Orthopaedic Infection – Audit of Theater Practices

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Prevention of infection remains one of the primary aims of the treatment in orthopaedic surgery. The role of antibiotics in the treatment of orthopaedic infections remains controversial. This study is the first step in evaluating the practice of sterilization and its efficacy in an orthopaedic theater of a teaching hospital. Specimens were collected from operating environment, ward environment, operating instruments, surgical gloves and infected wounds from the patients. Infective organisms were found on the most bizarre of the sites. Most interesting finding was the growth of Pseudomonas from the tip of sterilized drill bit and the same organism caused post operative wound infection. Methicilin Resistant Staph. Aureus (MRSA) was less of a problem in this unit but gram negative organisms were found at a majority of places. We believe that drastic measures are urgently required to improve the situation if we have to reduce the incidence of infection in our patients. Both gram positive and gram negative bacteria need to be addressed to with the prophylactic antibiotics like third generation cephalosporins.
Kay words: Orthopaedic infection audit

Prevention of infection remains one of the primary aims of the treatment in orthopaedic surgery. Most open fractures are contaminated with bacteria by the time patient reaches a hospital. Gustilo and Anderson, as well as Patzakis and Ivler[14], found that 60 to 70 per cent of their patients had a positive culture of a specimen that was taken from the site of the wound before treatment began. As orthopaedic surgeons we spend most of our time trying to control infection and keeping the non infected patients infection free.

The role of antibiotics in the treatment of orthopaedic infections remains controversial. While some investigators have advocated routine use of antibiotics[9,15], others have argued that thorough surgical debridement of the wounds and removal of the infected implants and foreign bodies is the main stay of treatment[13,17]. First generation cephalosporins being the most commonly prescribed antibiotics to prevent infection by Staphylococcus aureus infection, which is feared by most orthopaedic surgeons[9,14].

Audit is a continuous process of systematic analysis of an existing process to identify the problems and suggest methods of change. This study is the first step in evaluating the practice of sterilization and its efficacy in an orthopaedic theater of a teaching hospital. Our aim is to identify areas where a change in practice would be suggested and a repeat audit would be performed to close the audit loop.

Materials and Methods

A microbiologist (TE) collected microbiology specimens using Petri dishes and culture tubes with swab stick (commercially available) from the following sites (Table I) in the operating theater. All these specimens were then subjected to extensive analysis in the microbiology lab to identify the organism and its subtypes if required. Blood agar, MacConkey's media and Mannitol salt agar were used as the culture media for initial growth of the bacteria. Further identification of the organisms was carried out by several biochemical tests e.g; Oxidase, Catalase, Tripple Sugar Iron (TSI) Reaction, gram staining and. EPI-20-E System.

Further specimens were then collected from the infected wounds in the inpatients (Table II) and orthopaedic ward and operating theater environment including the air, linen, operating room floor and walls.

Additional specimens were collected from the surgeon's gloves and foot wear. All these specimens were submitted to the microbiology laboratory without any patient history (to reduce any bias).

All patients operated during the time of the study received first generation cephalosporins systemically from the time of induction till at least five days post-operatively or longer if there was evidence of wound infection.

No blood cultures or specimens from branulae / drain tips were taken. Dry cultures only were obtained from the wound surface, pus or blood using commercially available culture tubes (Table II).

Results

Most commonly isolated organism, both from the inanimate objects and patient wounds was Pseudomonas. It was found in nine[9] specimens of twenty seven[27] inanimate objects; therefore the incidence of contamination of the inanimate objects was 33.33%. It was also found in 27.7%[5]. infected wounds of the eighteen[18] specimens obtained from patients admitted in the orthopaedic unit at the time of this study. Table II

Second most commonly encountered organism was Staph. aureus. It was isolated from six[6] sources in the operating theater [22.22 %] and four[4] out of eighteen wounds i.e; 22.22%.

These results clearly show that similar infective organisms were isolated from the infected wounds as from the sources in the operating rooms and orthopaedic ward.

The results showed that almost all the items included in this study were contaminated with polymicrobial growth. Gram negative organisms were more commonly isolated than Stap. aureus. Both operating room and ward air specimens were contaminated with MRSA (Methicillin

Resistant Staph. aureus) and MSSA (Methicillin Sensitive Staph. aureus) along with other organisms. Interestingly these organisms were seldom isolated from any of the infected wounds (MRSA 13%).. Methicilin Resistant organisms are less of a problem in this unit. No Staph epidermidis was isolated from any of patient wounds.

Table I Data from the Inanimate Objects on the Orthopaedic Floor

Specimen Source	Culture Result
Spinal Trolly	Staph. Epidermidis
Unworn Reusable Gloves	Proteus + Pseudomonas
Scrub Nurse's Gloves–Reusable (after donning)	Proteus
Surgeon's Gloves –Single use (after donning)	No Growth
Operating Room –1 ------ Floor	Pseudomonas
Operating Room – 2 ------ Floor	Proteus + Baccilus
Operating Room – 3 ------ Floor	Staph. Aureus + Baccilus
Operating Room – 4 ------ Floor	E. Coli, S. Aureus , Proteus
Operating Room – 1 ------ Wall	Pseudomonas
Operating Room – 4 ------ Wall	S. Aureus +Pseudomonas
Operating Room – 1 ------ Light	Proteus + Pseudomonas
Operating Room – 2 ------ Light	No growth
Operating Room – 3 ------ Light	S. Epidermidis
Operating Room – 4 ------ Light	No Growth
Operating Room–4- Air Conditioner Ducting	S. Aureus + Proteus
Central Air Conditioner Ducting	S. Aureus
Tap Water for hand washing	Pseudomonas
Saline used for wound irrigation	S. Aureus
Hand Scrub	No Growth
Povidone – Iodine Solution	No Growth
Surgical Scissors (Unused)	Pseudomonas
Drill bit (Unused)	Pseudomonas
Ventilation Tube (Anaesthesia)	S. Aureus
Sterilised Gauze piece	Pseudomonas
Theater Shoes	Gram +ve and –ve contamination
Theater Air (Six(6) Random specimens)	Highly contaminated with MRSA, MSSA, S. Epidermidis, Fungi
Ward Air (Sixteen(16) Random specimens)	Highly contaminated with MRSA, MSSA, S. Epidermidis, Fungi

Sterilized gloves and instruments (scissors, drill bit and gauze piece), all were found contaminated with Pseudomonas. This can potentially innoculate these virulent organisms deep in the wound with grave consequences. The most disturbing fact was to find the infective organisms on the tip of a drill bit just before it was due to be used, the same patient was infected with the same (Pseudomonas) - Table II R17/1. The pseudomonas showed sensitivity to carbepanem group mostly whereas Staph. aureus were sensitive to vancomycin, fucidin and cephalosporins.

Table II: Data from Infected Patients

Pt. Identification Code	Culture Result	Remarks
R-6/1a	Pseudomonas	Open Fracture
R-6/1b	No Growth	No Injury
R-6/1c	S. Aureus	Skin wound
R6/2	Pseudomonas	Open Fracture
R6/3	Pseudomonas + S. Aureus	
R-6/4	Pseudomonas	
R-6/5	Proteus	
R-6/6	Mucoid E. Coli	Pelvic Fracture + Perineal wound
R-8	S. Aureus	
R-1	No Growth	
R-2	E. Coli	
R17/1	Pseudomonas	Contaminated drill bit, Pseudomonas
R-17/2	Proteus	
R-17/3	S. Aureus + Proteus	
R-15	No Growth	
R-3/1a	No Growth	Previously Infected and treated
R-3/1b	No Growth	Previously Infected and treated
R-3/2	S. Aureus	

Discussion

The findings in the present study draw our attention to a very grave situation in our operating theaters, which requires urgent attention.

Bourke (1985) in his experimental model found that the effect of antibiotics progressively lessened[2]. He also observed that antibiotic with a narrow spectrum of activity had more preventive effect. Antibiotics alone therefore can not be relied upon for infection control. This obviously has very important bearing on the management of open fractures.

Thus, the warning of Bowers et al.(1973) that caution should be exercised in extrapolating data on antibacterial prophylaxis in soft-tissue wounds to injuries of bone appears to be appropriate[3]. Infection is difficult to establish in healthy bone unless conditions favor the localization and proliferation of bacteria[10]. Also, infection in bone is difficult to eradicate once it has been established.

The first local response to wounding and bacterial contamination is an inflammatory reaction. An exudate forms and leukocytes migrate into the wound[11]. During the first few hours after inoculation, a large number of bacteria are killed by these local defense mechanisms[16]. The subsequent course of an infection is determined by the number of organisms that survive this period. In soft-tissue wounds in humans, the local defenses can deal with an inoculum of as many as 10^5 organisms per gram of tissue[6,12]. A larger number or the virulence of bacteria

overwhelms the local defenses, and infection results. Antibiotics may augment local defenses by enhancing this early killing of bacteria. However, even if the contaminating organisms are sensitive to the antibiotic, two factors may limit its effectiveness. First, if the wound is contaminated with a very large number of organisms, there may not be sufficient antibiotic to destroy enough of the bacteria to prevent infection. Second, the antibiotic may be prevented from coming into contact with the bacteria. Antibiotics penetrate necrotic tissue poorly and thus their action is hindered. The formation of a fibrinous coagulum that surrounds the bacteria and prevents their destruction by antibiotics has been demonstrated in some experimental wounds[8]. This is much more important in surgical wound infections where virulent bacteria are inoculated deep and they cause much severe infection.

The present study has identified a fault with the sterilization technique, environment / instrument interface and surgeon / instrument interface. All the specimens were collected from the orthopaedic floor where gram negative infections are expected to be relatively less common. On the contrary in this study most commonly grown organism (Pseudomonas and Proteus) are Gram negative. We were unable to pin point the source of infective organisms. We do hypothesize that these patients are infected / infested primarily in the poorly equipped emergency operating rooms (where the same operating room is shared by multiple specialties). These act as a pool of infection and act as a source of cross contamination of the electively admitted clean cases. They have usually developed resistance to the commonly used antibiotics.

In the present study we found out that although gram positive bacteria remain an important cause of post-operative wound infection, the gram negative bacteria (including Pseudomonas, Proteus and Eshericia coli) were found on almost all of operative instruments. They could therefore cause gram negative infection deep in the bone. This has an important bearing on the post operative management of these patients i.e; antibiotics covering gram negative bacteria would be required for prophylaxis as well as treatment in the post-operative period. We believe that systemic administration of broad spectrum antibiotics may decrease the incidence of post operative wound infection but this can not be substituted for the good operating theater management.

The findings in this study support an increased need for the vigilance on theater ergonomics. The sterilization and handling of the operating theater equipment also need improvement.

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