International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(2): 340-343

www.orthopaper.com
Received: 09-01-2020
Accepted: 10-02-2020

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Incidence of early surgical site infection in clean orthopaedic cases undergoing implant surgeries

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DOI: https://doi.org/10.22271/ortho.2020.v6.i2f.2066

Abstract
Introduction: Surgical site infection (SSI) is defined as microbial contamination of the surgical wound within 30 days of an operation or which occurs within 1 year following surgery if an implant is placed in a patient. The rate of surgical site infections varies from 1.4 to 22.7%. SSI becomes financial burden to patient as well as grossly reduces his quality of life.
Method: This observational and follow up study was conducted on 200 patients over a period of one year in the Department of Orthopaedics, Himalayan Institute of Medical Sciences (HIMS), Dehradun, Uttarakhand. All clean orthopaedic cases presented to OPD or Emergency who underwent implant surgery was included in the study.
Results: Out of 200 patients, 17 (8.5%) patients developed early surgical site infection. Most infections were found in age group between 41 to 60 years. Important risk factors for SSI were longer pre-op hospital stay, open surgeries, long duration surgeries, and use of drains, diabetes, anaemia and smoking. Staphylococcus was most common bacteria associated with SSI. Gram negative bacteria were also significant indicating nosocomial infection.
Conclusion: Incidence of SSI after implant surgery is fairly high even in clean orthopaedic cases. Identification of risk factors and appropriate measures are needed to control it.

Keywords: Surgical site infection, clean orthopaedic cases, implant surgery, risk factors

Introduction
Surgical site infection (SSI) is defined as microbial contamination of the surgical wound within 30 days of an operation or which occurs 1 year following surgery if an implant is placed in a patient". Surgical site infection becomes a serious problem in orthopaedics, especially if it occurs after an implant surgery. SSI's pertaining to orthopaedic procedures represents a catastrophic complication as it can increase the hospital stay of patient by 10 to 20 days, readmission rates to hospital also increase, care cost becomes a financial burden for patient and the family, physical activities of patient are grossly restricted and there is a huge diminution to patients quality of life [1]. Since the times of Hippocrates era, the most noteworthy discoveries have contributed to the awareness about surgical site infections. The SSI rates resulting from orthopaedic procedures may vary from 1.4 to 22.7% [2].
Bacterial sources include the environment of the operation theatre, surgical instruments, and clothing worn by surgeon and assisting paramedical staff members, bacteria present on the patient's skin and bacteria which already exist in the body of the patient. Implant-associated infections are the result of bacterial adherence to an implant surface which further results in formation of biofilm at the implantation site [3].
In view of increasing trend of implant surgery in orthopaedics and the devastating course it may follow once infection occurs, we want to know the Incidence of early surgical site infections in clean orthopaedic cases undergoing implant surgery and probable factors responsible for SSI at a tertiary care teaching hospital. The purpose of current study is to identify the risk factors of SSI so that the final surgical outcome can be improved. It will not only help clinicians to reduce SSI's but also to lessen financial burden as well as the morbidity it carries with itself.

Materials and Methods
"This study was conducted in the Department of Orthopaedics, Himalayan Institute of Medical Sciences (HIMS), Swami Ram Nagar, Dehradun",

a tertiary care hospital in Uttarakhand, over a period of one year. All clean orthopaedic cases which presented to the OPD or Emergency and were treated with implant surgery were included in the study after taking written Informed consent and Ethical clearance from the Ethical committee of the university.

Selection of subjects

Inclusion Criteria

1. All clean orthopaedic cases undergoing orthopaedic implant surgeries were included in the study.

Exclusion Criteria

1. Patients who had some active source of infection like respiratory or urinary infection or any other septic foci.
2. All open cases.
3. Non-implant surgeries.
4. Revision Surgeries.

Study Protocol

All implant surgeries were performed under aseptic precautions. Second generation Cephalosporin's were used for perioperative antibiotic prophylaxis. Antibiotics were given half hour before surgery and repeated per-operatively if surgery lasted for more than 2 hours. In post-operative period, the length of antibiotic cover depended upon duration and type of surgery. In surgeries lasting for > 2 hours and for more extensive surgeries antibiotics were given for > 48 hours. Dressings were changed on 3rd, 5th, 7th, and 11th day or as required. Patients were followed clinically till 1 year after surgery for signs & symptoms of surgical site infection (1). In case of any sign or symptoms of infection, patients were evaluated clinically and investigated haematologically & microbiologically. A case reporting form was used to collect the data from patients.

Results

A total number of 200 patients were included in this study during the period of 1 year. All cases were clean and underwent implant surgery. Out of 200 patients there were 130 (65%) male and 70 (35%) female. Out of these 200 patients, 17 (8.5%) patients developed early surgical site wound infection. In this study maximum infections were found between 41 to 60 years of age (10.53%). Males were infected in 13% of cases while females had infection rate of 5.71%. In this study, it was found that open surgeries had more surgical site infection rates (9.93) than closed ones (5.01).

Table no. 1 depicts association of SSI with pre-operative hospital stay and Table 2 depicts distribution of surgical site infection according to duration of surgery. Association of SSI with diabetes and smoking is depicted in table no. 3 and 4 respectively. Table no. 5 shows distribution of microorganisms among implant related infections.

Table 1: Association of SSI with pre-operative hospital stay

Pre-op hospital stay	No. of patients	Non-infected	Infected	Chi-square (p value)
24 to 48 hours	138	127	11 (7.98 %)	0.257 (0.69)
48 to 72 hours	39	37	2 (5.1 %)	
>72 hours	23	19	4 (17.4 %)	

Table 2: Distribution of surgical site infection according to duration of surgery

Duration of surgery	Number of Surgeries (n=200)	Non- infected (n=183)	Infected (17)	Chi-square (p-value)
< 1 Hour	8	8	0.00	2.74 (0.433)
1 – 2 Hours	90	85	5 (5.56%)	
2.1- 4 Hours	95	84	11 (11.58%)	
>4 Hours	7	6	1 (14.29%)	

Table 3: Association between surgical site infection and diabetes

	Total patients	Non- infected	Infected (n=17)	Chi-square (P value)
Non- Diabetic	183	171	12 (6.56%)	10.446(0.0054)
Diabetic	17	12	5 (29.411%)	

Table 4: Association between surgical site infection and smoking

Smoking	Number of patients (n=200)	Non-Infected	Infected (n=17)	Chi-square (P- value)
Non smoker	184	171	13 (7.06%)	6.087(0.0476)
Smoker	16	12	4 (25%)	

Table 5: Distribution of microorganisms among implant related infections

Organism	Number of cases	Percentage
Acenatobacter	2	11.76 %
Coagulase -ve Staphylococcus	5	29.41 %
Enterococcus Species	2	11.76 %
Klebsialla Pneumonae	1	5.9%
Psuedomonas Aerugenosa	1	5.9%
Staphylococcus Aureus	4	23.52%
E coli	2	11.76

Discussion

Orthopaedic implants have transformed the management of fractures and non-infectious joint arthritis. Today, the risk for orthopaedic implant–related infection is <1–2% [3]. The incidence rate of early surgical site infections found in the present study is 8.5% which is higher than accepted standard for early postoperative wound infection, which should be less than 1% [1] as per western literature. Franco LMC *et al*. concluded surgical site infection rates in hospitals in the United States ranges from 2% to 5% [4] and Ercole FF detected infection rate of 1.8% in a public hospital in Brasil [5]. However our infection rate is comparable to the infection rates in hospitals of most of the Asian countries. Study conducted by Amardeep G *et al*. detected infection rate of 4.435% [1] and study conducted by Jagiasi JD *et al*. found infection rates of 12.27% [6]. This may be implicated to poor general hygiene, nutritional status of the patients and lack of strict implementation of standard protocols to prevent SSI.

Duration of surgery was also very important factor as longer duration surgeries had high infection rates. Surgeries performed for more than 2 hours had infection rate of 11.58%. Duration of surgery was also found to be important risk factors in many other studies. Afifi IK *et al*. detected infection rate of 3.13% [7] and Tahir M *et al*. detected infection rate of 28.29% in surgeries performed for more than 2 hours [8]. Surgical time of <1 hour is associated with an infection rate of approximately 0.3%, doubling the surgical time triples the infection rate [8].

Out of 200 surgeries 141 were done with open reduction and 59 with closed reduction. Surgeries done with open reduction had high infection rates (9.93%) then surgeries done with close reduction internal fixation (5.08%). Amardeep G *et al*. [1] found infection rate of > 30% in open surgeries, this is because once skin is breached, commensal bacteria and other contaminants can enter the wound and cause infection. Soft tissue injury leads to impaired vascularity also enhance the chances of infection in open reduction.

Pre-operative hospital stay was also found to be important factor for surgical site infection. In this study, infection rate in patients operated after 72 hours of admission was 17.5% (4/23). Patients who were operated between 24 to 72 hours of admission had infection rate of 5.1% (2/39). Similar observations were found in study conducted by Jain BK, Banerjee M with infection rates of 26.92% in pre-operative stay of more than 72 hours [9]. Ikeanyi UOE *et al*. detected infection rate of 19% in patients having pre-operative stay of more than 72 hours and also concluded that patients with more than 5 days of pre-operative stay were almost 5 times more likely to develop infections than those stayed less [10].

Surgeries done with plate fixation also had more infection rates (11.76%) then performed with nailing (8.16%) and this may be implicated to open reduction in most of the surgeries performed with plates. Salman M *et al* also had similar observation with infection rate of >20 % with plating [11].

Use of drain was also found to be associated with high chances of surgical site infection and in present study infection rate with surgeries with drain was 12.5% (2/16) in comparison to surgeries without drain i.e. 8.15 % (15/184). Use of drain was found to be associated with high infection rates in many studies including Affifi IK where infection in surgeries with drain application was 8.66 % [7]. Drain is in contact with external environment where it is attached to collection bag and bacteria may enter during emptying it. Bacteria may also enter the surgical site through the insertion of drain. Drain also causes local tissue inflammation thus making it prone to infection. It becomes available for biofilm formation for bacteria on its surface.

Diabetes was found to be important factor for surgical site infection and infection rate was 29% in diabetics. This was similar to many other studies including study conducted by Amradeep G *et al*. where diabetes was one of the most important risk factors for surgical site infections [1]. Jagiasi JD also reported surgical site infection rate of 23.81% in diabetic patients [6]. Hyperglycaemic state impairs immunity by weakening antibacterial defence of neutrophils and phagocytes [12]. Diabetes mellitus inhibits fibroblast proliferation and collagen synthesis which affects wound healing [13].

Anaemic patients were more prone for infection and had infection rate of 15% in present study. This was comparable to other studies including Tondon *et al* where infection in anaemic patients was 11.67% [14]. Anaemia is indicative of poor nutritional status of the patient which leads to poor wound healing.

Smoking was found to be strongly associated with surgical site infection. In our country and region smokers also have and addiction of tobacco chewing. Infection rate of this combined addiction is 25% in present study. Smoking was considered as risk factor in many other studies including Mardanpour K *et al* where infection in smokers was 9.1% [15]. This is because smoking reduces the immunity as nicotine affects neutrophils that defend against infection and hence increases the chances of infection. In addition, chronic smokers also have reduced vascularity in their limbs leading to poor wound healing.

In this study, gram positive bacteria were responsible for 65% of infections and gram negative bacteria were implicated in 35% cases. The most common bacteria associated with orthopaedic device related infection in our study were staphylococcus (53%). Several other studies had similar results. Afifi IK et detected staphylococcus in 20% of infections [7]. This strongly implicates the intraoperative contamination as these are the main skin commensals. Bed sheets, dressing trollies and instruments have also been found to act as reservoir of staphylococcus aureus. Acenatobacter (11.6%), enterococcus species (11.76%) and E.coli (11.76%) were also predominantly found to be associated with SSI. Klebsiella pneumonae and Pseudomanas aerugenosa were 5.9% each. Overall infection rate with gram positive bacteria was 64.7% in comparison to gram negative which was 35.21%. This was also found in many studies including study done by Jagiasi JD *et al*. [6] Presence of Gram negative bacteria is indicative of hospital acquired infection.

Conclusion

Surgical site infections are considered to be one of the most dreaded complications after any orthopaedic implant surgery both for the surgeon as well as the patient. The surgical site infection rate in our study is 8.5% which is similar to the infection rates seen in other developing countries according to current literature. This rate is much higher when compared to the rate of infection found in the developed nations.

The most significant factors affecting the rate of infection according to our study are: Pre-operative hospitals stay of more than 48 hours, duration of surgery for more than 2 hours, surgeries done by open procedures, use of drain. Nicotine consumption in any form whether tobacco chewing or smoking was also found to be important risk factors. In our study we also found that Diabetes mellitus and anaemia are very important risk factors for SSI.

Surgical site infection is usually multifactorial in origin hence we should give consideration to each and every factor to prevent it. Strict adherence to pre-operative infection control protocols may curtail the complication of surgical site infection.

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