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A Retrospective Study on the Pattern of Pathogens Isolated from Surgical Site Wound Infection in Tertiary Care Hospital in Coimbatore, India

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Abstract

Surgeries in medical cases are inevitable, and infections in those surgical wounds are leading to drastic medical complications and can even cause death. Surgical site wound infection or surgical site infections (SSIs) are also associated with substantial morbidity and cost. A retrospective and analytical study was conducted over 164 cases. The wound and pus samples were collected and analyzed. Demographic studies revealed that males were more associated with SSIs than females and with age above 40. In microbial investigation, 33.5% of the samples reported positive with predomination of 36.36% Gram positive Staphylococcus species and others belonging to varied Gram negative organisms. Isolates also showed susceptibility pattern with few species presenting resistance to humdrum drugs.

Keywords: Surgical site wound infection; surgical site infections, prevalence.

Introduction

Health care-associated infections (HAIs) lay a substantial impact on the patient's morbidity, mortality, hospitalization time, and health care costs[1-4]. It is likely that around more than 2 million patients encounter various HAI related illnesses annually and that, approximately 77,000 of these patients will die either as a direct result of their HAI or with the HAI contributing to their death. Surgical site infections (SSIs) are secondary only to urinary tract infections, as they are the utmost frequently reported HAI[5,6].

SSIs are accountable for approximately around 14.5% of all HAIs or nosocomial infections. Globally, SSIs enhances morbidity and mortality, and also an extended hospital stay leading to additional costs to both the hospital and the individual[1,7]. The Centers for Disease Control and Prevention (CDC) have established standard criteria to define SSI[8,9], which are regarded the contemporary and of international standard. A SSI is defined as infection related to an operative procedure, which occurs at or near the surgical incision within a 30-day period.

The risk of SSI developing is influenced by a large number of patient- and procedure-specific characteristics. Patients aged over 65 years, who smoke or abuse alcohol, or with concurrent disorders including cardiogenic shock, chronic obstructive pulmonary disease, congestive heart failure, diabetes mellitus, poor cardiac output (ejection fraction <40%), hypertension, hypercholesterolaemia, obesity, peripheral or cerebral vascular disease, renal impairment, or receiving immunosuppressive therapy are at higher risk of SSI, while emergency surgery or reoperations are also associated with higher risk of SSI[10].

A better understanding of the incidence of SSI and its risk factors is helpful in guiding surveillance after hospital discharge and patient selection for perioperative antibiotic prophylaxis[11]. The risk of encountering SSI varies momentously, depending on the executed operative procedure and also on the explicit medical physiognomies of the patient undergoing that procedure[12].

Various microorganisms find their route into the surgical wounds resulting during any operating procedures and are the sources of SSIs. The microorganisms are found to be endogenous (normal microbiota), whereas in voluminous cases, the deadly pathogenic species are attained from other relative sources such as from the surgical equipments, implants or gloves, from the hospital environment or through medications which are administered throughout the operative procedure[13,14].

Profuse treatment with antiseptic agents such as chlorhexidine has not been shown to have a beneficial impact on SSI rates. However, appropriate skin preparation at the time of the operative procedure with an antiseptic agent is a well-established preventative measure. Acceptable antiseptic agents include alcohol, chlorhexidine, and iodine and iodophors, some of which now have been reformulated to provide a longer duration of action[13,15,16,17].

During the past three decades various European countries have initiated surveillance programmes for SSI control, aiming at lowering infection rates by providing reliable estimates to hospitals and surgeons. Some of these programmes published encouraging results, showing trends towards decreased SSI rates over time, at least for some operations[18,19,20]. For enhanced understanding on the health care practices, this study on

surveillance of SSI was initiated to get an idea of the infection among patients from multispecialty hospitals of Coimbatore, Tamil Nadu, India.

Material and Methods

This preliminary study was conducted over a period of nine months and the samples were collected from various multispecialty hospitals in Coimbatore, Tamil Nadu, India.

Study strategy: The surveillance of SSIs in our selected region was performed based on the protocols imposed by the US Centers for Disease Control and Prevention (CDC)[21]. An indirect surveillance was conducted by acquiring patient information and the surgical sites were inspected at time of dressing change 24 - 48 h postsurgery (direct surveillance)[22].

Sample Collection: The persons responsible for sample collection were trained on SSI definitions as outlined below. Infections were classified as SSIs if they occurred within 30 days after the operative procedure. Superficial incisional SSIs were considered if (a) purulent drainage was observed from the site; (b) organisms were isolated from an aseptically obtained culture of fluid or tissue; and (c) pain, tenderness, localized swelling, or redness were observed in the lesion. Deep incisional SSIs were diagnosed if (a) purulent drainage was observed; (b) a wound spontaneously dehisced or was deliberately opened by a deep incision in patients with at least one of the following signs or symptoms: fever (>38 °C), localized pain, or tenderness; and (c) an abscess or other evidence of infection was noted[23]. Pus samples were collected from SSIs according to strict aseptic precautions after eliciting detailed clinical and treatment history. The samples were immediately transported to the laboratory.

Chemicals: All the chemicals and antibiotic discs that were used in this study were purchased from Himedia, Mumbai.

Sample processing and identification: Swab samples were plated on nutrient agar, blood agar and MacConkey agar medium. Identification of microorganisms growing on the agar plates was performed by conventional methods (gram staining, motility assessment, catalase testing, oxidase testing) [24].

Antimicrobial susceptibility testing: The Kirby-Bauer disc-diffusion method on Mueller-Hinton agar (MHA) plates was used for susceptibility testing. Antibiotic disc strengths were used as suggested by the Clinical and Laboratory Standards Institute (CLSI)[25]. CLSI's criteria for susceptibility and resistance testing were followed. Gram negative bacterial isolated that showed intermediate susceptibility were reflected as resistant during reporting. Various antibiotic discs were used to study the antimicrobial sensitivity pattern of the isolates, and the antibiotics which were found to be prescribed on routine base to the patients were used. Inhibition zones around the antibiotic disc in the plates were measured using normal measuring scale, whereby their sensitivity level was measured. Statistical analyses were performed using the chi-square test. *P*-values ≤ 0.05 were considered clinically significant, and a value of <0.01 was highly significant.

Results and Discussion

Overall 164 samples from patients with SSI were collected for analysis. The samples from various surgical sites such as CABG, lapratomy, leg RTA, scrotal abscess, appendicetomy, burn wounds, trachiostomy, ambutational wounds, leg accidental wounds, bed sore wounds, cholecystectomy, thyroidectomy, herniorhaphy, hystectomy, skin wounds, abscess pus, aspiratory pus, chest aspiration and femoral catheter site were collected (procedure specific SSI rate are expressed in table-1) and microbiological analysis was performed during the study period. All the patients in the study had clean wounds. The overall SSIs infection rate of 33.5 % was determined among the samples.

Table-1
Procedure specific SSI rates in males and females

Nature of specimen	Male %	Female %
CABG	28.57%	50%
Lapratomy	33.33%	33.23%
Leg RTA	46.15%	0
Scrotal abscess	100%	0
Appendicectomy	42.85%	20%
Burn wounds	50%	0
Trachiostomy	50%	0
Ambutational wounds	25%	0
Leg accidental wounds	16.66%	0
Bed sore wounds	50%	50%
cholecystectomy	33.33%	40.00%
Thyroidectomy	33.33%	0
Herniorhaphy	0	33.33%
Hystectomy	20%	33.33%
Skin wounds	0	0
Abscess pus	0	0
Aspiratory pus	0	33.33%
Chest aspiration	0	0
Femoral catheter site	0	0

The demographic distributions of the collected samples are represented in figure-1. The age wise distribution showed that people aged between 15-24 years in males were mostly affected, whereas about 60% of SSI was seen in the age group of 55-64 years in females. Microbial profiling of the 33.5% samples revealed the presence of 36.4% Gram positive bacterial isolates and the Gram negative were around 63.6%. Within the Gram positive isolates *Staphylococcus* species was the predominant having its coagulase positive *S. aureus* reporting for 27.27%. *S. epidermidis* and *S. haemolyticus* were at the rate of 7.27% and 1.81% respectively.

Figure-2 expresses the overall percentage of the bacterial isolates. Wide array of Gram negative bacterial species were reported with *E. coli* and *P. aeruginosa* equally present at the rate of 18.18%. *K. pneumoniae* was found in 9.09% of the total Gram negative isolates. *M. morganii* and *E. faecalis* were found at the rate of 5.48%. Other strains such as *Enterobacter* species, *A. baumanii, S. marcescens* and *P. mirabilis* were also few (1.81%) among the Gram negative isolates. The bacterial isolates were tested for their antimicrobial sensitivity pattern by subjecting them to a wide array of antibiotics seeming to have been regular prescribed by the medical practitioners.

An assessment of antibiotic susceptibility pattern among pathogenic microorganisms revealed resistance pattern in all the isolated strains. Isolated strains of *S. aureus* were found to be susceptible against all major antibiotics, except for ciprflifacin and oxacillin, displaying meager (33.33%) activity. *S. epidermidis* has shown resistant pattern to many tested antibiotics, raising concern over its presence and activity. The Gram negative members such as *E. coli, K. pneumoniae, P. aeruginosa, E. faecali* and *M. morganii* were also subjected to antibiotic susceptibility testing and the results are tabulated in table-2.

Table-2
Antimicrobial susceptible pattern

Antibiotics	**Isolated microorganisms**						
	S. aureus	***S. epidermidis***	***E. coli***	***K. pneumoniae***	***P. aeruginosa***	***E. faecalis***	***M. morganii***
Amikacin	-	-		60%	40%	-	100%
Ampicillin	-	-	40%	-	-	-	-
Benzyl penicillin	-	-		-	-	66.66%	-
Ceftriaxone	-	-	40%	-	10%	-	66.66%
Ciprflifacin	33.33%	0%	-	-	-	-	-
Ciprofloxacin	-	-	-	-	-	66.66%	100%
Erythromycin	73.33%	0%	-	-	-	33.33%	-
Gentamycin	66.66%	50%	-	20%	50%	-	100%
Imipenen	-	-	100%	20%	80%	-	-
Linezolid	73.33%	0%	-	-	-	33.33%	-
Meropenem	-	-	60%	20%	60%	-	100%
Oxacillin	33.33%	0%	-	-	-	-	-
Piperacillin	-	-	60%	-	10%	-	100%
Tetracycline	73.33%	0%	-	-	-	66.66%	-
Tigecycline	-	-	-	-	-	66.66%	-
Vancomycin	73.33%	0%	-	-	-	33.33%	-

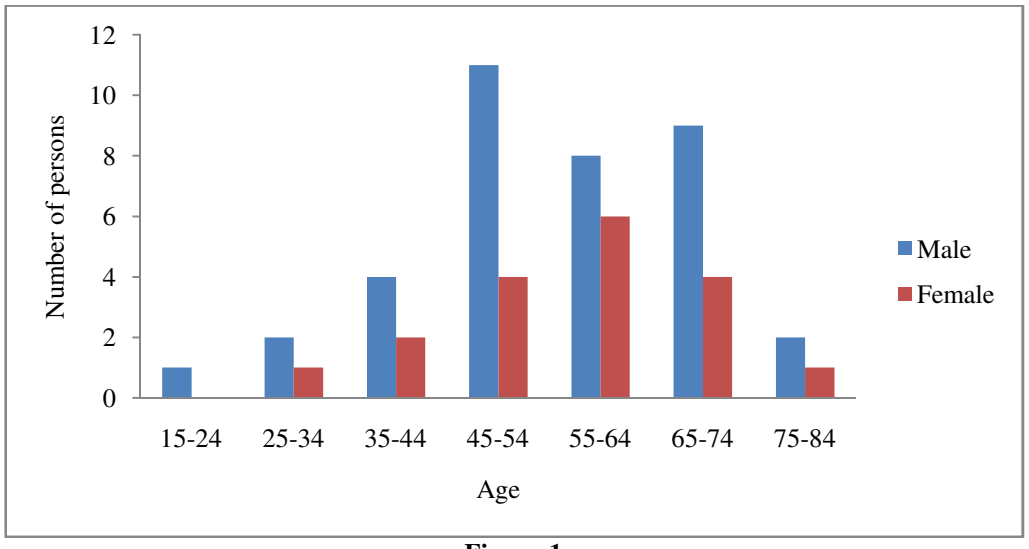

Figure-1
Age wise distribution of samples which were reported positive

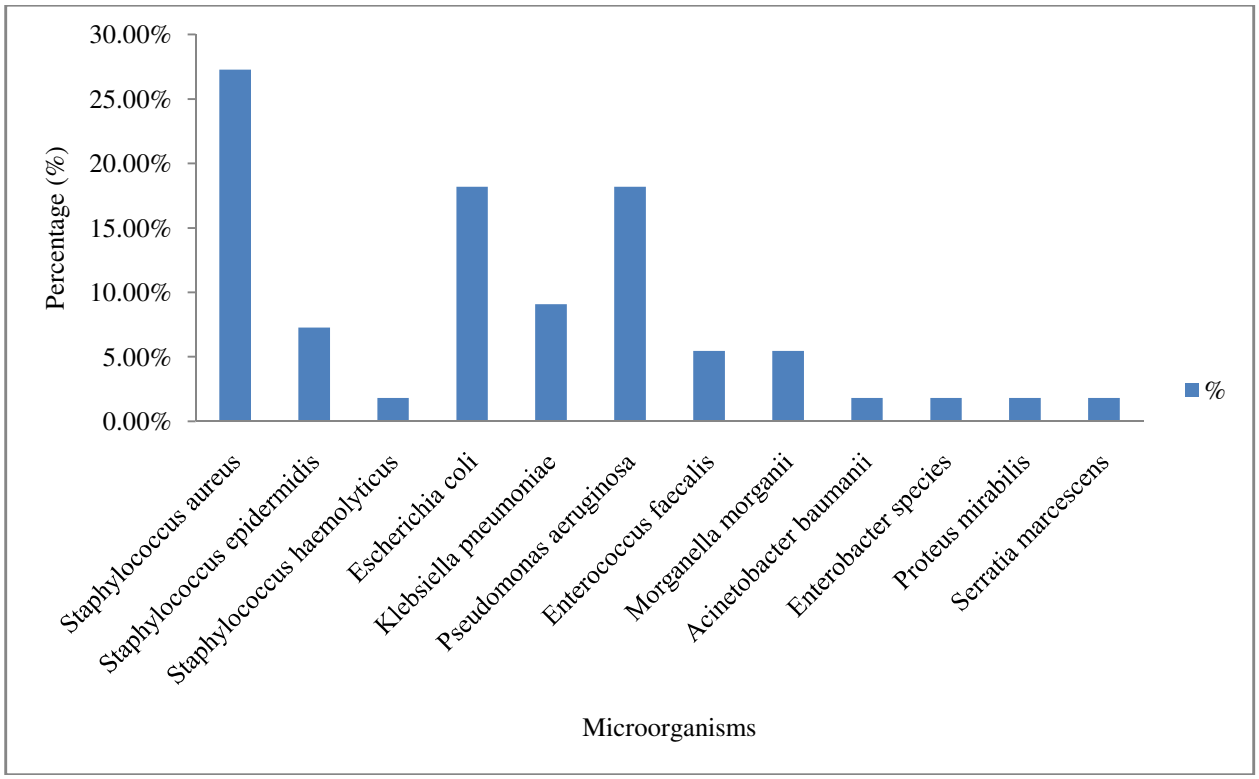

Figure-2
Percentage of various microorganisms that were isolated from positive SSIs samples

Discussion: Progresses in medical care have significantly decreased the rate of infectious complications in patients having undergone surgery, and still the control of infection remains a great challenge. Nosocomial infections are a significant health problem and require high-level surveillance in nursing homes. SSIs are the second most important among the nosocomial infection, and with a hastily aging surgical population, the incidence of SSI in the elderly population is increasing. Majority of the population is suffering from variety of illnesses, and at many situations there arises a need for surgery for complete recovery. This process of recovery has been found declining in many cases due to unwarranted infectious agents.

Nosocomial infections play a vital role in the recovery of a patient from infections. Various groups of microbes are found to cause infections at many levels in the humans, predominantly to those whose immunity is found to be low and whose chance of acquiring infection is high. Patients admitted in hospitals and those who have undergone surgical procedures have been found to be in high risk of nosocomial infections. Surgical site wound infections or surgical site infections (SSIs) play a vital role in those who had undergone surgery of any kind and location. The prevalence rate of surgical site wound infections, though preventable, is high as the normal human microbiota also finds itself a source and can cause infections. The etiology of surgical site infections is reliant on the site of the surgery, bacterial population in the underlying tissue and also the integrity of host defences[26]. In order to understand the infection rate and the infectious agents, this present study was aimed in understanding the pattern of pathogens isolated from surgical site wound infections in tertiary care hospitals in Coimbatore.

From the samples collected and processed for pathogens, the overall surgical wound infection rate was 33.5%. The microbial profiling of those 33.5% samples had revealed the presence of 36.4% Gram positive bacteria and 63.6% Gram negative bacteria. Studies by Agarwal[27], Rao and Harsha[28], Kowli et al.[29] and Anvikar[30], have shown the surgical site infection rates in India to be between 4 to 35%[31-34].

The demographic information on the ratio of male and females likely to be infected has revealed that males were found to be more susceptible for infection at all ages. The results were found correlating with those of Naik and Deshpande[35], who had reported that the number of male patients (63%) was higher than the female patients (37%). This could be due to increased mobility in the male population.

Most significant and the common organism isolated among the cases was *Staphylococcus aureus*. Numerous number of Gram negative isolates was also reported, with their growth pattern seeming to be enormous in most of the isolates. *Staphylococcus* species has been found to be predominant having its coagulase positive *S. aureus* reporting for 27.3%. *S. epidermidis* and *S. haemolyticus* were at the rate of 7.3% and 2.4% respectively. It has been regularly noted that *S. aureus* continues to be the

single most important bacterial species in the primary aetiology of surgical site infections since the past thirty years or so[36]. Among Gram negative microorganisms, *E. coli* and *P. aeruginosa* were found to be predominant with the presence of others including *K. pneumoniae*, *M. morganii*. Few others such as *E. faecalis, A. baumanii, Enterobacter* species, *S. marcescens* and *P. mirabilis* were also found in the samples. Studies on SSIs in India by Kownhar et al[34], have shown an incidence of 37%[37-40] and those done in USA by Eagye et al.[37] have shown an incidence of 39% of *S. aureus*. A higher predominance of *S. aureus* (51.6%) was observed by Keith et al. [39], in older operative patients.

The antibiotics that were tested, although had shown susceptibility pattern, but their rate is low. However, few strains of resistant bacteria were isolated from SSI. Although standard antimicrobial prophylaxis could work effectively in most cases, resistant strains, especially MRSA, could not be controlled. Isolation rate of MRSA was decreasing gradually, however, MRSA has been still the principal role in SSI.

Conclusion

It's been pragmatic that superficial and dirty wounds were seen to be more susceptible to nosocomial infection than other surgical sites and wound classes. Surgical site infection is increasingly recognized as a measure of the quality of the medical organization and also their patient care. This study had some limitations for analysis since it was done in a retrospective fashion. However surgical site infections cannot be utterly eradicated, lessening in the contamination rate to a negligible level could have substantial benefits.

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