the small increased risk of retrograde spread of bacteria into the wound, a risk which appears to be reduced if closed suction drainage is employed.

From our investigation it is apparent that following total hip replacement most of the drainage along suction drains occurs in the first 12 hours; by 24 hours drainage is reduced to approximately 2 ml per hour until the drain is removed. We also found that wound haematomas were not related to the length of time the suction drain had been *in situ*: removal at 24 hours was not associated with

a higher incidence of haematoma formation ($\chi = 0.626$). Nine of the 11 haematomas occurred when the drain was removed at 48 to 72 hours, and five of these nine drains had been non-functional for the 24 hours preceding removal. Thus it is reasonable to assume that earlier drain removal would not have exaggerated haematoma development. Furthermore, it is possible that tube blockage could have caused arrest of drainage in the five cases referred to, and earlier drain removal, with the possibility of free drainage, might have reduced the haematoma.

The positive cultures obtained in seven cases from the deep wound aspirate were identical to skin organisms cultured from that patient. The identical analytical profile indices and antibiotic sensitivities of the staphylococci cultured do not conclusively prove the origin of the organisms, but make the patients' skin the most likely source. Of the positive cultures obtained, five were from drains removed at 48 hours and two from drains removed at 72 hours; in two of these seven cases clinical wound sepsis followed although no organism could be isolated from the wound swabs. In four of the seven positive deep cultures the same organism was isolated from the surface of the 4 cm of suction drain which were in contact with the superficial tissues deep to the skin. Although skin contamination of the drain surface during

removal cannot be excluded it seems unlikely as this was not observed in any of the other 113 drains removed which had sterile deep cultures.

This study re-affirms the risk of ingress of skin micro-organisms into the wound either by way of the drain or drain track with an increased rate of wound sepsis. This is seen, however, only if the drainage tube remains in situ more than 24 hours ($\chi = 0.825$, $0.10 < p < 0.05$). By 24 hours postoperatively, the majority of wound aspiration has occurred and the risk of haematoma formation is not reduced by the continued presence of the drain. We therefore conclude that deep suction drains should be removed at the earliest time when aspiration has been completed, and certainly by 24 hours postoperatively following total hip replacement. Failure to do so may subject the patient to an increased risk of deep sepsis.

His co-authors report with deep regret the sudden death of Chris Simmons while on duty on January 21, 1988.

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