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PREVALENCE OF PATHOGENIC MICROBES IN POST OPERATIVE WOUND INFECTIONS IN VARIOUS SURGICAL SPECIALITIES

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ABSTRACT

The prevalence of post operative wound infections and its antimicrobial resistance pattern may vary from region to region and was included in this study. A battery of 108 post operative wound cases were included thereby various potential bacterial pathogens isolated from 94 patients and 134 isolates were possibly recovered. Among them *Staphylococcus aureus* (29.8%) predominated, followed by *Escherchia coli* (14.2%), *Klebsiella pneumonia* (11.9%), *Pseudomonas aeruginosa* (3%), *Proteus mirabilis* (1.5%), *Serratia marcescens* (0.7%) and *Candida albicans* (0.7%). Monomicrobial and polymicrobial infection was observed in 62.8% and 37.2% patients respectively. Orthopedic surgery and Gastrointestinal surgery was associated with an increased risk of infection due to Methicillin resistant *Staphylococcus aureus* and *Escherichia coli* respectively. Precise empirical therapy, policy of reviewing prescription patterns and continuous monitoring of resistance patterns of causative agents can help in preventing and controlling the postoperative infections.

INTRODUCTION

Surgical site infections are the most common nosocomial infections in surgical patients. They lead to increased morbidity and mortality and on average double the cost of medical care. Therefore, prevention has become paramount not only to decrease morbidity and mortality, but also to decrease the cost for healthcare. In the last decade, many landmarks studies have been published that decrease the incidence of post operative surgical site infections (SSI) (Kaye *et al*., 2005). The studies included prevention by interoperative heating of the patients to avoid low body temperatures, control of glucose levels and other interventions to improve support of care. More recently, targeted interventions to decrease the incidence of SSI have been developed (Owens *et al*., 2014).
Wound infections are common and serious complications of anaesthesia and surgery. Surgical wound infections prolong hospitalization by 5 to 20 days per infections and substantially increase costs (Whitehouse *et al*., 2002).

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The microorganisms which are responsible for wound infections depend on the surgical site, study population and antimicrobial use within the hospital. Outbreaks of post operative sepsis are common and such infection significantly leads to the severity of the patient's illness (Mu *et al*., 2011; Shahian *et al*., 2009). Some significant factors that can influence the incidence of subsequent infection are surgical techniques, skin preparations, timing and method of wound closure and antibiotic prophylaxis after certain types of surgery. The major classification of operative wounds based on degree of microbial contamination are clean wound, clean contaminated wound, contaminated wound and dirty or infected wound and the most common isolates in all types are *Staphylococcus aureus, Pseudomonas aeruginosa, Proteus vulgaris, Escherichia coli, Klebsiella* spp, *Enterococcus* spp, etc (Amrita *et al*., 2001). Despite the availability of extensive guidelines and protocols these infections are insufficiently controlled in most healthcare institutions. One important issue is the deficient implementation of the many recommendations. Recently bundles of care have been proposed to facilitate the implementation of patient safety measures. The bundle consists of perioperative normothermia, preoperative hair removal, perioperative antibiotic prophylaxis and limiting the number of door openings (Melling *et al*., 2002; Kurz *et al*., 1996). Currently the role of normothermia in the prevention of surgical site infections was well studied. Most of the studies highlighted the hypothermia may facilitate perioperative wound infections in two ways.

1. Intraoperative hypothermia triggers thermoregulatory vasoconstriction which decreases subcutaneous oxygen tension in humans; wound infection risk correlates with subcutaneous oxygen tension.
2. Mild core hypothermia directly impairs immune function including T cell mediated antibody production and non specific oxidative bacterial killing by neutrophils.

The widespread use of antimicrobials has been linked to the development of bacterial resistance leads to risk in treating infections (Gross *et al*., 2001). Antibiotic guidelines are crucial in high risk settings and policy makers should develop evidence based guidelines to effectively improve prescription quality and reduce costly and unsafe antibiotic consumption (Miliani *et al*., 2008). Even though the principles of antimicrobial prophylaxis in surgery are clearly established and several guidelines have been published in order to prevent SSIs, the implementation of these guidelines is difficult among surgeons and failure to comply with the standard of care has been widely reported (Tourmousoglou *et al*., 2008).

We have designed and conducted the present study, involving the major surgical departments of a tertiary care teaching hospital in Puducherry in order to access:

1. The prevalence of aerobic bacterial pathogens in the post operative wound infection
2. The comparison the etiological agents of post operative wound infection in various surgical specialities and also understand the associated risk factors.

MATERIALS AND METHODS

This study was performed at Mahatma Gandhi Medical College and Research Institute, Puducherry, a multispeciality teaching hospital where more number of surgeries performed annually. The surgical services include general, orthopaedic, vascular, paediatrics, otolaryngology, genitourinary, obstetrics and gynaecology. A dedicated infection control team under the leadership of the department of microbiology have been involved in the surveillance of SSIs. The infection control team received information about the microbiology cultures related to surgical wounds, which were then matched to the patient's medical chart to determine whether the culture was related to an operative procedure. Patients were included in the database in all cases of detection of inpatient SSI, readmission for SSI following surgery, emergency department evaluation for an SSI or if an SSI was found to have developed on an unrelated admission. The infection control team was not directly involved in care of surgical wounds. Therefore, wounds that were opened and not cultured were not included in the database. Patient data were entered and included date of surgical procedure, date of infection identification, attending surgeon, surgical procedure, surgical service, isolated culture and sensitivity, and wound classification. An SSI was defined as a postsurgical infection that developed within 30 days after surgery (Kassavin *et al*., 2011).

The sample size of 108 pus samples included in this study (April 2010 – June 2011). The inclusion criteria are pus swabs, aspirates from post operative wound infections and the exclusion criteria are wound swabs from trauma, burns, stitch abscess, episiotomy wounds and circumcision site. Two swabs or aspirates per patient were collected – one for gram staining and another for culture. After 24 hours of incubation, the isolates were identified by colony morphology, gram staining and biochemical tests (Forbes *et al*., 2006). Antibiotic sensitivity test (AST) by disc diffusion method was performed according to the CLSI guidelines for all isolates with the control strains of *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 and *Staphylococcus aureus* ATCC 25923 (Bauer *et al*., 1996; NCCLS, 2003).

RESULTS AND DISCUSSION

A total number of 108 samples included, of which 43 were male (40%) and 65 were female (60%). In the cases included, 45% showed clean surgery and 55% showed clean contaminated surgery. The most common surgeries made on the patients in percentage were depicted in Figure 1. The onset of the post operative wound infections was well studied in this investigations by which 38 patients was recorded for infection within the first week following surgery, 47 patients observed in the second week and 9 patients found after third week (Figure 2).

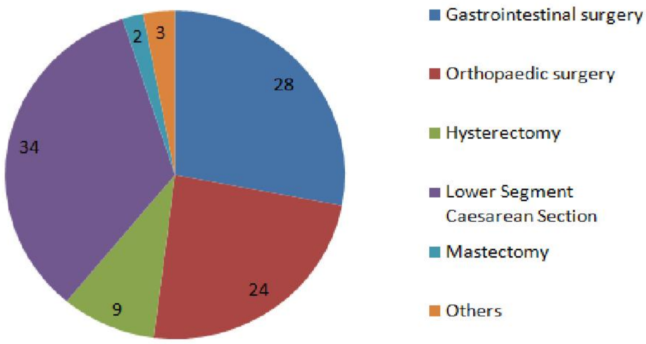

Figure 1. Types of surgeries performed in the patients

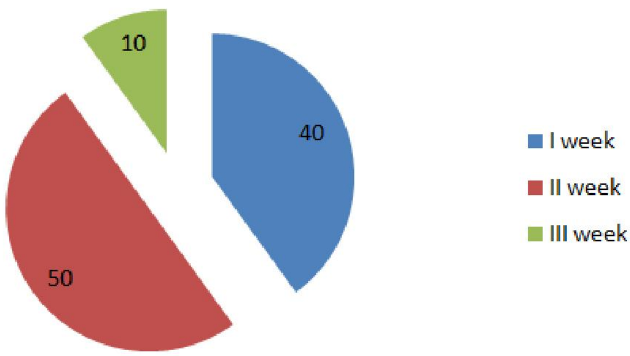

Figure 2. Time of onset of post operative infections

Microbiological profile

Among the 108 samples included, 94 (87%) had growth and 14 (13%) had no growth. About 134 isolates were possible with post operative wound infections included in this investigation. The microbial pathogens isolated from the pus samples of post operative wound cases are summarized in Table 1 and Figure 3. Underlying risk factors were also analyzed which yielded that diabetes mellitus (56) cases and systemic hypertension (35) cases noted. Interestingly, the risk of complications after coronary artery stenting may not be increased in diabetes. In another study of complications after renal transplantation there was no difference between recipients with diabetes and those without diabetes and it seems that there are other greater risk factors for poor outcome (including age of donor and recipient, time awaiting transplantation, etc). This perhaps illustrates that it is important in assessing risk of complications in patients with diabetes undergoing surgery to consider the specific type of surgery and anaesthetic technique. There is evidence for higher risk in those with diabetes undergoing surgery and, when such evidence is lacking, it may in part be testament to the relative safety of modern surgery and anaesthesia (Lanzer *et al*., 2006; Bittar *et al*., 2006).

Table 1. Isolates of 134 from 94 patients with post operative wound infections

Microbial pathogens	Number of isolates
Gram positive bacterial pathogens	
Methicillin sensitive *Staphylococcus aureus* (MSSA)	40 (29.8)
Coagulase negative Staphylococci	25 (18.7)
Methicillin resistant *Staphylococcus aureus* (MRSA)	11 (8.2)
Enterococcus sp.	3 (2.2)
Streptococcus pyogenes	2 (1.5)
Gram negative bacterial pathogens	
Escherichia coli	19 (14.2)
Klebsiella pneumoniae	16 (11.9)
Citrobacter sp.	4 (3)
Non fermenting Gram negative bacilli	4 (3)
Pseudomonas aeruginosa	4 (3)
Proteus mirabilis	2 (1.5)
Klebsiella oxytoca	1 (0.7)
Serratia marcescens	1 (0.7)
Acinetobacter sp.	1 (0.7)
Fungal pathogen	
Candida albicans	1 (0.7)

[Figures in parenthesis showed percentage]

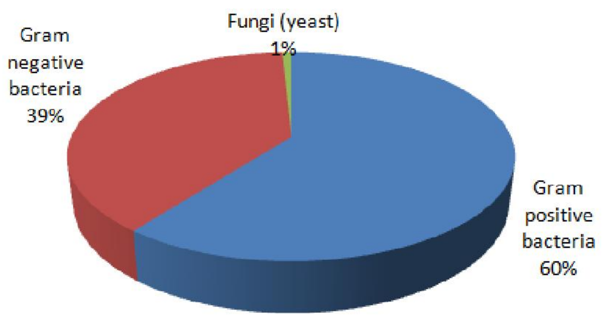

Figure 3. Percentage frequency of microbial isolates in wound infection

Prolonged duration of operation results in increased exposure of operation site to air, prolonged trauma, stress of prolonged anaesthesia and sometimes blood loss. Our study reveals a clear cut increased number of SSI cases, where surgery has been prolonged ≥ 2 hours. Studies conducted on SSI in Aurangabad (Anvikar *et al*., 1999), Mumbai (Lilani *et al*., 2005), Hyderabad (Roa and Harsha, 1975) and Orissa (Tripathy and Roy, 1984) have reported a similar observation. In fact, this correlation has been established since 1964 by the Public health laboratory services (PHLS) in England and Wales (Berard and Gandon, 1964). The use of drains has contributed significantly as a risk factor in causing SSI in this study. This could be due to the fact that they are more likely to be used in contaminated or dirty wounds and in emergency and prolonged operations which increases the probability of the wound getting infected. Some studies supported our identification with approximately of 25% and 8% of drained and undrained wounds getting infected (Avinkar *et al*., 1999; Berard and Ganson, 1964. The rate of infection was highest in contaminated type of wounds, followed by clean contaminated wounds and least in clean wounds. This is an expected observation. Similar rates were noted in clean contaminated and clean cases (Bittar *et al*., 2006; Avinkar *et al.,* 1999).

Certain underlying conditions like anaemia, diabetes, and smoking may alter or decrease the immune status thus significantly increasing the risk of SSI. It is also an important cause of increasing the pre operative stay of the patient which steeply increases the risk of SSI in such patients. In our study, 7.6% of patients with SSI had some underlying conditions, anaemia and diabetes mellitus being the commonest. Each day of extra hospitalization adds to the risk of acquiring SSI and this has been confirmed by various studies; however, it was noted that diabetes mellitus and dehydration did not contribute to the occurrence of SSI. These two factors could have been responsible for this unexpected outcome. Pre operative antibiotics are known to decrease incidence of SSI cases. However, prophylactic antimicrobials are more frequently given to patients who are poor risks from the stand point of susceptibility to infection (Tripathy and Roy, 1984; Berard and Gandon, 1964). Regarding the type of infecting bacteria, out of the 94 positive cultures in the current study, the majority (40%) grew *S. aureus*, which reflects the predominance of SSI in gastrointestinal and orthopaedic surgeries. In a study from India, the most predominant isolate was *S. aureus* (37%) of which 21.7% were MRSA compared to the low isolation rate of *S. aureus* in our study 5% where 50% were MRSA.

The possible reason for this difference is the smaller number of abdominal and perineal operations in the Indian study, compared to our series (Liu *et al*., 1999; Varsha *et al*., 2012). In a major mastectomy study, the commonest isolate as expected was *S. aureus*, more than one third were MRSA (Nahed and Laham, 2012). Surprisingly, the common nosocomial pathogen *Pseudomonas* was isolated in very less number and the exact reason for this pattern could not be clearly defined but may be due to less sample size and probably the study of environmental factors may reveal the hidden facts beyond this pattern of isolates (Olsen *et al*., 2009). SSIs are mostly caused by MDR hospital flora. Superficial site infections are caused by contamination from skin which is easily colonized by hospital flora. Deep SSIs are caused by contamination from endogenous visceral flora or skin contaminants gaining entry and in fascia and muscles through incision or port sites (Ramesh and Dharini, 2012; Rubin, 2006; Gotturp *et al*., 2005). The lack of significance could partly be explained by a non existing antibiotic policy regarding different procedures in these patients; in this study, only few of the patients received pre-operative antibiotic prophylaxis. The findings of this study necessitate the introduction of evidence based antibiotic policy in this hospital and other hospitals in developing countries (Cruse and Foord, 1980). By this study, we come to the conclusion that minimally invasive surgery provides the advantage of lesser surgical site infection as compared to open surgery. This study endures from a few limitations, firstly, the number of infected cases was small, and secondly, if follow up cultures and molecular typing were done, it would give a better view.

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