Prevalence of *Pseudomonas aeruginosa* in Surgical Site Infection in a Tertiary Care Centre

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**Abstract**

*Pseudomonas aeruginosa* is a leading cause of nosocomial infections. Infections caused by it are often severe and life threatening and difficult to treat because the organism is inherently resistant to many drug classes (MDR) and is able to acquire resistance to all effective antimicrobial drugs. Over the years, *P. aeruginosa* contributes substantially to morbidity and mortality related to surgical site infection (SSI) worldwide, the third most commonly reported nosocomial infection. People infected with drug-resistant organisms like *P. aeruginosa* are more likely to have longer and more expensive hospital stays, and may be more likely to die as a result of the infection. The study was aimed to determine the prevalence and drug resistance pattern of *P. aeruginosa* in SSI. Over a 2-year period, specimens were received as postoperative wound swabs in Microbiology department and processed for isolation and identification of bacterial pathogens, according to the standard microbiological techniques. Antibiotic Sensitivity test was performed on Mueller Hinton agar by Kirby Bauer’s disc diffusion method. Out of 360 bacterial organism isolated, 68 (18.89%) were *P. aeruginosa*. A total of 11 (16.18%) isolates were resistant to three or more antibiotic classes (multidrug resistance). Imipenem and piperacillin/tazobactam showed high sensitivity, with 88.24% and 89.71% respectively. Continued monitoring of susceptibility pattern of *P. aeruginosa* from SSI need to be carried out in individual settings so as to detect the true burden of multidrug resistance in organisms and prevent their further emergence by judicious use of drugs.

**Keywords**

Surgical site infection (SSI), *P. aeruginosa*, Antimicrobial susceptibility testing.

**Introduction**

Among Surgical patients, surgical site infection (SSI) is an important cause of health care associated infection (Ranjan *et al.*, 2010). They account for approximately a quarter of nosocomial infection.

SSI have been responsible for increasing cost of treatment due to prolong hospital stay as well as high morbidity and mortality related to surgical operation and continue to be major problem even in hospital with most Morden facility and standard protocols of preoperative preparation and antibiotic prophylaxis (Lilani *et al.*, 2005). Incidence of SSI in India ranges from 4.04% to 30% (More *et al.*, 2015).

The virulence factor and invasive property of the microorganisms are the important risk factor for development of infection, but the physiological state of the tissue in the wound and immunological integrity of the host also shows equal importance in determining whether infection occurs or not (Ranjan *et al.*, 2010). The common pathogenic bacteria
isolated from SSI include Staphylococci, Pseudomonas, Streptococci, Enterococci, E.coli, Klebsiella, Enterobacter, Citrobacter, Acinetobacter, Proteus, etc (Naik et al., 2011).

In the recent years, increasing incidence of P. aeruginosa in SSI is a serious problem in developing countries as infections caused by it are often severe and life threatening and difficult to treat because the organism is inherently resistant to many drug classes (MDR) either intrinsically or following acquisition of resistant gene thus reducing treatment options for patients. Also P. aeruginosa shows variety of virulence factors like lipopolysaccharides (LPSs), exotoxin A, leucocidin, extracellular slime, proteases, phospholipase, and several other enzymes which make it the most clinically significant pathogen among non-fermenting bacteria. Pseudomonas aeruginosa is a leading cause of nosocomial infection, ranking second among gram-negative pathogens as reported by the United States national nosocomial infection surveillance system. P. aeruginosa contributes substantially to SSI-related morbidity and mortality worldwide. So the present study was aimed to determine the prevalence of P. aeruginosa in the isolates of postoperative wounds infection in our setting and its antimicrobial susceptibility pattern.

Materials and Methods

The present study was carried out at a tertiary care centre in the Microbiology department from January 2015 to December 2016. Two wound swabs were collected aseptically from all clinically suspected cases of SSI from all surgical wards, one swab was used for Gram stain and the other for culture. All the collected swabs were processed for detection of aerobic bacteria without delay in the following manner (Collee et al., 2006; Forbes et al., 2007).

a. Gram stain microscopy by 1st swab.

b. Inoculation on culture media by using 2nd swab (Blood agar, MacConkey agar).

c. Preliminary identification of the growth (Gram stain, catalase test, oxidase test, motility, etc.).

d. Routine standard biochemical tests for confirm identification.

e. Antimicrobial susceptibility testing by Kirby Bauer disk diffusion method (Performance Standards for Antimicrobial Susceptibility Testing, 2015).

Antibiotic testing was not done of other bacterial isolates in this study since our focus was on the prevalence of P. aeruginosa. Antibiotics used in our study were piperacillin (100 μg), ceftazidime (30 μg), imipenem (10 μg), piperacillin/tazobactam (100/10 μg), gentamicin (10μg), cefepime (30μg) and ciprofloxacin (5 μg).

Results and Discussion

Total 360 specimen were obtained from post-operative wound infection patients admitted in surgery, orthopaedics, Obstetrics and gynaecology ward. Among them 278 (77.22%) sample revealed growth while 82(22.78%) showed no growth. Pseudomonas aeruginosa 68(18.89%) was the most common isolate followed by E. coli 58 (16.11%), Klebsiella spp.53 (14.72%), Staphylococcus aureus 46(12.78%), Proteus spp.32 (8.89%) and Acinetobacter spp 21(5.84%). Pseudomonas aeruginosa had showed maximum susceptibility to Pipracillin-Tazobactam (89.71%) and Imipenem (88.24%) (Table 1).

Out of 68 P. aeruginosa 11(16.18%) were resistant to three or more class of drug
(MDR). Frequency of isolation of *P. aeruginosa* was maximum in patients who underwent caesarean section followed by abscess drainage and Diabetic foot (Table 2). We found that *P. aeruginosa* infection was more common in age group 21–40 years and males (54.41%) were more affected than female (45.59%).

Surgical site infection (SSI) is an important cause of health care associated infection among surgical patients. Patients who developed SSI have longer hospital stay, more expensive hospitalization and increased morbidity and mortality. In present study 77.22% sample had shown growth of aerobic bacteria. Similar finding were observed in other studies by Insan *et al.*, (2013) and More *et al.*, (2015). *Pseudomonas aeruginosa* 68(18.89%) was the most common bacteria isolated in our study followed by *E. coli* 58 (16.11%), *Klebsiella* spp.53 (14.72%), Staphylococcus aureus 46(12.78%) which can be correlated well with the findings of other studies by Ranjan *et al.*, (2010) and Lilani *et al.*, (2005) while Negi *et al.*, (2015) found *E. coli* as common isolate and Mundhada *et al.*, (2015) reported *S. aureus* as predominant organism in their studies. When factors such as age and sex of the patient were considered, *P. aeruginosa* was found to be more common in males than female and highest in the age group 21–40 years which can be correlates with results recorded by Ranjan *et al.*, (2010) and More *et al.*, (2015).

Table 1 The susceptibility pattern of *P. aeruginosa* isolated from post-operative wound swab (n=68)

| Antibiotic              | Percentage of susceptibility (%) |
|-------------------------|----------------------------------|
| piperacillin/tazobactam| 61(89.71%)                       |
| Imipenem                | 60(88.24%)                       |
| Piperacillin            | 47(69.12%)                       |
| Ceftazidime             | 42(61.76%)                       |
| Gentamicin              | 21(30.88%)                       |
| Cefepime                | 18(26.47%)                       |
| Ciprofloxacin           | 12(17.64%)                       |

Table 2 Prevalence of *P. aeruginosa* isolated from different type of surgeries

| Type of Surgery     | Total no. of specimens | Total no of *P. aeruginosa* isolated | Percentage (%) |
|--------------------|------------------------|--------------------------------------|----------------|
| Cesarean section   | 91                     | 26                                   | 38.25%         |
| Abscess drainage   | 77                     | 19                                   | 27.68%         |
| Diabetic foot      | 66                     | 10                                   | 14.70%         |
| Abdominal abscess  | 27                     | 8                                    | 11.76%         |
| Bone excision      | 17                     | 5                                    | 7.35%          |
Antimicrobial susceptibility pattern of *P. aeruginosa* shows highest sensitivity to Pipracillin-Tazobactam followed by imipenem while maximum resistance to ciprofloxacin, cefepime and Gentamicin. Similar results were recorded by Ranjan et al., Navneet et al., and Mohamad et al., (Ranjan et al., 2010; Navaneeth et al., 2002; Mahmoud et al., 2013). In present study, out of 68 *P. aeruginosa* 11(16.18%) were resistant to three or more class of drug (MDR). Similar finding were recorded in study by Mohamad et al., (2013) (10.60%) while in contrast Srinivas et al., (2012) reported 86.90% MDR *P. aeruginosa* in their study. In our study, *P. aeruginosa* isolation rate was highest from patients who underwent caesarean section followed by abscess drainage and Diabetic foot. In contrast to this Ranjan et al., (2010) isolated *P. aeruginosa* mainly from patients of abscess drainage followed by Diabetic foot and caesarean section.

In conclusion, SSI is major risk in surgeries in spite of use of modern surgical and sterilization technique and use of prophylactic antibiotic during surgery. SSI represent substantial burden of disease not only on patient but also on health care services in terms of morbidity, mortality and the economic costs. According to our study, continued monitoring of susceptibility pattern of *P. aeruginosa* from SSI need to be carried out in individual settings so as to detect the true burden of multidrug resistance in organisms and prevent their further emergence by judicious use of drugs.

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How to cite this article:

Sapana Mundhada, Anu Sharma, KishorIngole, Sadiya Shaikh. 2017. Prevalence of Pseudomonas aeruginosa in Surgical Site Infection in a Tertiary Care Centre. Int.J.Curr.Microbiol.App.Sci. 6(4): 1202-1206. doi: https://doi.org/10.20546/ijcmas.2017.604.147