SURGICAL SITE INFECTIONS IN ELECTIVE SURGERIES: A STUDY FROM A TEACHING HOSPITAL IN SOUTH INDIA

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ABSTRACT

BACKGROUND

Surgical Site Infections (SSIs) continue to be a major complication despite the improvements in surgical practice. Infections caused by drug-resistant pathogens are expensive in terms of cost of treatment, morbidity and prolonged hospitalisation. Early detection, treatment and prevention of surgical infections are important, because it may lead to sepsis with substantial morbidity and mortality.

The aim of this study is to find out the infection rate in elective surgeries and to identify the pathogens with their antibiotic sensitivity pattern.

MATERIALS AND METHODS

A prospective study was conducted among 245 post-operative patients admitted in the General Surgery wards of a teaching hospital in south India. Swabs were taken from the surgical sites for bacteriological analysis after 48 hours of surgery. Each case was followed up till a period of one month. Second swab was taken if any wound infection was noticed and antibiotic sensitivity pattern of the pathogens were studied against the commonly used antibiotics.

RESULTS

Among the 245 cases studied infection rates were 3% in clean surgeries, 8.3% in clean contaminated and 30% in contaminated types of surgeries. Overall, SSI rate was 4.9%. Staphylococcus aureus (50%) and Escherichia coli (38%) were the major pathogens. 37.5% of S. aureus were Methicillin resistant, while 57.1% of the Gram-negative pathogens were resistant to 3rd generation cephalosporin. Wound colonisation was noticed in 28.2% wound sites, which was predominated by S. aureus (80.5%).

CONCLUSION

High prevalence of S. aureus and Methicillin Resistant Staphylococcus aureus (MRSA) suggest the recommendations to prevent cross infections by improving hygienic measures including hand washing. Screening of nasal carriage of MRSA in attending health care professionals is to be considered. The reduced susceptibility profile of Gram negative pathogens indicates the limited usefulness of antibiotics for prophylaxis and treatment and so antibiotic policy is to be revised.

KEYWORDS

Surgical Site Infection, Antibiotic Sensitivity, Infection Rate, Cross Infection.

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BACKGROUND

SSIs are defined as infections that occur within 30 days of surgery and accounts for 12.3% of hospital acquired infections.[1] Infection rates varied from 2.5% to 41.9% for various institutions depending on the type of operations and underlying patient status.[2,3] In India the rate of SSI is found to be 4% - 30%.[4] Clean wound infection rate is the most valuable reflection of general quality in any hospital. Early diagnosis of surgical infection is important, because it may lead to sepsis and increase the morbidity.

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In 1964, the National Research Council of United States classified operative wounds into four categories based on the degree of expected bacterial contamination. Infection rate in these categories are clean (1% - 5%), clean contaminated 3%-11% and contaminated 10% - 17% and dirty more than 27%.[5]

Major source of wound infections is endogenous contamination from the patient's own flora. Exogenous infections are acquired from the hospital environment or other infected patients.[5]

The problem of cross infection from exogenous sources of S. aureus remains a challenge. About 25% - 36% of these infections are preventable through the adherence to strict guidelines by healthcare workers.[6]

Surveillance of SSI with local data regarding the bacterial isolates and its antibiotic susceptibility patterns are important to modify the antibiotic therapy and formulate infection control protocols.

MATERIALS AND METHODS

A prospective study was done in 245 elective surgeries in a teaching hospital of Kerala state of south India after the

approval of Institutional Review Board. Post-operative patients above 15 years admitted in the general surgery wards were included in the study during a period of one year, September 2010 to August 2011.

Surgical wound is categorised based on the extent of intraoperative contamination as clean, clean contaminated and contaminated and dirty. Critically ill patients and non-consented patients were excluded. Dirty surgical wounds where the incision is through an infected area, laparoscopic surgeries and stitch abscess were also excluded.

Patient's data included age, sex, type of surgery, risk factors and antibiotics prescribed. Samples were taken from the surgical sites after 48 hours of surgery when the first dressing was changed. Any inflammation or discharge from wound site was looked for. Samples were sent for microbiological analysis and antibiotic susceptibility tests using standard laboratory methods. Colonisers were defined based on the appearance of wound where there was no inflammation or discharge and Gram staining where pus cells were absent or only occasional. Second swab was taken if any signs of wound infection were noticed. Clinically infected wound showed signs of inflammation and wound dehiscence or discharge. Gram stain showed pus cells. Each case was followed up till the day of discharge and at the time of post-operative review up to a month after hospital discharge.

The role of nasal carriers in causing SSIs of elective surgeries was looked for. Nasal swabs were collected from the attending staff members for screening S. aureus and MRSA.

Statistical analysis was done using Epi Info-7, developed by CDC.

RESULTS

245 samples were collected from 105 (42.9%) male and 140 (57.1%) female patients.

The distributions of bacterial growth were analysed based on the different surgical sites (Table 1); 139 (56.7%) samples were bacteriologically sterile. Colonisation of potential pathogens as well as skin contaminants was found in 106 (43.3%) cases.

Site of Surgery	No. Growth	Skin Flora	Gram Positive Isolates	Gram Negative Isolates	Gram Positive and Gram Negative Isolates
Thyroidectomy (65)	45 (69.2%)	7 (10.8%)	13 (20%)	0 (0%)	0 (0%)
Sialadenectomy (6)	4 (66.6%)	1 (16.7%)	1 (16.7%)	0 (0%)	0 (0%)
Mastectomy (25)	15 (60%)	6 (24%)	2 (8%)	0 (0%)	2 (8%)
Abdominal wall Hernias (32)	16 (50%)	6 (18.8%)	7 (21.9%)	1 (3.1%)	2 (6.2%)
Biliary tract surgeries (9)	7 (77.8%)	2 (22.2%)	0 (0%)	0 (0%)	0 (0%)
Gastric surgeries (26)	18 (69.2%)	2 (7.7%)	6 (23.1%)	0 (0%)	0 (0%)
Appendicectomy (3)	2 (66.7%)	0 (0%)	1 (33.3%)	0 (0%)	0 (0%)
Colonic surgery (10)	4 (40%)	1 (10%)	2 (20%)	2 (20%)	1 (10%)
Nephrectomy (2)	2 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Inguinal and Genital sites (52)	16 (30.7%)	10 (19.2%)	20 (38.5%)	3 (5.8%)	3 (5.8%)
Varicose vein and Lower limb surgeries (15)	9 (60%)	2 (13.3%)	4 (26.7%)	0 (0%)	0 (0%)
TOTAL CASES 245	**139 (56.7%)**	**37 (15.1%)**	**56 (22.9%)**	**5 (2%)**	**8 (3.3%)**

Table 1. Bacterial Growth at Surgical Sites after 48 Hours of Surgery (245)

Gram positive organisms were the major isolates in 64 wound sites and a greater part was S. aureus (96.9%). 13 wound swabs yielded Gram negative bacteria, which included E. coli 5 (38.4%), P. aeruginosa 3 (23.1%), Acinetobacter 3 (23.1%) and Klebsiella 2 (15.4%).

Out of the 245 cases studied there were 199 (81.2%) clean, 36 (14.7%) clean contaminated and 10 (4.1%) contaminated cases. In 12 (4.9%) patients, wound infection was noticed before discharging from the hospital. Infection rates in different wound classes were studied (Table 2).

Wound Class (N = 245)	Non-Infected (233)	Infected (12)
Clean (199)	193 (97%)	6 (3%)
Clean-Contaminated (36)	33 (91.7%)	3 (8.3%)
Contaminated (10)	7 (70%)	3 (30%)

Table 2. Infection Rates in different Wound Classes

Among the clean surgeries one case each from the thyroidectomy, mastectomy, varicose vein, inguinal hernia and two incisional hernias were infected. S. aureus was the common isolate in clean wound infections. Mixed infection with E. coli was noticed in two cases.

In clean contaminated type of surgeries, three cases were infected. Pure growth of E. coli, K. pneumonia and S. aureus were yielded from one gastrectomy and two of the cholecystectomy wounds.

Three colonic surgeries were infected among the contaminated type wounds, where E. coli was the common pathogen. Apart from E. coli, S. aureus and E. faecalis was associated with two cases. The frequency of pathogenic isolates was given in Figure 1.

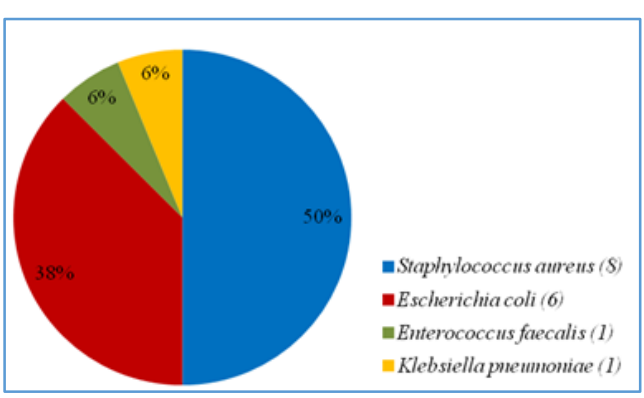

Figure 1. Frequency of Pathogens in Surgical Site Infection

Antibiotic sensitivity pattern of the pathogenic isolates were studied against the commonly used antibiotics. The sensitivity patterns were given in Table 4.

Antibiotics	S. aureus(8)	E. faecalis(1)	E. coli(6)	Klebsiella-pneumoniae(1)
Penicillin	1 (12.5%)	0 (0%)	-	-
Ampicillin	-	1 (100%)	0 (0%)	0 (0%)
Erythromycin	3 (37.5%)	-	-	-
Cloxacillin (Cefoxitin disc)	5 (62.5%)	-	-	-
Linezolid	8 (100%)	1 (100%)	-	-
Vancomycin	8 (100%)	1 (100%)	-	-
Cephalexin	-	-	1 (16.7%)	0 (0%)
3rd gen. Cephalosporin	-	-	3 (50%)	0 (0%)
Ciprofloxacin	-	-	2 (33.3%)	1 (100%)
Cotrimoxazole	-	-	3 (50%)	1 (100%)
Gentamicin	5 (62.5%)	*1 (100%)	3 (50%)	1 (100%)
Amikacin	-	-	6 (100%)	1 (100%)
Piperacillin-tazobactam	-	-	6 (100%)	1 (100%)
Imipenem	-	-	6 (100%)	1 (100%)

Table 3. Antibiotic Sensitivity Pattern of Pathogens–Sensitivity %

*Gentamicin 120 mcg was used.

The four Gram negative isolates resistant to 3rd generation cephalosporin were screened for ESBL production. Escherichia coli(3) and Klebsiella pneumoniae(1) were found to be ESBL producers.

Being the major coloniser and potential pathogen of clean wounds, S. aureus screening was done for detecting nasal carriers. Among the 20 staff members in surgical wards, five (25%) were found to be S. aureus carriers and 60% of these isolates were MRSA. Antibiotic sensitivity pattern was shown in Figure 2.

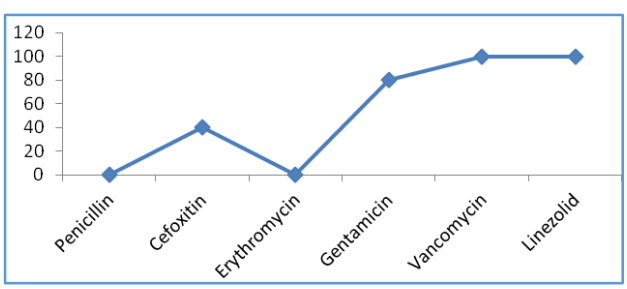

Figure 2. Staphylococcus aureus in Nasal Carriers- Antibiotic Sensitivity %

DISCUSSION

The study hospital was newly constructed and started functioning from 2006. The operation theatre was situated in a separate block attached to the post-operative wards. In the present study, the infection rate was low (4.9%) compared to other studies of Lilani et al, Mumbai (8.95%),[7] Awari et al Ahmedabad (8.29%)[8] and Saito et al Japan (7.6%).[9] But infection rate was higher than reports from Columbia (2.6%),[10] United States (2.8%),[11] Iran (2.4%)[12] and Mangolia (3.9%).[13]

The infected cases included 4 males (3.8%) and 8 females (5.7%) in the study group. Infection rate did not differ significantly by sex (χ2-0.14, p= 0.7). Higher infection rate was seen in the age group above 70 years. There was no statistically significant difference in infection rate in different age groups (χ2- 0.81, p= 0.81).

Infection rate in clean surgeries were 6 (3%). Infection rates were 3 (8.3%) in clean contaminated and 3 (30%) in contaminated type of surgeries. The rate of infection is significantly higher in the contaminated group compared to clean and clean contaminated wounds. (Chi square value χ2-15.44, p= 0.00008). The infection rate of clean and clean contaminated wounds correlates with the standards of infection risk accepted by the National Research Council wound classification. The accepted range of infection rates in clean surgery is 1% - 5%, clean contaminated 3% - 11% and contaminated wounds 10% - 17%.[5]

A number of studies report an infection rate of 1.6% to 18% for clean, 1.5% to 22.4% in clean contaminated and 8.5% to 32.26% in contaminated surgeries.[7,8,11,14,15,16]

Among the 245 wound sites after 48 hours of surgery, Gram positive cocci (83.1%) were the major isolates and 96.9% of them were S. aureus. Among the Gram-negative colonisers, E. coli was predominated (38.4%). The distributions of colonisers isolated from the wound sites were consistent with the normal flora of human body. Wound colonisation does not necessarily lead on to infection. The importance of the microbial load at wound site is relevant irrespective of routine antibiotic prophylaxis. In clean contaminated, contaminated surgeries the isolated pathogens closely resemble the normal endogenous microflora of the surgically resected organ.[14]

In this study, the major pathogens isolated from infected wound were S. aureus (50%) followed by E. coli (38%), which was comparable with other reports.[7,16,17,18] Studies by Insan et al at Mumbai (32.8%),[1] Murthy et al Manipal (32%),[18] Kownhar et al Chennai (37%),[19] Anguzu et al Uganda (45.1%)[20] have found S. aureus as the commonest pathogen isolated from SSIs. Among the Gram negative pathogens, E. coli was the commonest isolate as seen in other studies.[16,17,21]

Among the S. aureus isolates, 62.5% was sensitive to Cloxacillin. The prevalence of MRSA (37.5%) from wound infection was found to be higher than reported from Chennai (21.7%),[19] Mumbai (27.85%),[21] Nagpur (26.92%)[22] and Vellore (24%),[23] but was lower than that reported from Delhi (38.56%).[17]

The resistance observed in S. aureus was attributed to irrational use of antibiotics, which highlight the need of regular surveillance to monitor infections and antibiotic profiles against the frequently encountered pathogens.

57.1% of Gram negative pathogens were resistant to the commonly used antibiotic, 3rd generation cephalosporins and were found to be ESBL producers. ESBL producers (57.1%) are lower in this study compared to the reports published by Mohanty et al (66.75%),[17] Sonawane et al (71.72%)[21] and Mathur et al (68%).[24]

Nasal carriers of S. aureus are at three to six times increased risk for healthcare associated infections than non-carriers and low level carriers.[25,26] Higher percentage of MRSA (60%) was seen in nasal carriers when compared to the MRSA isolated from SSIs (37.5%). But the difference is not statistically significant in this study ($\chi 2$- 0.48, p= 0.82).

CONCLUSION

The surgical site infection rate is 4.9%. S. aureus is the commonest pathogen followed by E. coli. High prevalence of S. aureus and MRSA suggest the recommendations to prevent cross infections by improving hygienic measures including hand washing. Screening of nasal carriage of MRSA in attending healthcare professionals is advisable. The reduced susceptibility profile of Gram negative pathogens suggest that the existing antibiotic policy is needed to be revised based on the epidemiology of drug resistant bacteria.

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