AN INVESTIGATION INTO CONTAMINATION OF OPERATIVE SUCTION

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A study of the contamination of suckers used during total hip replacement has been undertaken. Thirty suckers used throughout the operation had their tips cultured: from 11 of these bacteria were grown. The organisms found were those which have previously been implicated in deep infection of total hip replacements. In subsequent operations a further 31 suckers were used for cleaning only the femoral shaft; of these only one was contaminated. This suggests that sucker contamination is related to how long the sucker is in use; consequently it is recommended that a new sucker be used for the preparation of the femoral shaft.

Deep infection is a serious complication of total hip replacement; it may necessitate further surgery and sometimes even excision arthroplasty. Many surgeons now believe that infection acquired at operation may only become manifest months or even years later (Charnley 1972; Glynn and Sheehan 1983). Prolonged use of suction during operation has caused concern because of the increased risk of infection. Large volumes of air are drawn through the wound and pass through the sucker and contamination of sucker tips from aspirated theatre air has been reported (Meals and Knoke 1978). This could have serious implications during total joint replacement as the contaminated tip would be in intimate contact with the depths of the wound.

This present study investigated the contamination of sucker tips by culturing those used in hip surgery, and set out to determine whether such contamination could be reduced by using a clean sucker at different stages of the operation.

MATERIALS AND METHODS

Two consecutive series of patients were studied. The first (Group 1) comprised two patients who had Thompson hemiarthroplasties and 28 who had total hip replacements; the second series (Group 2) consisted of four patients who had Thompson hemiarthroplasties and 27 who had total hip replacements. The operations were all performed on routine lists in the same operating theatre, which was used only for orthopaedic surgery. There was no laminar air flow system, but the theatre was maintained at a positive pressure with respect to the scrub room, anaesthetic room and corridors. The surgeons

wore conventional theatre gowns and two pairs of gloves. The prepared skin at the operation site was covered with an adhesive plastic drape which was then incised with the skin. All patients received a cephalosporin antibiotic prophylactically, the first dose being given with the premedication.

For patients in Group 1 the same sucker was used throughout the operation. The suction was switched on when the surgeon first required it, and was left aspirating continuously until the end of the operation. When not in use the sucker was placed in the diathermy quiver. The time for which the suction operated was recorded, along with the volume of aspirate accumulated at the end of the operation. Two centimetres of the sucker tip were cut off at the end of the operation and sent immediately in a sterile container for culture.

For patients in Group 2 suction was used as required, but when the femoral shaft was being prepared and cleaned a new sucker, the "femoral sucker", was used. In order to minimise the aspiration of air by this sucker it was replaced by a third one as soon as the

Table 1. Bacteria isolated from surgical suction tips

Organism	Number of isolates	
	Group 1	Group 2
None	19	30
<i>Staphylococcus epidermidis</i> *	7	1
Group C streptococcus*	1	0
<i>Streptococcus faecalis</i>	1	0
Diphtheroids	1	0
Micrococci	1	0
<i>Pseudomonas</i>	1	0

* One tip grew both *Staphylococcus epidermidis* and Group C streptococcus.

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Table II. Bacteria isolated at revision operations undertaken for infection

Organism	Charnley 1972	Fitzgerald <i>et al.</i> 1977	Kamme and Lindberg 1981	Besselaar and Marti 1983	Weber 1983	Present series
<i>Staphylococcus aureus</i>	33	10	7	14	3	
<i>Staphylococcus epidermidis</i> and coagulase-negative staphylococci	4	8	9	3	8	8
Micrococci		8				1
Streptococci		9		8	2	2
Group B streptococci			1			
<i>Diplococcus pneumoniae</i>			2			
<i>Escherichia coli</i>		2	4	2	1	
<i>Pseudomonas</i>	1	3		2		1
<i>Proteus</i> spp.	6	3	2			
Other Gram-negative rods	5	3	1			
<i>Propionibacterium acnes</i>			6			
Other Gram-positive rods (diphtheroids etc)		1			1	1
Peptococci			10	1		

femoral prosthesis was in place. The duration of use of the femoral sucker was recorded, and its tip was sent for immediate culture. The tips were cultured in thioglycolate broth (Difco) for 48 hours at 37°C and the broth was then subcultured onto chocolate agar (for incubation in 10% CO₂) and onto blood agar plates for aerobic and anaerobic incubation. All plates were incubated for 48 hours and the anaerobic plates for five days. All isolates were identified by standard methods (Cowan and Steel 1974), and staphylococci were speciated by API Staph (API Systems SA).

RESULTS

Of the 30 cases in Group 1, 11 (37%) showed bacterial contamination of the sucker tip. The commonest organ-

ism was *Staphylococcus epidermidis*. Of the tips cultured from Group 2 patients only one was contaminated. The organisms cultured are listed in Table I. The difference in the number of contaminated tips between the two groups is highly significant ($P = 0.002$, Fisher's exact test).

The duration of use of the suckers differed between the two groups ($P < 0.001$, Student's *t*-test). In Group 1, where the same sucker was used throughout the operation, the average time of use was 82 minutes (SD 20.2). In Group 2, where the sucker was used only for preparation of the femoral shaft, the average time was 17 minutes (SD 8.7).

There was no correlation between the rate of contamination and the volume of fluid aspirated, the number of surgeons involved, the number of people in the theatre, or the length of time since the operating list began.

DISCUSSION

Subclinical infection around the prosthesis has been implicated as a cause of late loosening, necessitating revision (Kamme and Lindberg 1981; Glynn and Sheehan 1983; Walenkamp 1983). Many authors have identified contamination at the time of operation as a major source of such infection (Charnley 1972; Kamme *et al.* 1974). A variety of species of bacteria have been found in patients whose prostheses were being revised for loosening (Charnley 1972; Kamme and Lindberg 1981; Besselaar and Marti 1983; Weber 1983; Fitzgerald *et al.* 1977). Table II compares these published findings with those in the present series. The distribution of species reported were similar, although anaerobes were less commonly found if no special arrangements were made for the transport of specimens for anaerobic culture.

In the present series the bacteria contaminating the sucker tips were similar to those found at revision of infected or loose prostheses (Table III). The relative pau-

Table III. The percentage incidence* of bacterial isolates in the published series listed in Table II, and in the present series

Organisms	Present series	Other published series
<i>Staphylococcus epidermidis</i> and coagulase-negative staphylococci	61	28
Micrococci	8	7
Streptococci	15	16
Group B streptococcus		1
<i>Diplococcus pneumoniae</i>		2
<i>Escherichia coli</i>		8
<i>Pseudomonas</i>	8	5
<i>Proteus</i> spp.		9
Other Gram-negative rods		8
<i>Propionibacterium acnes</i>		5
Other Gram-positive rods (diphtheroids etc.)	8	2
Peptococci		9

* The percentage incidence is calculated by totalling the incidence of each species throughout the series and expressing these values as percentages of the grand total of incidence for all species, having excluded the isolates of *Staphylococcus aureus*

city of anaerobes in our series may have been due to the lack of a special transport system. However, anaerobes are not commonly airborne, a fact which may also explain their low incidence on the sucker tips.

The complete absence of any growth of *Staphylococcus aureus* suggests that entry of this organism is not related directly to air contamination, as the sucker is simply a means of concentrating airborne bacteria. Instead, carriage into the wound may be by fomites, or by glove penetration.

Conclusion. This report has demonstrated that during the course of a total hip replacement the operative sucker becomes contaminated with precisely those organisms which have previously been implicated in deep infections; and further, that this contamination is directly proportional to the duration of use of the sucker. Such organisms might then be transferred from the sucker tip into the femoral shaft during preparation and cleaning. Although it has not been shown that infection has been caused by sucker contamination, the correlation between contamination and the length of time the sucker is in use suggests this possibility; consequently it raises doubts over the prolonged use of surgical suction devices in operations involving the implantation of prosthetic materials. It is recommended that if suction is to be used during total hip replacement, a new sterile sucker should be introduced when femoral preparation begins.

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REFERENCES

- Besselaar PP, Marti RK. Management of infected hip prostheses. In: Marti RK, ed. *Progress in cemented total hip surgery and revision*. Proceedings of a symposium held in Amsterdam on October 16, 1982. Amsterdam: Excerpta Medica, 1983:161-5.
- Charnley J. Postoperative infection after total hip replacement with special reference to air contamination in the operating room. *Clin Orthop* 1972;**87**:167-87.
- Cowan ST, Steel KJ. *Manual for the identification of medical bacteria*. 2nd ed. Cambridge: Cambridge University Press, 1974.
- Fitzgerald RH Jr, Noland DR, Ilstrup DM, Van Scoy RE, Washington JA II, Coventry MB. Deep wound sepsis following total hip arthroplasty. *J Bone Joint Surg [Am]* 1977; **59-A**:847-55.
- Glynn MK, Sheehan JM. An analysis of the causes of deep infection after hip and knee arthroplasties. *Clin Orthop* 1983;**178**:202-6.
- Kamme C, Lidgren L, Lindberg L, Mardh P-A. Anaerobic bacteria in late infections after total hip arthroplasty. *Scand J Infect Dis* 1974; **6**:161-5.
- Kamme C, Lindberg L. Aerobic and anaerobic bacteria in deep infections after total hip arthroplasty: differential diagnosis between infectious and non-infectious loosening. *Clin Orthop* 1981;**154**:201-7.
- Meals RA, Knoke L. The surgical suction tip: a contaminated instrument. *J Bone Joint Surg [Am]* 1978;**60-A**:409-10.
- Walenkamp GHM. The place of gentamicin-PMMA beads in revision arthroplasty. In: Marti RK, ed. *Progress in cemented total hip surgery and revision*. Proceedings of a symposium held in Amsterdam on October 16, 1982. Amsterdam: Excerpta Medica, 1983:147-54.
- Weber BG. Influence of surgical technique and laminar flow on infection rate. In: Marti RK, ed. *Progress in cemented total hip surgery and revision*. Proceedings of a symposium held in Amsterdam on October 16, 1982. Amsterdam: Excerpta Medica, 1983:43-6.