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ORIGINAL STUDY

Suction during orthopaedic surgery. How safe is the suction tip ?

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The use of a suction system is mandatory in most orthopaedic procedures. In the unlikely event of contamination of the system, deep wound infection could occur, jeopardising the operation.

We have prospectively studied 50 patients who underwent elective and orthopaedic trauma procedures during which a suction system was used. At the end of each procedure the suction catheter tip was sent for culture and microbiology. The suction tips showed bacterial contamination in 27 cases (54%). Staphylococcus species were responsible in 21 cases (77.8%). The tip was contaminated in only 1/11 procedures lasting less than one hour (9.1%), as compared with 26/39 procedures when operative time exceeded one hour (66.7%). However, deep wound infection was recorded in only one case.

We believe that despite the low risk of deep wound infection, changing the suction tip every hour in long orthopaedic procedures or using the on/off switch is well justified in an effort to minimise the chances of deep wound infection.

Keywords : suction tip ; contamination.

INTRODUCTION

The use of a suction system in order to clear debris, surgical smoke and blood is widespread in orthopaedic procedures. This system, when operating continuously, aspirates significant quantities of blood, fluids and air that are proportional to the amount of time the suction system is on and the level of negative pressure used. The continuous passage of large quantities of air through a blood-soaked catheter tip can lead to contamination, which in turn has been linked with the theoretical risk of deep wound infection (*5-7*).

We have carried out a prospective clinical trial in an effort to establish the risk of suction tip contamination in a non-ultra-clean air operating theatre environment and correlate this with the occurrence of deep wound infection.

MATERIAL AND METHODS

During a four-month period a total of 50 patients (27 women and 23 men) undergoing an orthopaedic

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Table I

Operative procedure	Number
Pertrochanteric fracture - ORIF	12
Subcapital fracture - Thompson hemiarthroplasty	11
Tibial plateau fracture - ORIF	5
Humeral shaft fracture - ORIF	3
Open Bankart procedure	3
Discectomy	4
Spinal decompression - posterior stabilisation	4
Acetabular fracture - ORIF	3
Patella fracture - ORIF	3
Forearm fracture - ORIF	2
Total	50

operative procedure were studied. The mean age was 57.2 years (range : 17 to 82) and according to our protocol the type of operation, the length of operative procedure and the operating surgeon were recorded.

A wide range of elective and trauma procedures were included in this study (table I). All procedures were carried out in the same non-ultra-clean air operating theatre by or under the supervision of four senior orthopaedic surgeons. All patients received 750 mg of cefuroxime as antibiotic prophylaxis on induction and for 48 hours thereafter.

A sterile disposable suction was used in all cases. This was connected to a suction bottle that was set at 1,500 l/h and was left aspirating continuously throughout the operation. At the end of each procedure the distal 3 cm of the suction catheter were cut off, placed in a sterile bottle and sent immediately to the microbiology department, where the suction tip was placed in nutrient broth for 48 h and then plated for culture. Ten control suction catheter tips, one every five procedures, were placed on the operating table in a separate quiver, and were cultured with an identical technique, in order to validate the microbiological technique and exclude contamination as a reason for positive culture.

RESULTS

Twenty seven out of 50 suction catheter tips sent for culture microbiology showed bacterial contamination (54%). In 23 of those cases (85.2%) the suction tip was contaminated with only one organism, while in the remaining 4 cases (14.8%) contamination with two organisms was recorded. This gave us a total of 31 isolates in 27 patients (table II). The culture was negative in all ten control suction tips.

Table II

Microorganisms	Isolates (%)
Staph. Aureus	6 (19,4%)
Coagulase negative Staph.	15 (48,4%)
Non-haemolytic Streptococci	2 (6,4%)
Micrococci	3 (9,7%)
E. Coli	1 (3,2%)
Diphtheroids	4 (12,9%)

* Positive cultures in 27 samples ; 4 double isolates.

Further result analysis showed that the culture was positive in only 1/11 (9.1%) operations lasting less than one hour (mean : 49 min, range : 25 to 60), while a positive culture was recorded in 26 out of the remaining 39 procedures (66.7%) where operative time exceeded 1 hour (mean : 119 min, range : 65-240 min). Suction tip contamination was significantly higher for operative length exceeding 1 hour (chi-test : $p = 0.011$). The incidence of contaminated suction catheter tips was not linked to any one surgeon or specific procedure.

Furthermore, contamination with Staphylococcus species was recorded in 21 out of the 27 cases with a positive culture (77.8%) and Staphylococcus species accounted for 21/31 isolates (67.7%). Patients were followed for a period of between six and twelve months and only one (Spinal decompression-posterior stabilisation) developed a deep wound infection, despite of the relatively high percentage of suction catheter tip contamination. The microorganism responsible for the infection was the same as the one contaminating the suction catheter tip during the initial procedure.

DISCUSSION

It has been suggested that the suction catheter tip may well be a reservoir for microorganisms and this seems to be the case in both conventional and ultra-clean air theatres *(3,6,7)*. The continuous passage of large quantities of air through a blood-soaked catheter tip can lead to its contamination, with the suction subsequently acting in theory as a source of wound contamination.

Previous studies suggest that contamination does not equal infection *(3,6-8)* and that cultures

performed during clean orthopaedic surgery may not be useful in predicting postoperative infection (*1*). However, there is evidence that contamination occurring during the time of surgery can be a contributing factor to subclinical or late infection especially around artificial joint prostheses (*2,4*).

Suction catheter tip contamination can occur both due to airborne and due to direct contamination by members of the operating team. The length of time the catheter is in use has been implicated with an increase in the incidence of catheter tip contamination. It appears that prolonged exposure of the suction tip to theatre environment increases the risk of direct contamination, while longer suction use increases the amount of air passing through it and therefore the risk of contamination from airborne contaminants. There are no studies though addressing the question if the length of an operative procedure is directly linked to the risk of suction tip contamination, nor do we know from what point onwards using the same catheter tip becomes less safe.

The contamination rate found in our study is somewhat higher than what has been reported in the past (16.6% to 41%). As it has been suggested though by Robinson *et al* (*7*), who report a suction catheter contamination rate of 41% in a laminar air flow theatre, this may partly be due to the exact culture technique used. Namely, in our study the suction tip was placed in nutrient broth for 48 hours and then plated for culture as opposed to direct plating.

Changing the suction catheter, especially when preparing the femoral shaft, has been suggested in the past as a potential way of reducing the incidence of catheter contamination (*3,6,7*). The resulting decrease in the incidence of catheter contamination when changing the suction catheter during the procedure has been attributed to its shorter time of use.

The present study was performed in a prospective fashion and included a wide range of orthopaedic procedures. To our knowledge it was the first one specifically targeted in elucidating the potential link between the length of suction use and its safety. It appears that operative length of more than one hour increases the risk of suction catheter contamination, raising it sevenfold from 9.1 to 66.7%. Furthermore, in light of the fact that in almost 80% of cases where the suction tip culture was positive a Staphylococcus species was present, adding an anti-staphylococcal agent to our prophylaxis scheme might be a reasonable option. As suggested in the past, placing the catheter in a holster containing an aseptic solution could also be a further means of reducing the rate of suction tip contamination.

Although contamination does not equal infection and the above statement made by other authors has been corroborated by our findings, the frequency of suction catheter contamination especially in procedures lasting over one hour is high enough to justify concerns. We believe that in the light of our findings changing the suction catheter every hour in long orthopaedic procedures or using a suction with an on/off switch so as to prevent continuous suction and therefore to minimise the amount of air passing through the suction is well justified.

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