ORIGINAL ARTICLE

SURGICAL SITE INFECTION IN ORTHOPAEDIC IMPLANTS AND ITS COMMON BACTERIA WITH THEIR SENSITIVITIES TO ANTIBIOTICS, IN OPEN REDUCTION INTERNAL FIXATION

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Background: Surgical site infection in orthopaedic implants is a major problem, causing long hospital stay, cost to the patient and is a burden on health care facilities. It increases rate of non-union, osteomyelitis, implant failure, sepsis, multiorgan dysfunction and even death. Surgical site infection is defined as pain, erythema, swelling and discharge from wound site. Surgical site infection in orthopaedic implants is more challenging to the treating orthopaedic surgeon as the causative organism is protected by a biofilm over the implant's surface. Antibiotics cannot cross this film to reach the bacteria's, causing infection. **Method**: This descriptive case series study includes 132 patients of both genders with ages between 13–60 years conducted at Orthopaedic Unit, Ayub Medical College, Abbottabad from 1st October 2015 to 31st March 2016. Patients with close fractures of long bones were included in the study to determine the frequency of surgical site infection in orthopaedic implants and the type of bacteria involved and their sensitivity to various antibiotics. All implants were of stainless steel. The implants used were Dynamic hip screws, Dynamic compression screws, plates, k-wires, Interlocking nails, SIGN nails, Austin Moore prosthesis and tension band wires. Pre-op and post-op antibiotics used were combination of Sulbactum and Cefoperazone which was given 1 hour before surgery and continued for 72 hours after surgery. Patients were followed up to 4 weeks. Pus was taken on culture stick, from those who developed infection. Results were entered in the *pro forma*. **Results:** A total of 132 patients of long bone fractures, who were treated with open reduction and internal fixation, were studied. Only 7 patients developed infection. Staphylococcus Aureus was isolated from all 7 patients. *Staphylococcus aureus* was sensitive to Linezolid, Fusidic Acid, and vancomycin. Cotrimoxazole, tetracycline, Gentamycin and Clindamycin were partially effective. **Conclusion:** Surgical Site Infection is common in orthopaedic implants, occurring in 5.30% cases. *Staphylococcus aureus* is the common bacteria, causing it.

Keywords: Surgical site infection; Orthopaedic implants; Open reduction internal fixation; Close fracture

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INTRODUCTION

Surgical site infection in orthopaedic implants is a major problem, causing long hospital stay, cost to the patient and is a burden on health care facilities. It increases rate of non-union, osteomyelitis, implant failure, sepsis, multiorgan dysfunction and even death. Surgical site infection is defined as pain, erythema, swelling and discharge from wound site.[1–3]

Surgical site infection in orthopaedic implants is more challenging to the treating orthopaedic surgeon as the causative organism is protected by a biofilm over the implant's surface. Antibiotics cannot cross this film to reach the bacterias, causing infection. A number of microorganisms have been incriminated for surgical site infection in orthopaedic implants but *Staphylococcus aureus, E coli* are the two most common bacterias, causing implant infection. Most of these are resistant to various antibiotics. Currently, ampicillin and vancomycin are showing effectiveness against Staphylococcus Aureus while gentamicin, levofloxacin and amikacin are effective against E Coli. Both these bacterias are also sensitive to ciprofloxacin, ceftriaxone, cefoperazone, sulbactem, imipenem and Tazobactum.[1,2]

Risk factors, associated with surgical site infection in orthopaedic implants can be divided into patient related, hospital related; surgeon and operation theatre staff related risk factors. Patient related risk factors are comorbidities, malnourishment, dirty wounds, immunosuppressive drugs and vascular insufficiency. Hospital related risk factors include inadequate sterilization, lamellar air flow and cold operation theatres. Casual mood of surgeons, inadequate scrubbing, more movements into operation theatre and long duration of surgeries, are surgeon and staff associated risk factors.[4]

Various studies have shown different frequencies in different countries, even at different centres. About 2–5% develops surgical site infection after surgery.[2] We can minimize this frequency by

using titanium implants which resist biofilm formation, implants coated with antibiotics and monoclonal antibodies against fibronectin. Short pre-op hospital stay, prophylactic antibiotics, proper antiseptics, proper surgical techniques and Operation theatre's discipline; have decreased frequency of surgical site infection. Post-op hypothermia, recovery room supplemental oxygenation and post-op wound care, are other important considerations in reducing surgical site infection rates in orthopaedic implants.[5–7]

Treatment consists of culture and sensitivity based antibiotics and serial dressings. If union has already been achieved, remove implant and treat him with antibiotics based on culture and sensitivity report.[5] Staphylococcus Aureus in Biofilm can be effectively treated by rifampicin and rifamycin due to more penetration of these drugs into biofilm while Floroquinolones for Gram negative bacilli.[5]

This study aimed at identifying the frequency of infection at surgical sites in orthopaedic implants and bacteria involved with their antibiotic sensitivities in orthopaedic implants.

MATERIAL AND METHODS

This study was conducted at Orthopaedic unit of Ayub Teaching Hospital, Abbottabad, after approval from Hospital ethical committee. The duration of study was 6 months, from October 1st, 2015 to 31st March 2016. A total of 132 patients of both genders and close fracture of long bones, were included in the study. Sample size was calculated using World Health Organization software, using the formula to determine proportion with absolute precision 4%, confidence level 95%, anticipated proportion of outcome 5.7%.[1] The age limits were taken between 13 years to 60 years. Patients with comorbidities, immune-compromise and open fractures were excluded from the study group.

Diagnosis was established on the basis of history, examination and radiological findings. Patients were informed about his/her fractures and our study. Informed consent was taken. All pre-op baseline investigations were done. Pre-op antibiotic (Cefazolin), which was given to patients, one hour before starting surgery. Strict sterilization measures, scrubbing, and draping techniques were followed before surgery. Patients were continued on intravenous antibiotics for 72 hours, post-operatively. Patients were followed up to 4 weeks. Infected cases were inquired for any antibiotics, if using. Antibiotics were stopped for 72 hours. Pus taken from deep inside the wound and sent for culture and sensitivity to a single reliable laboratory. Meanwhile the patients were started on empirical antibiotics and daily dressing till the C/S report was available. Afterwards the patients were started on antibiotics as per culture report for duration of 3 weeks or till there was no discharge from wound. Combination of Sulbactum and cefoperazone was started as empirical antibiotic.[1] The data was entered in the predesigned pro forma.

Collected data was analysed by SPSS 10.0. Continuous variables like age were described in terms of mean±standard deviation. Categorical variables like type of implant, gender and infection was described in terms of frequencies and percentages. Data was presented in tables and graphs. Data was stratified by and gender and analysed. Chi-Square Test was used to know the significant difference with regard to outcome variables in gender at 5% level of significance.

RESULTS

A total of 132 patients with closed fractures of long bones were included in the study. Mean age of the patients was 39.67±13.307 ranging from 13 to 60 years. Out of total 132 patients there were 71 (53.8%) male and 61 (46.2%) female. Of these 36 (27.27%) were treated with dynamic hip screw for trochanteric fractures, 34 (25.75%) were treated with interlocking nails for shaft of femur fractures, 19 (14.39%) treated with surgical implant generation network (SIGN) nails for shaft of tibia fractures.

Radius ulna fractures, fixed with plates were 15 (11.36%) in number. Medial malleolar fractures, fixed with tension band wires and k wires, were 8 (6.06%) in number. Austin Moore prosthesis was used in 5 (3.78%) cases for neck of femur fractures. Sub trochanteric fractures of femur, treated with dynamic compression screws were 5 (3.78%) in number. Shaft of femur fractures, treated with dynamic compression plates were 4 (3.03%). Humerus plating for shaft of humerus fractures were 3 (2.27%) and 3 (2.27%) k wires and tension band wire fixation of olecranon fractures done out of 132 patients as shown in table 1. Of these 7 patients (5.30%) developed infection. Among these 7 patients 3 had, 1 each with Austin Moore prosthesis, humerus plate, radius plate and tension band wiring of the olecranon (Table-2)

Staphylococcus aureus was isolated from all infected cases. Only one (14.28%) (Tension band wire of the olecranon) was sensitive to ceftrixone. The remaining was resistant to cephalosporin group of antibiotics. Linezolid, fusidic acid and vancomycin was showing 100% effectiveness against *Staphylococcus aureus.* Resistance to Levofloxacin was 100%. Four cases (57.14%) show sensitivity to gentamycin. Six cases (85.71%) were sensitive to cotrimoxazole. Tetracycline sensitivity was in 5 cases (71.42%). Clindamycin sensitivity was in 4 cases (57.14%).

Table-1: Frequency of disease and procedure

Disease & Procedure	n	%
dynamic hip screw for trochanteric fractures	36	27.27
interlocking nails for shaft of femur fractures	34	25.76
SIGN nails for shaft of tibia fractures	19	14.39
Radius ulna fractures, fixed with plates	15	11.36
Medial malleolar fractures, fixed with tension band wires and k wires	8	6.06
Austin Moore prosthesis for neck of femur fractures	5	3.79
Subtrochanteric fractures of femur, treated with dynamic compression screws	5	3.79
Shaft of femur fractures, treated with dynamic compression plates	4	3.03
Humerus plating for shaft of humerus fractures	3	2.27
k wires and tension band wire fixation of olecranon fractures	3	2.27
Total	132	100

Table-2: Frequency of infection in different implants

Infection	n	%
Dynamic Hip Screw (DHS)	3	2.27
Austin Moore Prosthesis	1	0.76
Humerus plate	1	0.76
Radius Plates	1	0.76
Tension Band wiring of the olecranon	1	0.76
Total	7	5.30

Table-3: *Staphylococcus aureus* sensitivity to various antibiotics

Antibiotics	number of cases sensitive	Percentage of cases sensitive	Total infected cases
Linezolid	7	100	7
Vancomycin	7	100	7
Fusidic Acid	7	100	7
Co-trimoxazole	6	85.71	7
Tetracyclin	5	71.42	7
Clindamycin	4	57.14	7
Gentamycin	4	57.14	7
Ceftrixone	1	14.28	7
Levofloxacin	0	0	7

DISCUSSION

Surgical site infection, especially in orthopaedics, is very debilitating to the patient, overburden at health care services and burden over the economy of the patient and government. So, its frequency is kept to minimum by good setups (2.1%).[11] At set ups like ours, this rate is 5.76%, as reported by Khan et al in his study.[8] This is very much comparable to our study which is 5.03%. Our setup is not well developed, like those in which this rate is 2.1%, as reported by Jain et al, because of better sterilization methods.[11]

But our study is very much comparable to one that was held at Khyber Teaching Hospital, Peshawar by Salman *et al*., in 2014.[1] In that study the rate was 5.8%, very much comparable to our study. In some studies, it is approaching 12.6% even at good setups, like military hospital of Saudi Arabia, reported by Fattah.[12] But they have included both open and close fractures in the study. Infection rates in open fractures are very high. We only included close fractures in our study. This is probably the reason, why our setup has this much low infection rates as compared to those of Fattah.[12] Another study by Mulhim *et al*. reported an infection rate of 2.55%, as good as any good centre in the world.[10]

Orthopaedics implant infection is more difficult to control because of biofilm made over the implants. It is difficult for the drugs to enter it and clear the bacteria causing infection. Therefore, strict measures in scrubbing, draping techniques, sterilization of surgical instruments and implants, ought to be taken. Pre-operatively preparing the patient, optimizing the baselines, use of titanium implants, pre-op antibiotics use decrease infection frequency. Serious attitude of surgeon and operation theatre staff and lamellar airflow circulation system also decrease rates of infection. Postoperative measures which decrease infection rates are supplemental oxygenation in recovery room, avoiding hypothermia, optimizing nutrition, continuing intra venous antibiotics for 72 hours and post-operative wound care.[5–7]

The isolated bacteria in almost all studies, all around the world is *Staphylococcus aureus*, causing orthopaedic implant infections.[1,7,8,10] But its culture and sensitivity reports differ at different setups. Staphylococcus Aureus was the only bacteria isolated from pus that we sent for culture and sensitivity. We put the patients on oral antibiotics according to culture and sensitivity reports and daily dressings and debridement's for 3 weeks or till pus discharge stopped. All the patients responded to the treatment. No case underwent pre-mature removal of implant.

Staphylococcus aureus was the only isolated bacteria in our study. In other contemporary studies, Staphylococcus aureus and *E coli* was isolated.[1] *E coli* is a nosocomial infection. No case was infected by *E coli* in our study because of short hospital stay. Gram negative organisms were isolated by khan *et al* 7 years ago, in the same unit.[8] This change is possibly of improved operation theatre, sterilization and short hospital stay. Out of these 132 cases, no case was kept in ward for more than 48 hours. *E coli* was associated with prolong hospital stay in various studies. Polymicrobes are reported in open fractures which were highly contaminated at initial insult, as reported by Fattah.[12] Also, polymicrobes were reported by Mulhim *et al*, when they operated upon patients with soft tissue injury, in emergency operation theatre.[10] We included patients, operated on elective list.

Sensitivity to antibiotics is variable for some drugs, like Cotrimoxazole is effective against most staphylococcus Aureus but ineffective against one. This is a very encouraging sign to see the sensitivity

of this drug as it is cheap drug. The most common prophylactic antibiotic used in our tertiary care hospitals is third generation cephalosporins, reported by khan *et al*.[9] We also used combination of cefoperazone and sulbactum prophylactically. Sensitivity to Linezolid, Vancomycin and fusidic acid is 100% in our study. We used these drugs aggressively to prevent development of resistance, as reported by Slama *et al*.[13] Sensitivity of ceftriaxone has decreased, as was previously reported by Salman *et al*, in their study.[1] Only one patient's pus was sensitive to Ceftriaxone.

This probably due to injudious use of this Ceftriaxone. Similar to previous study of Salman *et al*, Vancomycin is still effective against Staphylococcus Aureus. This is probably due to its judious use.[1] Combination of Sulbactum and Cefoperazone was effective against *Staphylococcus aureus* in our study and of Salman et al, as well[1]. This was of great help in prescribing antibiotics, empirically to infected cases. Studies on sensitivity in orthopaedic implants are limited and further multi-centre studies are needed in this regard. This was probably one very important factor in early control of infection and will help us in future in infection control in orthopaedic implants.

CONCLUSION

Surgical site infection in orthopaedic implants occurs with unacceptably high frequency. *Staphalococcus aureus* is the bacteria responsible for surgical site infection in orthopaedic implants.

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