Surgical site infections in orthopedic implant surgery and its risk factors: A prospective study in teaching hospital

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Abstract

Background: Surgical site infections (SSI) in orthopaedic implant surgery is a devastating complication range from 1-2% to 22%. It leads to increase case cost, prolongs antibiotic use/abuse, increases morbidity and rehabilitation.

Method: This prospective study was conducted on 248 patients with closed fracture cases undergoing clean and elective orthopaedic implant surgeries admitted at Mandya Institute of Medical Sciences, Mandya (Karnataka), India between October 2016 to March 2017.

Results: The surgical site infection was diagnosed in 11 (4.435%) patients within 3 months after surgery. Staphylococcus aureus was the most common infective organism isolated in 54.54% cases. On data analysis SSI was significantly associated with increasing age, diabetes mellitus, smoking and anemia.

Conclusion: Incidence of SSI in implants surgeries are quite high, proper measure are needed to control it.

Keywords: Surgical site infection, orthopaedic surgery, risk factors

Introduction

Surgical site infection (SSI) is defined as microbial contamination of the surgical wound within 30 days of an operation or within 1 year after surgery if an implant is placed in a patient [1]. In orthopedics, the surgical site infection after implant surgery is a disaster both for the patient and surgeon [1]. SSI’s are one of the most common nosocomial infections besides pneumonia, urinary tract infections, and bloodstream infections [2]. SSI is the second or third most frequent infection among surgical patients. It is responsible for approximately 17% of all healthcare-related infections [3]. Surgical site infections cause increased morbidity, mortality, extended hospital in-patient stays, and economic burden to the hospital resources [4].

SSI’s related to orthopedic procedures represents a severe and catastrophic complication for patients, surgeons and hospital institutions, as an infection can extend the patient’s hospitalization time by up to two weeks, double re-hospitalization rates, increase care costs by more than 300%, besides causing important physical limitations that significantly reduce patients quality of life after the surgery [3]. Incidence levels of orthopedic SSI’s can range between 0.8 and 71%, [5-9]

The pathogenesis of infection in fractures fixation devices is related to micro-organisms, which grow in biofilm and therefore its eradication is difficult [10]. These infections are classified in to three stages, i.e., early (less than two weeks), delayed (2 to 10 weeks) and late (more than 10 weeks) infection [11]. In 1896, Brewer reported the infection rates of 39% in postoperative patients that was reduced to 0.2% with proper aseptic measures in recent times. At the beginning of 19th century, the rate of infection was reduced due to basic aseptic measures and antibiotic use. The most common infecting organism in orthopedic infection is Staphylococcus aureus [12]. Hence the present study designed to estimate the rate of infection in orthopedic implant surgery in a public hospital and also to identify causative organisms and risk factors associated with surgical site infections.
Material and Methods
This prospective study was conducted in department of Orthopedics at Mandy Institute of Medical Sciences, Mandya, Karnataka from October-2016 to March-2017. The inclusion criteria were closed fracture cases of either gender in all age groups admitted for elective implant surgery. Exclusion criteria were soft tissue surgery, open fractures needing external fixation devices, pathological fractures or patient with pre-existing cardiac/pulmonary/renal disease. The patients particular were recorded on a prescribed proforma which included name, age, sex, diagnosis, comorbidity, smoking history, nutritional status, type of implant, skin at risk as variables. All patients were given first generation cephalosporins as a standard practice prophylactic intravenous antibiotics on call to the operating room. Based on the criteria, patients were included in the study after taking informed written consent during postoperative period. Patients were observed for postoperative wound infection till discharge. The follow up will be done up to three months according to a protocol, first visit after two weeks and subsequent visits on monthly basis.

The diagnosis of infection was based clinical observations and microbiology reports which was done as routine investigations. If the aerobic cultures are negative, anaerobic culture will be considered. Infection will be graded superficial or deep and early, delayed or late. The infection will be considered superficial when it did not penetrate the deep fascia while the deep infection was inside the deep fascia. At least 3 swab samples from the most inflamed areas will be sent for culture to improve yield and minimize diagnostic error in a sterile culture tube. The risk factors assessed includes age, sex, duration of hospital stay, nutrition status, presence of diabetes mellitus, smoking habits, hypertension, anemia, whether drainage was performed, duration of drainage, open/closed reduction of fracture.

Results
Out of 248 patients, 165 (66.53%) were male and 83(33.46%) were female. Eleven (4.43%) patients developed infections out of which 8 were male and 3 were female. The superficial infection was in 2 (18.18%) patients, while deep infection was in 9 (81.81%) patients. There were 7(63.63%) cases of early infection and 2(18.18%) each in delayed and late stages. The age of the patients was more than 60 years in 7 (63.33%) patients with 5 (45.45%) patient having co-morbidities, 30 to 60 years in 2 (18.18%) patients and below 30 year in 2 (18.18%) patient.

The risk factors are shown in Table-1. The microorganisms implicated are shown in Table-2. The infection rate in different type of implant is shown in Table-3.

Out of 11 infected cases, implant was removed in 2 patients one with ORIF of peri-articular fracture and one operated with PFN, while the rest of the patients were treated with intravenous antibiotics and multiple debridement.

### Table 1: Risk factors

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Infected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advancing age (&gt;60 yrs)</td>
<td>2(18.18%)</td>
</tr>
<tr>
<td>Comorbidities in elderly patient(s)</td>
<td>5(45.45%)</td>
</tr>
<tr>
<td>Diabetes, anemia</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>3(27.27%)</td>
</tr>
<tr>
<td>Skin at risk</td>
<td>1(9.09%)</td>
</tr>
</tbody>
</table>

### Table 2: Micro-organisms implicated

<table>
<thead>
<tr>
<th>Micro-organisms</th>
<th>Infected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staph aureus</td>
<td>6(54.54%)</td>
</tr>
<tr>
<td>E-coli and proteus</td>
<td>2(18.18%)</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>2(18.18%)</td>
</tr>
<tr>
<td>Polymicrobial</td>
<td>1(9.09%)</td>
</tr>
</tbody>
</table>

### Table 3: Infection in different type of implant surgeries

<table>
<thead>
<tr>
<th>Surgeries</th>
<th>Performed</th>
<th>Infected</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS/PFN</td>
<td>42</td>
<td>3(27.27%)</td>
</tr>
<tr>
<td>AMP/Bipolar Prosthesis</td>
<td>47</td>
<td>1(9.09%)</td>
</tr>
<tr>
<td>Plating of long bone shaft fractures</td>
<td>61</td>
<td>1(9.09%)</td>
</tr>
<tr>
<td>Nailing of long bones</td>
<td>56</td>
<td>1(9.09%)</td>
</tr>
<tr>
<td>ORIF of peri-articular fractures</td>
<td>27</td>
<td>3(27.27%)</td>
</tr>
<tr>
<td>CRIF/ORIF with canulated screws</td>
<td>11</td>
<td>1(9.09%)</td>
</tr>
<tr>
<td>ORIF of tarsal bones</td>
<td>4</td>
<td>1(9.09%)</td>
</tr>
<tr>
<td>Total</td>
<td>248</td>
<td>11(100%)</td>
</tr>
</tbody>
</table>

Discussion
The incidence rate of surgical site infections found in the present study is 4.435% which is much higher than accepted standard for postoperative wound infection, which should be less than 1%. Our infection rate is comparable to another study in which the infection rate was 5% [13] and is much lower than other studies by K. S. Dhillon et al [14] they found infection rate in 6.8% while I.Onche et al [15] found 7.5 % and N. E. Ngim et al [16] found 9.38% infection rate. Marston et al [17] reported 5% superficial and 0.25% deep infection in 413 total hip replacements in ideal circumstances. According to some studies, the overall superficial and deep infection rate is 7.8% and 10% respectively [18] while we reported 0.806 % superficial and 3.629 % deep infection. The rate of postoperative wound infection without prophylactic antibiotic is high as compared to the use of prophylactic antibiotic [19]. Our infection rate with prophylactic antibiotic is 4.435% which is higher as compared to another study i.e., 3.97% [20].

The difference in incidence rate of SSI in different studies may be related to different inclusion criteria, different surgical set ups and facilities available.

In our study, we found that SSIs are more common in patients above 60 years of age. It may because of low immunity, increasing catabolism, increasing co-morbidities and low wound healing rates in old age patients [21]. Stephen Apanga et al, [22] Aikaterini Masagala et al, [23] Ibtessam K Afifi et al, [24] A.L. Akinyoola et al [25] and Khan MS et al [26] also reported that SSI is common in old aged patient.

Significant association of diabetes mellitus was found with SSI. Sachin et al [27], Yang K et al, [28] Ibtessam K Afifi et al, [24] Aikaterini Masagala et al [23] and Guo-qing et al [29] found that diabetes mellitus as independent risk factor with significant increase in the development of SSI. Delayed wound healing and neutrophil dysfunction may be the cause of increasing SSI among diabetics [24]. Anemia is also an important risk factor in development of SSI. Similar results were observed by Awan MS [30].

The timing of administration of antibiotics prophylaxis is also critical factor in development of SSI. The administration of antibiotics 2 hours or more before surgery or post-operatively was definitely associated with a higher SSI rate. The antibiotics should be administered ideally within 30 minutes and certainly within two hours of the time of incision [31]. So the selection of proper antibiotics and time of its administration can reduce the incidence of SSI to the great extent.
Staphylococcus aureus was predominant causative organism in this study which is 54.54%. Jadranka Maksimovic et al., Ibtesam K Afifi, Khan et al. and Wassaf MA et al. also found same organism. About 10-30% of healthy people carry this organism in their nares. Infections by these organisms can also be caused by patients themselves. Although eradication of Staphylococcus aureus nasal carriage with mupirocin was found to be effective, this measure reduced the surgical site infections rates only in some studies. Bedsheets, instruments and dressing have also been found to act as reservoirs of S. aureus. Rajvir Singh et al. recorded gram negative infections as major threat and isolated gram negative organisms in 75.6% cases. There are some limitations of the study. It covered a period of only 6 months and thus may not account for seasonal variations. Demographic characteristics of hospital population may be changed during winter. We have followed post-operative patients for only 3 months, but in implant surgeries infection can develop 1 year long after surgery.

Conclusion

Surgical site infections are a considerable problem in orthopedic patients. Our infection rate was quite high and infections associated with fracture fixation devices. Injury. 2006; 37(suppl 2):S59-66.


