Original Article

Wound infections in orthopaedics: A report of the bacteriological pattern and their susceptibility to antibiotics

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Abstract

Background: Surgical wound infections are increasingly becoming difficult to manage with the rise of drug resistance among the bacterial isolates. With the use of implants for open reduction and internal fixation which are foreign bodies, trauma surgeries remain a grave risk for infection. **Aims**: To find the causative agents of surgical wound infections and their antibiotic susceptibility pattern among orthopaedic patients and also to observe changing trend of infection pattern. **Materials and Methods**: During six years of the study (2009-2014) 10808 pus or aspirate samples from surgical site wound infections of the patients attending the OPD and wards of the orthopaedic department were processed in the laboratory. Samples were cultured and identification was done using conventional methods. The antibiotic susceptibility test was performed using the Kirby Bauer's disk diffusion method as per Clinical Laboratory Standards Institute 2013 guidelines. The ESBL and MRSA were detected by standard methods. **Results**: The overall culture positivity rate was estimated at 53%, out of which 46% were from the inpatients and 54% from the OPD. *Staphylococcus aureus* was isolated in 34%, out of which 48% were methicillin resistant *Staphylococcus aureus* (MRSA). Among the gram-negative bacteria, *P. aeruginosa* (18%), *Klebsiella pneumoniae* (18%), *E coli* (11%) and *Acinetobacter baumanii*(8%)were isolated. A gradual increase in the antibiotic resistance against the commonly used drugs was observed in both the gram-positive and gram-negative flora. **Conclusion**: The incidence of wound infections in the orthopaedic cases is high. The drug resistance is an emerging problem.

Keywords: Antibiotic resistance, Orthopaedics, Surgical wound infection.

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INTRODUCTION

The newer techniques and sophisticated tools used for treatment has led to an alarming rise of surgical wound infections in the past few years[1]. Surgical wound infections are one of the most common nosocomial infections besides pneumonia, urinary tract infections, and bloodstream infections[2]. The CDC had published definitions for nosocomial infection in 1988, which had included surgical wound infections. In 1992, the definitions for Surgical Site Infections (SSI) were modified to include three wound locations: superficial incisional SSIs, deep incisional SSIs and organ space SSIs[3]. Among the nosocomial infections surgical wound infections have the highest prevalence rates in the orthopaedic wards[2]. These infections are commonly caused by bacteria, among which, *Staphylococcus aureus* is the most frequent causative agent. Other common bacteria are *Enterococcus* spp, *Pseudomonas aeruginosa*, *Escherichia coli* and other members of the family Enterobacteriaceae. Among the orthopaedic patients, *S. aureus* accounts for the majority of these surgical wound infections. In these patients, such infections are difficult to treat because these organisms can form biofilm on the orthopaedic implants that renders them resistant to antibiotic treatment and can thereby compromise eradication of infection[4]. Antibiotic-resistant strains have

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increasingly been associated with these infections. Methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE) and extended spectrum beta-lactamase (ESBL) producing gram-negative bacteria are of particular concern. Studies have shown that the antibiotic resistance described in *S. aureus*, *E. coli*, and *P. aeruginosa* to the commonly used antibiotics such as ampicillin, trimethoprim-sulphamethoxazole, gentamicin, chloramphenicol and third-generation cephalosporins were relatively higher in developing countries (50-100%) as compared to that in the developed countries (0-50%). However, in both the situations the resistance to oxacillin, erythromycin and clindamycin among the *S. aureus* that were isolated were substantially high (10-60%)[4,3,5]. The rise of antibiotic resistance among the bacterial pathogens is usually due to the improper use of antibiotics. This may be contained by developing hospital based empirical treatment policy depending upon the common antibiotics used in the particular hospital along with the antibiotic susceptibility data that is generated by the laboratory. Methicillin-resistant *Staphylococcus aureus* (MRSA) are isolates of *S. aureus* which have acquired genes encoding antibiotic resistance to all penicillins including methicillin. This resistance is mediated by an altered penicillin binding protein (PBP2a) which is encoded by the *Mec*A gene. They were first discovered in the United Kingdom in 1961 but have now become a major clinical problem worldwide[6]. This study was carried out to see the changing pattern of bacterial flora and their antibiotic susceptibility pattern in the surgical wound infections in orthopaedic patients.

MATERIALS AND METHODS

This study was conducted over a period of six years (January 2009 - December 2014) in the Department of Microbiology and the 150 bedded Institute of Orthopaedics attached to a tertiary care hospital in New Delhi. The liquid pus samples, exudates and pus swabs from the surgical wounds of the patients, admitted in the wards and also from the outpatient department, were processed in the microbiology laboratory. Through the six years, 10808 samples were processed in the laboratory (1668 samples in 2009, 1801 in 2010, 1946 in 2011, 1171 in 2012, 1396 in 2013 and 2226 in 2014). The samples were cultured on 5% Sheep Blood agar, MacConkey agar plates and a Brain Heart Infusion (BHI) broth. These were then incubated overnight at 37°C and then examined for the presence of growth. The sterile plates were re-incubated till 48 hours. Subculture of the broths was done using standard procedure whenever it is indicated. The isolates were identified using conventional methods[7]. Anaerobic cultures were done only in cases of suspected anaerobic infections by the clinicians. Direct microscopy after gram staining was done. Antibiotic susceptibility test was done using Kirby Bauers Disk Diffusion method. The antibiotics tested were penicillin (10U), gentamicin (10µg), erythromycin (15µg), clindamycin (2µg), ciprofloxacin (5µg) and vancomycin for the gram-positive bacteria and ceftazidime (30µg), amikacin (30µg), ciprofloxacin (5µg), netilmicin (30µg), piperacillin-sulbactam (100/10µg), imipenem (10µg), meropenem (10µg), ertapenem (10µg), colistin (10µg) and tigecycline (15µg) for gram-negative bacteria. MRSA was detected using Cefoxitin (30µg) disc. The diameters of the zones of inhibition were recorded and interpreted according to the CLSI guidelines 2013. The environmental surveillance of the Operation theatre (OT) and the Orthopaedic ward is routinely conducted by the department of Microbiology at this hospital since 2010. During which the surfaces of various instruments and furniture such as the stretchers, OT table, stands used for intravenous solutions, the trolley in which sterile instruments and gowns is kept, the X-machine, the suction cannula tip and other surfaces were swiped with a sterile cotton swab that has been moistened with sterile BHI broth. In the laboratory these swabs were then inoculated on 5% Sheep Blood agar and MacConkey agar plates and then incubated at 37°C overnight. The colonies are then counted and identified following the conventional methods.

OBSERVATIONS AND RESULTS

The bacterial isolation from the samples received from the surgical wound infection were 33.7% (895/1668) in 2009, 54.7% (986/1801) in 2010, 55.2% (1075/1946) in 2011, 53.5% (948/1171) in 2012, 60.6% (846/1396) in 2013 and 44% (980/2226) in 2014. Thus a total of 10,808 samples were processed and 5729 (53%) bacterial pathogens were isolated in the samples. Out of these 46% (2617) were from the inpatients and 54% (3112) from the outpatient department (OPD).

The pattern of distribution of the various pathogens isolated during the six year period can be seen in Figure 1. *S. aureus* was the most commonly isolated bacteria (34%, 1920) out of which (48%, 881) were methicillin-resistant *Staphylococcus aureus* (MRSA). Out of the total MRSA (73.5%, 648) were from the OPD and (26.5%, 233) from the Ward. These isolates were also resistant to ciprofloxacin (71.2%), erythromycin (68.7%), gentamicin (54.5%) and clindamicin (40.3%). All these strains were sensitive to vancomycin. Through the six years of the study it was seen that the resistance to penicillin had been gradually increasing from 54.5% to as high as 94.8% which could also be seen by the increasing isolation of MRSA from 36.7% to 54.8%. A gradual increase in

resistance to the other antibiotics namely gentamicin (18.1% to 54.4%), ciprofloxacin (43.2% to 86.2%) and erythromycin (34.5% to 61.7%) were also observed. (Fig 2) The common gram-negative bacteria isolated were *P. aeruginosa* (18%), *Klebsiellapneumoniae* (18%), *E coli* (11%) and *Acinetobacter baumanii* (8%). Among these, it was observed that there was a gradual rise in their resistance against the commonly used antibiotics such as cephalosporins (70.5% to 79.6%), amikacin (48.5% to 61.4%), ciprofloxacin (51.8% to 77.7%). The gradual rise in resistance was observed across the different gram-negative bacteria (Fig 3) It was also observed that *S. aureus* was the most common environmental isolate. It was isolated from various items such as the stretchers, the stands for Intravenous solutions, the OT table, the trolley to carry sterile instruments and gowns, the X-Ray machine and the suction cannula tip etc. Other bacteria isolated from the environment were *E. coli*, *Klebsiella sp, Acinetobacter sp* and *P. aeruginosa.* These isolation indicate that the source of bacterial infection probably is present in the hospital environment.

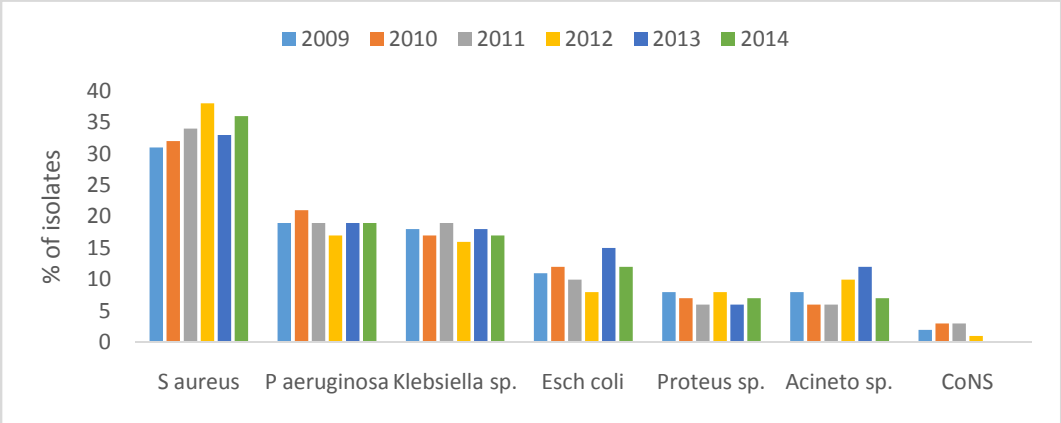

Figure 1: Distribution of pathogenic organisms causing surgical wound infections

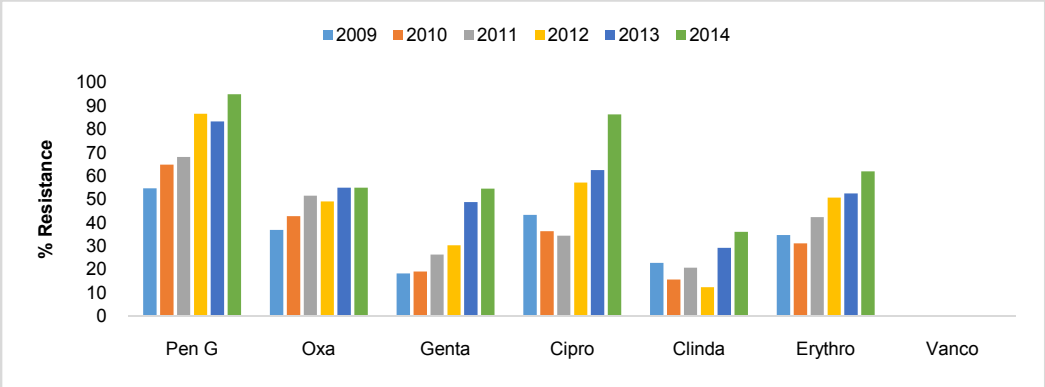

Figure 2: Antibiotic susceptibility of *S. aureus*

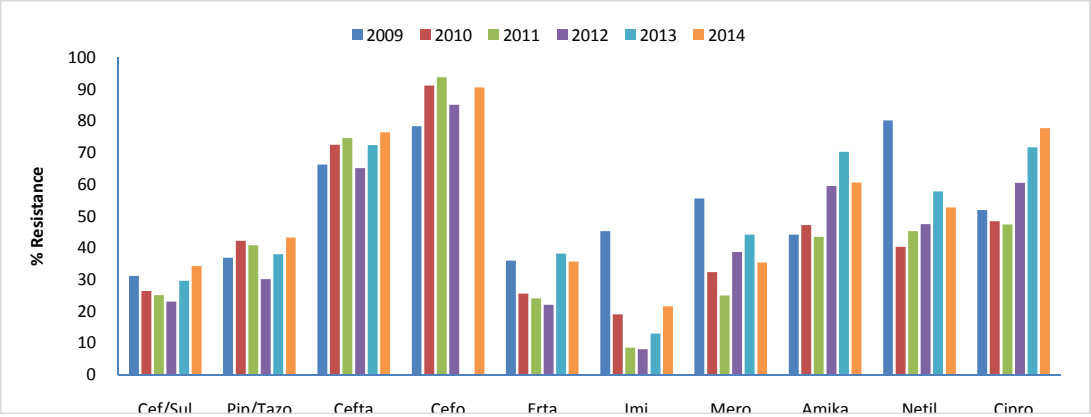

Figure 3: Antibiotic susceptibility of gram-negative bacteria

DISCUSSION

Surgical wound infections in orthopaedic patients are the most common cause of morbidity. Infections not only prolong the hospital stay but also increase the healthcare cost of the patients. In a study conducted at CMC Vellore confirmed that the expenditure for treating an infection caused by antibiotic-resistant bacteria is almost double. This included the medication charges, the hospital stay charges and also special care charges like that of an Intensive Care Unit (ICU). Most of these patients often have prolonged stay in the hospital and develop complications that require them to be admitted in the ICUs and thus further increase their expenditure[8]. In orthopaedics, the rate of surgical wound infection is 53.1% which is in concurrence with the present study[1]. The number of *S. aureus* isolated in this study were found to be comparable to that of a study from France where it seen to be 41.7% [9]. The finding was also in concurrence with those who quoted a very high rate of 85.25%[6]. This high incidence of Staphylococcus surgical wound infection in the latter study might be due to the fact the samples in this study also included those from the skin of the patients, their beds and the atmosphere apart from the wound samples. Similarly the rate of MRSA are also variable. The number of MRSA isolated in the present study was much lower as compared to a study from Serbia where 79.2% MRSA were isolated and it was much higher as compared to another study from India where only 12.7% of MRSA were isolated[2,10]. The high number of MRSA reported from Serbia was attributed to a small sample size compared to the other studies. The other organisms that were isolated in this study were similar to those isolated in two studies. In the first study, *Pseudomonas aeruginosa* (6.3%), *Klebsiella* sp (4.2%) and *E. coli* (3.1%) were isolated. In the second study from India the common organisms were *E. coli* (34.4%), *Pseudomonas* sp (26.1%) and *Klebsiella* sp (8.1%)[9,1]. The resistance pattern of the gram-negative isolates in this study were slightly lower compared to another study from India, where the resistance to ciprofloxacin ranged from 16% to 77%, cephalosporins from 16% to 92% and aminoglycoside from 8% to 88%[4]. These high results may be due to the small sample size in the study. It was observed that the most probable sources of infection were from the stretchers, the stands for intravenous solutions, the OT table, the trolley to carry sterile instruments and gowns, the X-Ray machine and the suction cannula tip. The other sources of infection are also described by Aggarwal *et al.* who observed that the source of wound infection was most probably the gut flora, which in prolonged bed ridden patients can contaminate their surroundings. In addition, the contaminated bucket or water that was used for soaking the plaster of paris bandages, or the nasal carriage of *Staphylococcus* were also described as sources of infection. Apart from these, it was stated that the over-crowded wards, the low socioeconomic status of the patients and their lack of hygiene and education could also contribute to the infections[1]. One of the important findings in the present study is the alarming rise in the antibiotic resistance. The other note-worthy finding is that the number of MRSA that were isolated from the patients attending the OPD (73.5%) was very high as compared to that in the ward (26.5%) which is a matter of concern and to some extent represent the picture in the community as these also include the follow up cases. It is therefore necessary to control these infections. There have been reviews on the various methods of reducing surgical wound infections. Various measures namely preoperative skin antiseptics for preventing surgical wound infections after clean surgery, antimicrobial drugs for treating MRS Acolonization, preoperative hair removal to reduce surgical wound infection, surgical hand antisepsis to reduce surgical wound infection, preoperative bathing or shower with skin antiseptics to prevent surgical wound infection, dressings and topical agents for surgical wound healing by secondary intention.[3]

CONCLUSION

Surgical wound infections are becoming a great burden to the patients with the emergence of antibiotic resistance among the causative pathogens. There are multiple factors which contributeto the development of infection and drug resistance, leading to prolongedhospital stay and also leads to increased health care cost. Strict asepsis, pre-operative precautions and hand hygiene are some of the known factors which goes a long way in reduction of infection rates in the hospital.

REFERENCES

1. Agrawal AC, Jain S, Jain RK and Raza HKT: Pathogenic bacteria in an orthopaedic hospital in India: J Infect Dev Ctries.2008 Apr; 2(2):120-3.
2. Maksimović J, Marković-Denić L, Bumbaširević M, Marinković J and Vlajinac H: Surgical Site Infections in Orthopedic Patients: Prospective Cohort Study: Croat Med J. 2008 Feb; 49(1):58-65.
3. Cooper RA: Surgical site infections: epidemiology and microbiological aspects in trauma and orthopaedic surgery: Int Wound J. 2013 Dec; 10(suppl. 1):3-8.
4. Seni J, Najjuka CF, Kateete DP, Makobore P, Joloba ML, Kajumbula H, Kapesa A and Bwanga F: Antimicrobial resistance in hospitalized surgical patients: a silently emerging public health concern in Uganda: BMC Research Notes. 2013 Jul; 6:298-305.
5. Chen AF, Wessel CB and Rao N: Staphylococcus aureus Screening and Decolonization in Orthopaedic Surgery and Reduction of Surgical Site Infections: Clin Orthop Relat Res. 2013 Jul; 471(7):2383–99.

6. Udobi CE, Obajuluwa AF and Onaolapo JA: Prevalence and Antibiotic Resistance Pattern of Methicillin-Resistant Staphylococcus aureus from an Orthopaedic Hospital in Nigeria:Biomed Res Int. 2013;860467.Epub 2013 Oct 27.
7. Collee JG, Duguid JP, Fraser AG, Marmion BP and Simmons A: Laboratory strategy in the diagnosis of infective syndromes In: Mackie and McCartney Practical Medical Microbiology. 14th ed. Edinburgh: Churchill Livingstone; 1996. pp. 53-94.
8. Chandy SJ, Naik GS, Balaji V, Jeyaseelan V, Thomas K and Lundborg CS: High cost burden and health consequences of antibiotic resistance: the price to pay: J Infect Dev Ctries.2014Sep; 8(9):1096-102.
9. Mabita C, Marcheixa PS, Mounierb M, Dijouxa P, Pestourieb N, Bonnevialle P, Bonnometd F and The French Society of Orthopaedic Surgery, Traumatology (SOFCOT): Impact of a surgical site infection (SSI) surveillance program in orthopedics and traumatology:Orthop Traumatol Surg Res. 2012 Oct;98(6):690-5.
10. Fernandes A and Dias M: The Microbiological Profiles of Infected Prosthetic Implants with an Emphasis on the Organisms which Form Biofilms:J Clin Diagn Res. 2013 Feb;7(2):219-23.

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