

Original Article

INCIDENCES OF STAPHYLOCOCCUS SPECIES IN SURGICAL SITE INFECTIONS-PROSPECTIVE STUDY FROM TERTIARY CARE CENTER, COIMBATORE, TAMILNADU

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ABSTRACT

Objective: Surgical site infection (SSIs) is of great importance to regulatory agencies and public because of their clinical implication and occurrence. Human skin is populated with normal bacterial flora, which also gains access during immunocompromised state causing infection. This present study focuses on surveillance of SSIs with emphases over *Staphylococcus* species infection among patients from tertiary care centers of Coimbatore, TamilNadu, India.

Methods: Clinical samples were collected and plated on mannitol salt agar (MSA) medium for isolation of *Staphylococcus* species. Furthermore, other conventional methods like Gram staining, catalase reaction were also performed in strict aseptic conditions with standard microbiological procedures for sample processing.

Results: A total of 221 samples were collected and processed which resulted in 42.08% positivity with 59.13% Gram positive strains. *Staphylococcus* species were more prevalent in the Gram positive isolates, where other Gram negative microorganisms such as *E. coli*, *P. aeruginosa*, *K. pneumoniae*, *M. morgani*, *E. faecalis*, *Enterobacter* species, *A. baumannii*, *S. marcescens* and *P. mirabilis* were also isolated. The antibiogram pattern of the *Staphylococcus* species revealed resistance to antibiotics.

Conclusion: This study has shown the prevalence of *Staphylococcus* species among SSIs, implicating the importance of further extended surveillance for better understanding of the prevalence rate and antimicrobial resistance pattern.

Keywords: Nosocomial infection, Post-operative wound infection, *Staphylococcus aureus*, Surgical wound infection.

INTRODUCTION

Various health care-associated infections (HAIs) are posing a major impact on patient's hospitalization time and health care costs [1-4]. It is estimated that around 77, 000 among 2 million people who acquire HAIs each year die, either as a direct result of their HAI. Surgical site infections (SSIs) are the most commonly reported HAIs and are secondary to urinary tract infections [5, 6]. Surgical site infections contribute to the increased morbidity and mortality worldwide with prolonged sanatorium stay and increased costs to both the hospital and individual [1, 7]. The Centers for Disease Control and Prevention (CDC) have developed standard criteria to define SSI [8, 9], which are regarded the contemporary and of international standard where a SSI is defined as infection associated to an operative procedure, which occurs at or near the surgical incision within a 30-day period.

Enhanced understanding in the incidence of SSI and its risk factors are helpful in guiding surveillance after hospital discharge and patient selection for preoperative antibiotic prophylaxis [10]. The risks in the development of SSIs vary, rendering to the nature of an operative procedure and specific clinical characteristics of the patient undergoing that procedure [11]. Predominantly SSIs are caused by microorganisms those get introduced into the surgical wound at the time of the medical procedures where, these microorganisms are one's endogenous flora, but occasionally many pathogenic microorganisms are acquired from exogenous sources such as air, surgical equipment, implants or gloves, or even from medications administered during the operative procedure [12, 13].

The surgical wound can be clean, clean-contaminated, contaminated or dirty-infected with prominent microorganisms and predominant being the Gram positive cocci, *Staphylococcus aureus*, though other Gram negative aerobes are also prevalent. A ten years (1986 to 1996) study over 17, 671 isolates by NNIS and CDC had showed the predominance of Gram positive *Staphylococcus aureus* and coagulase negative *Staphylococci* species; *Streptococcus* species and *Enterococcus*

species. Gram negative bacilli such as *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter* species, *Proteus mirabilis*, *Klebsiella pneumoniae* has also been reported along with *Candida albicans* and few anaerobic bacteria. The emergence of methicillin resistant *Staphylococcus aureus* (MRSA) has increased from 9% in 1995 to 30% in 2000 thereby increasing the morbidity and mortality rates [14-17].

Staphylococcus aureus is a major cause of frequent infections both in communities and healthcare facilities and is presenting resistance to various antimicrobial agents [18, 19]. This development of resistance to multiple drugs has caused substantial difficulty in the management of this infection and it has become a healthcare concern worldwide [20, 21]. Asia has been reported with the maximum incidence of methicillin-resistant *S. aureus* (MRSA) in the world [22-24]. Vancomycin-intermediate *S. aureus* (VISA) strains and vancomycin-resistant *S. aureus* (VRSA) strains are also being increasingly identified in certain countries of Asian region [25-28]. Furthermore, similar to the reports in Europe, a novel MRSA strain that had spread in livestock animals had been recently identified as a significant human pathogen in Asia [29]. The proportion of MRSA among clinical isolates has been reported to be strikingly high in South Asia with a rate of 80.8% being reported in an Indian hospital during 1999 [30]. It has also been reported from two multi centre studies in India that MRSA rates are 41% and 45%, respectively, in 2008-2009 and 2011 [31, 32].

Staphylococcus aureus being a major cause of many serious hospitals and community acquired infections; this present study has focused on the surveillance of SSI with emphases over *Staphylococcus* species infection among patients from tertiary care centers of Coimbatore, Tamil Nadu, India to understand the present scenario of the organism causing infection.

MATERIALS AND METHODS

Surveillance of *Staphylococcus* species was conducted over a period of twenty months and the samples were collected from various

tertiary care centers and also from various multi specialty hospitals in Coimbatore, Tamil Nadu, India.

Chemicals

All the reagents, chemicals, culture media and antibiotic discs that were used in this study were purchased from Himedia, Mumbai, India.

Study design

Surveillance method framed by the US Center for Disease Control and Prevention (CDC) was utilized for assessing the SSI [33]. An indirect surveillance was conducted by acquiring patient information and the surgical sites were inspected at the time of dressing change 24-48 h post-surgery (direct surveillance) [34].

Sample collection

Nursing assistant or the person responsible for sample collection was trained on SSI definition as outlined. 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 ($>38^{\circ}\text{C}$), localized pain, or tenderness; and (c) an abscess or other evidence of infection was noted [35]. 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 [36].

Sample processing and identification

Collected swab samples were plated on mannitol salt agar (MSA) medium for isolation of *Staphylococcus* species. Furthermore, other conventional methods like Gram staining, catalase reaction and also the ability to produce coagulase was assessed and the isolates were confirmed [37].

Antimicrobial susceptibility testing

All the isolates were tested for antibiotic resistance by Kirby-Bauer disk diffusion method in accordance with the standards recommended by the Clinical and Laboratory Standards Institute (CLSI) [38]. CLSI interpretative criteria for susceptibility and resistance testing were used. Antibiotics that are prescribed on the routine base to the patients were used to study the antimicrobial sensitivity pattern of the isolates. Inhibition zones around the antibiotic disc in the plates were measured using normal measuring scale, whereby their sensitivity level was measured [36].

Statistical analysis

The obtained results are represented as mean \pm SD, where the values at $p<0.05$ are considered significant as determined by one way analysis of variance (ANOVA). Analyses were performed using SPSS statistical package (version 17.0).

RESULTS

The wound and pus samples for microbiological analysis from various surgical sites such as abscess pus, ambulatory wounds, appendectomy, bed sore wounds, burn wounds, CABG, chest aspiration, cholecystectomy, femoral catheter site, herniorrhaphy, hysterectomy, laparotomy, leg accidental wounds, leg RTA, scrotal abscess, skin wounds, thyroidectomy and tracheostomy were collected from around 221 patients, where multiple samples of a same patient was recorded with the same identification. Age wise demographic distribution of the patients is represented in fig. 1.

Microbiological analysis revealed 42.08% positivity among the collected samples. From the bacterial analysis of the obtained positive samples both Gram positive and Gram negative bacterial isolates were present at a rate of 59.13% Gram positive bacteria and

the others being the Gram negative bacterial strains. Collective members of Gram negative bacterial species such as *E. coli*, *P. aeruginosa*, *K. pneumoniae*, *M. morganii*, *E. faecalis* were isolated. Other few strains namely *Enterobacter* species, *A. baumannii*, *S. marcescens* and *P. mirabilis* were also isolated from the 40.86% Gram negative samples.

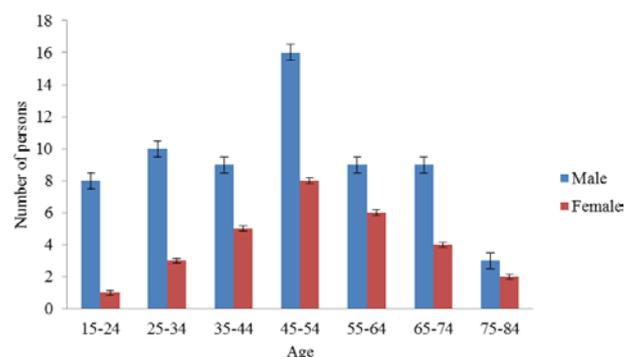


Fig. 1: Age wise distribution of positive samples values are represented as mean \pm SD

The analysis of the Gram positive isolates resulted with 80% predominance of Gram positive cocci, *Staphylococcus* species with its members *S. aureus* (65.45%), *S. epidermidis* (23.63%) and *S. haemolyticus* (10.90%). Fig. 2 represents the diverse microbial isolates that were isolated in this study.

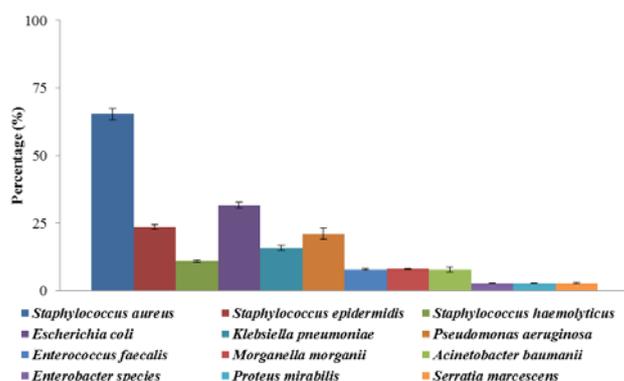


Fig. 2: Percentage of various microorganisms isolated from positive SSIs samples values are represented as mean \pm SD

All the isolated bacterial strains were screened and further subjected for antimicrobial sensitivity testing where their pattern of sensitivity was tested using a wide array of antibiotics those prescribed to patients by medical practitioners. The antibiotic susceptibility pattern among isolated pathogenic microorganisms revealed resistance pattern in most of the isolates. The antibiogram pattern of the *Staphylococcus* species (*S. aureus*, *S. epidermidis* and *S. haemolyticus*) are represented as percentage values in the table (table 1).

DISCUSSION

For various medical conditions, surgery is essential for a comprehensive recovery and about 200 million patients worldwide are exposed to numerous medical complications and undergo surgery each year [39]. The process of reoperation in health is being found deteriorating in numerous medical cases due to gratuitous infectious agents. The control of infection and infectious agents causing infection remains a great challenge though, prodigious advancement in medical practices have been accomplished. Nosocomial infections are a major problem and detection of its presence require high-level surveillances, where surgical site infection is found to be the second most common type of nosocomial infection.

Microorganisms are found to cause infections at several levels in humans, mostly to immune compromised whose chance of acquiring infection is high.

Patients undergoing medical/surgical procedures are hospitalized for recovery, where they are found to be in high menace of nosocomial infections. Surgical site wound infections or surgical site

infections (SSIs) play a significant role in those who had undergone any surgery in any location. The occurrence rate of surgical site wound infections, though avoidable is found increasing as the normal human microbiota bargains its source causing undesirable infections. The etiology of infection is reliant on the site of the surgery, bacterial load and integrity of host defences [36, 40].

Table 1: Antibigram pattern of *Staphylococcus* species

Antibiotics	<i>Staphylococcus</i> species		
	<i>S. aureus</i>	<i>S. epidermidis</i>	<i>S. haemolyticus</i>
Amikacin	19.44±0.87%	23.07±1.01%	16.66±1.03%
Ampicillin	5.55±0.26%	7.69±0.22%	-
Cefotaxime	13.88±1.09%	7.69±0.54 %	16.66±0.93%
Chloramphenicol	5.55±0.31%	7.69±0.36%	-
Clindamycin	8.33±0.36%	7.69±0.31 %	-
Gentamycin	5.55±0.20%	-	-
Imipenen	5.55±0.29%	-	16.66±0.72%
Oxacillin	16.66±0.78%	7.69±0.29%	16.66±0.60%
Vancomycin	19.44±0.85%	38.46±1.28 %	33.33±1.27%

Values are represented as mean±SD, n=55

Among the microorganisms, the Gram positives are found to cause several skin infections even leading to death due to their toxicity. As a measure to control the spread and to realize the contributory microorganism, surveillance is very essential. Thus this present study had focused on the surveillance of SSIs with emphases over detection of *Staphylococcus* species causing infection among patients from tertiary care centers of Coimbatore, Tamil Nadu, India.

Surgical site wound samples that were collected and processed for pathogens had presented an infection rate of 42.08% however the bacterial profile of the positive cases has shown the presence of 59.13% Gram positive bacteria with the rest covering the Gram negative bacterial flora (40.86%). Previous reports by Agarwal [41], Rao and Harsha [42], Kowli et al. [43] and Anvikar [44], has shown that the SSI rates to be around 4 to 35% in India [45-48]. Amid the bacterial isolates the Gram positive *Staphylococcus* species has been found to dominate with its strains *S. aureus* (65.45%), *S. epidermidis* (23.63%) and *S. haemolyticus* (10.90%). Srikanth et al. [49] had reported that the *S. aureus* is the most important pathogens affecting humans and had acquired resistance to various antibiotics, a leading cause of hospital and community acquired infections. The obtained results correlate with the previous study showing the dominance of *Staphylococcus* species.

The obtained antibiogram results have disclosed both resistant and susceptibility pattern. Resistant strains of *S. aureus* possess serious threat, as they can cause other medical complications. Though the isolation of MRSA strains was low, it's still considered a threat for the treatment process and MRSA still plays a principal role in SSI. In an earlier study conducted by in Tamilnadu, it has been reported that out of 906 strains of *S. aureus* isolated from clinical samples, 250 (31.1%) were found to be methicillin resistant [50]. Furthermore, it has been reported that in India during 2000-2001, MRSA was responsible for 10.9% of community-associated pyoderma cases [51]. The obtained results of this study are in correlation with previous studies, thus posing an importance for the surveillance of *Staphylococcus* species.

CONCLUSION

Surgical site infections can be recognized as the monitor for the excellence in medical practice and patient care. Though *Staphylococcus* species are common microflora of humans, *S. aureus* with multiple drug resistance is a major human pathogen associating with a huge disease burden. This study results have shown that, the execution of surveillance at all levels is immediately required to advance insights into the current epidemiology of *S. aureus* infection in all medical cases. Though surgical site infections cannot be completely eliminated, their level of infection can be lessened to a negligible amount thus creating substantial benefits in health care.

CONFLICT OF INTERESTS

Declared None

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