

## BACTERIA IN HIP SURGERY

### *A Study of Routine Aerobic and Anaerobic Cultivation from Skin and Closed Suction Wound Drains*

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One hundred and seven patients with closed suction wound drains after hip surgery were investigated with regard to bacteria in the drain. In one-third of the cases bacterial contamination of the wound was found. In more than half the total number of cases the bacteria in the wound were not identical with those found on the skin, either pre- or post-operatively. Anaerobe bacteria occurred only in one case. Penicillin administration considerably reduced the frequency of positive cultures. These findings support the prophylactic use of antibiotics in the prevention of late infections in endoprosthesis operations even when the early infection-rate is satisfactorily low.

*Key words:* wound infection; hip; drainage; antibiotic

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Wound infections are still a major problem in surgery and the literature on this topic is extensive; this is partly due to diverging and inconclusive definitions of "wound infection". The presence of pathogenic microorganisms in the operative wound may, however, be regarded as the central problem. The virulence, the number of microorganisms and the local conditions influencing their growth are some important factors which determine whether clinical infection will occur or not. The use of large implants may also result in complications from bacteria earlier regarded as apathogenic. Thus, the bacteria "normally" found in operation wounds are becoming increasingly interesting. The aim of this investigation was to study the frequency of different bacteria in the wound postoper-

atively, their correlation with the cutaneous flora and the symptoms from the wound. Since the problems of infection are at present of great importance, particularly in hip surgery, a material of "clean" hip operations was used for the study.

## MATERIAL AND METHODS

The study was carried out at the Departments of Orthopaedic Surgery and Clinical Bacteriology at the University Hospital of Umeå. Only cases of clean hip surgery operated on in the years 1973 and 1974 in which closed suction drains were applied are included. Operations performed during the summer months each year when the majority of the regular staff members were on vacation were excluded. No special routines such as a "clean air chamber" or local installation of antibiotics were used, but operating room discipline, according to standardized surgical prin-

Table 1. Patient material distributed according to method of operation.

	No. of cases
Operations using endoprosthesis + acrylic cement (total hip replacement 65 cases)	71
Operations using AO plate for fixation	22
Operations using Nyström or van Bahr nails	10
Operations of other types (e.g. elective operations for extraction of material for osteosynthesis)	4
<b>Total</b>	<b>107</b>

ciples, was emphasized. The operating theatres used belonged to a 15 room central operation department. Altogether 107 patients were included in this study (Table 1). In 18 cases, parenteral treatment with benzylpenicillin was begun at the time of the operation as prophylaxis against infection, a routine measure for operations lasting more than 90 min. The investigation was extended to the third post-operative week. The samples for bacterial culture were all collected in the orthopaedic wards. The following routines were used:

a. In all cases of hip surgery a blood plate was pressed against the skin at the trochanteric region before disinfection of the skin.

b. A sample from the drain fluid was taken when the drain container was emptied after operation. For this a sterile cotton stick was dipped into the drain fluid and put into an anaerobic transport tube (anaerobic culture tube, Labora) which was one-third filled with Stuarts medium and two-thirds filled with O<sub>2</sub> free CO<sub>2</sub> gas.

c. When no more drain fluid could be collected, the drains were removed. Before removal of the drain a sample was taken at the site of perforation of the skin using a cotton stick soaked in saline which was then transferred into an anaerobic transport tube (see above). Two cm of the inner part of the drain tube was cut off and put into an anaerobic transport tube.

Using the method described by Moore (1966) the transport tubes for anaerobes were opened in O<sub>2</sub> free CO<sub>2</sub> gas. The skin blood plates (a) were incubated aerobically at 37° C for 24 h. The two cotton sticks (b + c) were used to streak blood and haematin agar plates. Finally these sticks were used to inoculate an extract bouillon and an anaerobic trypticase soy broth (BBL). All media were incubated at 37° for 48 h.

The culture media were examined after 24 and 48 h before they were discarded.

The identification of the bacteria was performed according to Cowan & Steel (1970). Bacteria of the same species were accepted as identical if they also showed the same antibiogram in analysis with a panel of nine antibiotics.

A positive culture from the drain was regarded as indicating the presence of the actual organism in the surgical wound. The same is valid for a positive culture from the tip of the drain except for a few cases when the same organism was also found on the skin at the site of perforation by the drain.

## FINDINGS

The bacteria isolated from the skin are seen in Table 2. In some patients several species were isolated.

*Patients without prophylactic antibiotic treatment (89 patients. See Table 3):* Only one patient developed a deep wound infection requiring surgical treatment. This was a 76-year-old man suffering from coxarthrosis. Arthroplasty with a total hip prosthesis and acrylic cement was performed. After the operation fever and symptoms from the wound indicated an infection. *Clostridium welchii* was isolated from the two drains inserted at the

Table 2. Microorganisms cultured from the skin before operation.

Microorganism	No. of cases	Per cent of total
Staph. albus	94	88
Staph. aureus	23	22
<i>β</i> -streptococcus pyogenes (Group A)	1	1
<i>α</i> -haemolytic streptococcus	6	6
Streptococcus faecalis	6	6
Diphtheroid rods (aerobic)	2	2
Bacillus species	13	12
E. coli	3	3
Pseudomonas species	5	5
Candida albicans	1	1
Yeasts not specified	1	1
<b>Total number of patients</b>	<b>107</b>	

Table 3. Patients not treated with antibiotics (89 cases) tested for bacterial growth in the drain fluid and the tip of the drain.

Microorganism	No. of cases	Per cent of positive culture
Staph. albus	15	32
Staph. aureus	6	
$\alpha$ -haemolytic streptococcus	4	
Streptococcus faecalis	3	
Diphtheroid rods (aerobic)	2	
Clostridium perfringens	1	
Aeromonas sp.	1	
No growth	57	3

operation and the same organism was later cultured directly from the wound.

In 32 patients (36 per cent) bacteria grew in cultures from the wounds (Table 3). Apart from the case referred to above only aerobic bacteria were detected in the remaining cases. Of these patients with positive bacterial cultures from their wounds, 10 (31 per cent) had the same organism present in the preoperative skin culture, and six (18 per cent) had the same organism at the site of perforation of the skin by the drain.

In 16 patients (18 per cent) symptoms from the operation wound were noted,

Table 4. Patients not treated with antibiotics postoperatively (16 cases) but with symptoms from the wound. Species isolated from the drain fluid and from the tip of the drain.

Microorganism	No. of cases	Per cent of positive culture
Staph. albus	6	38
Staph. aureus	5	31
Streptococcus faecalis	1	
Diphtheroid rods	1	
Bacillus sp.	1	
Clostr. perfringens	1	
Aeromonas	1	
No growth	5	

e.g. slight secretion, haematoma or redness. Since these symptoms were neither severe nor long-lasting none of these patients was regarded or treated as having a wound infection. In this group bacteria were isolated from the drain in 11 cases (69 per cent) (Table 4). From some patients several bacterial species were isolated.

Among the 73 patients without any clinical symptom of infection 21 (29 per cent) had bacteria in the drain.

*Patients treated with penicillin prophylactically (18 patients):* In three cases bacteria were cultured from the drains (Staph. albus, two cases; Bac. subtilis, one case). Two other patients had symptoms from the wound but were not regarded as having wound infections.

## DISCUSSION

Thirty-one per cent of the patients with bacteria cultured from the wounds had the same organism in the preoperative skin culture. About 18 per cent had the same bacteria at the drainhole as in the wound. Thus more than 50 per cent of the bacteria in the wound seem to have come from sources other than the patient or from localisations on the patient other than the operation area.

A positive culture was about twice as common in the group of patients with symptoms from the wound as in the whole material. This indicates that in this group patients with transient wound infections or wounds containing haematoma or/and necrosis leading to diminished resistance to bacteria are also included. Deep wound infection occurred in only one case in the present series. Bacteria were, however, found in the wound in about one-third of the total number of cases. Earlier reports by Howe (1964), Howard et al. (1964), Fitzgerald et al. (1973) also suggest that bacterial contamination of the operation wound is much more common than clinically man-

ifested infections. The results of these observations indicate that a variety of organisms generally contaminates the operation wound, and that some strains were detected by a positive culture and in a few cases some strains caused clinical infection.

In this study the infection dose seems not to have been reached in most cases. As indicated by Kamme et al. (1974), low virulent bacteria otherwise regarded as apathogenic (e.g. staph. albus), may be involved in the so-called late infections occurring after endoprosthesis operations. Bacteria of this group were in this investigation frequently isolated from the inside of the wound. In the investigation of Kamme et al. (1974) anaerobe bacteria were not found to be uncommon in late infections. Against this background, it is interesting to note that anaerobes were rarely isolated from the wound in this investigation at the early phase after the operation. The discrepancy may be due to the low number and to the slow growth of anaerobes in the operation cavity at this early stage after the operation. The anaerobe bacteria found by Kamme et al. (1974) could also have reached the area later, i.e. by haemato-genous infection.

Recent findings by Ericson et al. (1973) indicate that prophylactic treatment with antibiotics significantly reduces the number of early as well as late infections. However, the opposite results have been reported by Tachdjian & Compere (1957). In this investigation a smaller number of positive cultures from the wounds in the group treated with penicillin was obtained as compared to the group without treatment.

Since the incidence of clinical infection is strongly influenced by the size of the infection dose our results suggest that

even under good conditions (i.e. an actual frequency of early deep infection of about 1 per cent), bacterial contamination in hip surgery occurs in about 30 per cent of all cases. This may mean that, despite the low incidence of early deep infections, there is a high risk of late infections at operations where endoprotheses are used. This supports the use of prophylactic treatment with antibiotics at every operation where a potential risk of late infection exists, even if the early infection rate is usually low.

## REFERENCES

- Charnley, J. (1972) Postoperative infection after total hip replacement with special reference to air contamination in the operation room. *Clin. Orthop.* **87**, 168-187.
- Cowan, S. T. & Steel, K. I. (1970) *Manual for the identification of medical bacteria*. University Press, Cambridge.
- Ericson, C., Lindgren, L. & Lindberg, L. (1973) Cloxacillin in the prophylaxis of late infections in total hip arthroplasties. *J. Bone Jt Surg.* **55-A**, 808-813.
- Fitzgerald, R. H. Jr., Peterson, L. F. A., Washington, J. A., Van Scoy, R. E. & Coventry, M. B. (1973) Bacterial colonization of wounds and sepsis in total hip arthroplasty. *J. Bone Jt Surg.* **55-A**, 1242-1250.
- Howard, J. M. et al. (1964) Postoperative wound infections: The influence of ultraviolet irradiation of the operating room and of various other factors. *Ann. Surg.* **160**, part 2, suppl.
- Howe, C. W. (1964) Bacterial flora of clean wounds and its relation to subsequent sepsis. *Ann. J. Surg.* **107**, 696-700.
- Kamme, C., Lindgren, L., Lindberg, L. & Märth, P.-A. (1974) Anaerobic bacteria in late infections after total hip arthroplasty. *Scand. J. infect. Dis.* **6**, 161-165.
- Moore, W. E. L. (1966) Techniques for routine culture of fastidious anaerobes. *Intern. J. Syst. Bacteriol.* **16**, 173-190.
- Tachdjian, M. O. & Compere, E. L. (1957) Postoperative wound infections in orthopaedic surgery. Evaluation of prophylactic antibiotics. *J. Int. Coll. Surg.* **23**, 797-805.

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