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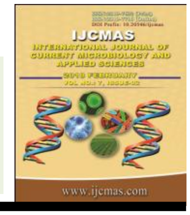

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A Study on Post-Operative Wound Infections

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A B S T R A C T

Sepsis in modern surgery continues to be a significant problem for healthcare practitioners across the globe.[1]Since initial antimicrobial therapy usually remains empiric; the knowledge of prevailing susceptibility patterns at individual institutions is a must. To determine the etiology of surgical site infections (SSI) in patients admitted to a tertiary care teaching hospital, study its antibiogram and the prevalence of ESBL. 200 patients who developed SSI in a teaching hospital during a period of one year were prospectively studied. Clinical records were also reviewed to assess the surgical wound, associated risk factors and outcome. 200 patients, 88 males and 112 females, who developed SSI, were studied. Of the wounds studied, 103 were from clean- contaminated wounds. The most common pathogen was *Staphylococcus aureus* (41.71%), followed by *Klebsiella pneumoniae* (19.43%) and *E. coli* (17.14%). MRSA prevalence was 28.77%. ESBL prevalence was also high. Most gram negative bacilli other than Pseudomonas aeruginosa were found to be resistant to 1st and 2nd line drugs and sensitive mainly to carbapenems and βlactam-βlactamase inhibitor combinations. With the increase in incidence of nosocomial infections and multi drug resistance, a meticulous and periodic surveillance of SSI is called for.

Introduction

Infection has always been a feature of human life and sepsis in modern surgery continues to be a significant problem for healthcare practitioners across the globe (Lilani *et al.,* 2005). The incidence of infection varies. Surgical site infectionis defined as infection occurring up to 30 days after surgery (or up to one year after surgery in patients receiving implants) (Alicia *et al.,* 1999). Surgical site infections are a major part of Health Care Associated Infections (HCAI), accounting for approximately a quarter of all nosocomial infections, (Alicia *et al.,* 1999; Ronald Lee Nichols, 2001; Suchitra Joyce *et al.,* 2009) and also the third most common of nosocomial infections (Alicia *et al.,* 1999; Suchitra Joyce *et al.,* 2009). Post-operative wound infection delays recovery often increases length of stay (doubled) and cost (Singh *et al.,* 2002) may produce lasting sequelae and require extra resources for investigations and management. Most of these infections are superficial and readily treated with a regimen of local care and antibiotics. However, soft tissue infections involving deeper layers like fascia and muscle can rapidly progress to systemic sepsis and prove fatal (Martone *et al.,* 2001; Mohanty *et* *al.,* 2004). These are the type of infections that require a wise choice of antimicrobials in addition to aggressive surgical debridement to limit tissue loss and preserve life (Martone *et al.,* 2001; Mohanty *et al.,* 2004).

Multi drug resistance is a dreaded problem in nosocomial infections including surgical site infections. Since initial antimicrobial therapy usually remains empiric, it is important to know, the prevailing susceptibility patterns of bacterial isolates at individual institutions by routine surveillance.

Intensive medical therapies and frequent use of antimicrobial drugs result in selection of resistant microbial flora. (Cruse, 1992; Cruse *et al.,* 1980) Hospitals are reservoirs for strains of bacteria that are multi drug resistant. SSI due to resistant organisms has been a problem with an increase in the incidence of methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin - resistant *Enterococcus* (VRE) and *Pseudomonas aeruginosa*. (Agarwal, 1972; Cruse, 1992; Rao *et al.,* 1975) There are however effective interventions for reducing the occurrence of HCAI.

Now with the use of antibiotics, a new era in the management of wound infections commenced. The search for new and more effective drugs continues even today. The pace, however, has slowed remarkably. Also, unfortunately, eradication of the infective plague affecting surgical wounds has not ended because of the insurgence of antibiotic-resistant bacterial strains and the nature of more adventurous surgical intervention in immune compromised patients and in implant surgery. Companies involved in the search for new antibiotics are also finding it increasingly difficult to keep up with the pace at which bacterial resistance renders their findings useless.

With the increase in incidence of nosocomial infections and multi drug resistance, a meticulous and periodic surveillance of various hospital acquired infections is called for.

Aim of the study

To determine the bacterial etiology of surgical site infections in a group of patients with surgical site infections admitted to Surgery and Obstetrics and Gynaecology (O&G) in Medical College, Thiruvananthapuram and to study its antimicrobial susceptibility profile.

To find out the prevalence of ESBL among the organisms isolated.

Materials and Methods

Study setting and design

The prospective study was conducted on a group of inpatients from a tertiary care teaching hospital, in south Kerala after obtaining ethical clearance. Patients developing post-operative wound infections after a surgery done in the same hospital during a one year period 2008 -2009was included in the study. Only wounds which can be classified as clean, clean-contaminated or contaminated were included in the study. The microbiological methods used for culture, identification of the pathogen, finding the antimicrobial susceptibility profile and the methods for ESBL detection was also reviewed.

Data collection

Data regarding the demographic characteristics, type of surgery performed whether planned or emergency, classification of the surgical wound, other associated risk factors, antibiotic therapy given and outcome were collected from case records. Surgical wounds are classified as clean, clean contaminated, contaminated and dirty wounds

Clean: An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered.

Clean-Contaminated: Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination

Contaminated: Open, fresh, accidental wounds including operations with major breaks in sterile technique

Dirty or Infected: Includes old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera

Microbiological methods

The present study was conducted in the Dept. of Microbiology, Government Medical College, Thiruvananthapuram. 200 operated cases in Surgery and Obstetrics and Gynaecology were included in this study.

Two sterile swabs or in some cases, syringe aspirate were obtained from the post-operative infected wounds after informed written consent of the patient and transported to the lab and processed without delay.

Samples were subjected to gram staining and culture. For culture, the specimen was inoculated into the following media-

5% Blood agar (BA)
Macconkeyagar (MA)
Salt agar (SA)
Chocolate agar (CA)
Glucose broth (GB)
Robertson Cooked meat medium (RCM)
After overnight incubation, the plates were read for growth. Smears were made from liquid media if it appeared turbid and subculture done accordingly. The colonies were then identified by the conventional microbiological methods. Antimicrobial susceptibility testing was done by Kirby-Bauer disc diffusion method and interpretation was done according to CLSI guidelines.

ESBL detection by Double Disc Synergy Test (DDST): Synergy was determined between a disc of amoxicillin-clavulanate (20 µg/10 µg) (augmentin) and a 30-µg disc of three third-generation cephalosporin antibiotics namely Ceftriaxone, Cefotaxime and Ceftazidime placed at a distance of 20 mm from center to center on a Mueller-Hinton Agar (MHA) plate swabbed with the test isolate. Clear extension of the edge of the inhibition zone of cephalosporin toward the augmentin disc resulting in a characteristically shaped zone referred to as ‘keyhole’ was interpreted as positive for ESBL production.

Control strains of *Staphylococcus aureus* Atcc 25923, *E coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 and ESBL-producing *Klebsiella pneumoniae* ATCC 700603 were used throughout the study.

Results and Discussion

Patients’ characteristics

As per the inclusion criteria, pus samples were taken from 200 patients who had Surgical Site Infections (SSI). Of this, 127 cases were taken from Surgery and 73 cases from Obstetrics and Gynaec (O&G). Age of the patients ranged between 20-89years with a median age of patients developing SSI in Surgery cases being 45.0 and in O&Gbeing 29.0. 88 patients were males and 112 patients were females with a male to female ratio1: 1.3.The age distribution of patients developing SSI is given in table 1. Most of the SSI studied was from clean contaminated wounds. The tabulation of SSI based on the wound class is given in table 2.

Association of certain risk factors like diabetes mellitus, previous hospitalization, extremes of age and emergency surgery was studied. It was seen that 82 patients (41%) had unplanned emergency surgery, 75 patients (37.5%) had previous history of hospitalization and 74 patients (37%) had diabetes mellitus. The categorization of these risk factors is given in table 3.

Etiology

Bacterial pathogens were isolated from 147 individuals. A single etiologic agent was identified in 120(60%) patients, multiple agents were found in 27(13.5%), and culture negative in 53(26.5%). A high preponderance of aerobic bacteria was observed. Among the common pathogens were *Staphylococcus aureus* (73 patients, 41.71%), *Klebsiella pneumoniae* (34 patients, 19.43%) *and E. coli* (30 patients, 17.14%). The detailed etiology is given in table 4.

Antimicrobial resistance

The antibiotic resistance pattern of gram positive cocci and gram negative bacilli to the commonly tested antibiotics is given in tables 5a and 5b. Because of the increased resistance pattern to III generation Cephalosporins, Class I ESBL was tested for the *E coli* and *K pneumoniae* isolates using DDST. 18 (60%) E coli and 22 (64.71%) *Klebsiellapneumoniae* were found to be ESBL producers by this method.

Outcome

191(95.5%) patients had uneventful recovery following appropriate antibiotic therapy, while 9 (4.5%) patients died due to fulminant sepsis before the organism was isolated.

This study provides data on the microbiology and antibiotic susceptibility pattern in a group of patients who developed SSI in the institution. The development of postoperative SSI is known to be multifactorial, arising from a complex relationship and delicate interplay between host, microbe and environmental factors. SSIs may occur following any surgical incision, even after the use of minimally invasive techniques, so SSIs need to be reported through systematic monitoring. The dominant causative microorganisms and treatment options have changed over time. Today, most common pathogens are resistant to common antibiotics and there is a need for a high index of suspicion, prompt operative intervention, appropriate antibiotic treatment and proper resuscitation. (Josep Ballus *et al.*, 2015)

During the course of one year, a total of 200 surgical site infections (SSI) were studied. Samples were collected only from those patients with confirmation of SSI by the surgeon.Gram negative bacilli predominated in Surgery accounting for 53% of isolates. This is in accordance with previous studies showing that gram negative bacilli predominate in abdominal surgeries. (Josep Ballus *et al.*, 2015) In O&G, gram positive bacteria predominated probably because most of the surgeries were clean surgeries. (Nichols, 1984) A number of studies in literature indicates gradual increase in the emergence of antibiotic resistant microorganisms in surgical patients. (Agarwal, 1972; Rao *et al.*, 1975)

Most of the isolates obtained in Surgery were resistant to multiple drugs. This could be due to the higher antibiotics given to patients on admission due to complications, or due to gastro- intestinal surgeries performed (Josep Ballus *et al.*, 2015).

The following antibiotic discs were used

• **Penicillin (10IU)**	• **III[rd] gen Cephalosporins(30 µg)**
• **Ampicillin (10 µg)**	• Cefoxitin (30 µg)
• **Erythromycin (15 µg)**	• Vancomycin (30 µg)
• **Gentamicin (10µg)**	• Rifampicin (5 µg)
• **I[st]genCephalosporins(30 µg)**	• Clindamycin (2 µg)
• **Cotrimoxazole (1.25/23.75 µg)**	• Linezolid (30 µg)
• **Amikacin (30 µg)**	• Cefoperazone-Sulbactum (75+30µg)
• **Ciprofloxacin (5 µg)**	• Imipenem (10 µg)
• **Piperacillin-Tazobactam (100+10µg)**	

Table.1 Age wise distribution of patients

Age distribution	Surgery	O&G	Total
20-29	22	40	62
30-39	23	17	40
40-49	34	9	43
50-59	25	3	28
60-69	17	4	21
70-79	4	-	4
80-89	2	-	2
Total	127	73	200

Table.2 Distribution of SSI based on wound

Wound class	Surgery	O&G	Total
Clean	71	-	71
Clean-contaminated	33	73	106
Contaminated	23	-	23
Total	127	73	200

Table.3 Categorization of patient associated risk factors

	No of patients	% of patients
Emergency surgery	82	41%
Previous h/o hospitalization	75	37.5%
Diabetes mellitus	74	37%
No risk	32	16%
Age>70 years	6	3%

Table.4 Etiology

Organism	Surgery
Staphylococcus aureus	73 (41.71%)
Staphylococcus epidermidis	10 (5.71%)
Enterococcus faecalis	10 (5.71%)
Streptococci	2 (1.14%)
Klebsiellapneumoniae	34 (19.43%)
E coli	30 (17.14%)
Pseudomonas aeruginosa	10 (5.71%)
Acinetobacterbaumannii	6 (3.43%)
Total	175

Table.5a Antimicrobial resistance pattern of gram positive bacteria isolated from surgical wounds

S. No	Antibiotic	*Staphylococcus aureus*	Coagulase negative Staphylococci	Enterococci
1.	Penicillin	70(95.89%)	9(90%)	10(100%)
2.	Ampicillin	NT	NT	10(100%)
3.	Gentamicin	33(45.21%)	8(80%)	9(90%)
4.	Erythromicin	43(58.90%)	7(70%)	10(100%)
5.	Oxacillin	21(28.77%)	6(60%)	NT
6.	Amikacin	10(13.70%)	2(20%)	NT
7.	Vancomycin	0(0%)	0(0%)	0(0%)
8.	Linezolid	0(0%)	0(0%)	0(0%)

Table.5b Antimicrobial resistance pattern of gram negative bacteria isolated from surgical wounds

S. No	Antibiotic	*Enterobacteriaceae*	*Pseudomonas aeruginosa*	*Acinetobacterbaumanii*
1.	Ampicillin	62(96.88%)	NT	6(100%)
2.	Gentamicin	43(67.19%)	5(50%)	5(83.33%)
3.	Ist generation Cephalosporins	59(92.19%)	NT	6(100%)
4.	IIIrd generation Cepahalosporins	55(85.94%)	3(30%) (Ceftazidime)	6(100%)
1.	Amikacin	13(20.31%)	2(20%)	3(50%)
2.	Ciprofloxacin	53(82.81%)	4(40%)	5(83.33%)
3.	Cotrimoxazole	46(71.88%)	NT	5(83.33%)
4.	Piperacillin/Tazobactam	24(37.50%)	2(20%)	4(66.67%)
5.	Cefaperazone/Sulbactam	16(25%)	2(20%)	2(33.33%)
6.	Imipenem	0(0%)	0(0%)	1(16.67%)
7.	Meropenem	0(0%)	0(0%)	1(16.67%)

When these patients developed infection, the pathogens were found to be multi drug resistant due to antibiotic selection.

21(28.77%) of *Staphylococcus aureus* were methicillin resistant and 6(60%) of coagulase negative Staphylococci were methicillin resistant showing the rising prevalence of methicillin resistance among Staphylococci (Cruse *et al.,* 1980; Mohanty *et al.*, 2004; Lilani *et al.,* 2005). But Vancomycin resistance was not encountered in the study.

As in other studies, (Cruse *et al.*, 1980; Josep Ballus *et al.,* 2015; Mandakini Pawar *et al.,* 2008; Nichols, 1984) most of the Enterobacteriaceae isolates and *Acinetobacterbaumanii* were multi drug resistant and only sensitive to higher antibiotics like Piperacillin Tazobactum (Resistance- 24(37.50%) among Enterobacteriaceae and 4(66.67%) among *Acinetobacter baumanii*) and Cefaperazone Sulbactum (Resistance- 16(25%) among Enterobacteriaceae and 2(33.33%) among *Acinetobacter baumanii*). No carbapenem resistance was noted among Enterobacteriaceae and *Pseudomonas aeruginosa* but 1(16.67%) *Acinetobacter baumanii* was found to be carbapenem resistant. Also gram negative bacilli demonstrated high prevalence of ESBL (68.23%).

Death rate in this study was 4.5 % which is slightly more than the WHO statistics (2.1%), but comparable with Indian scenario. With resistant strains the mortality also increases as seen from studies conducted in India, 13.9% vs 1.8% seen with sensitive strains. (Mandakini Pawar *et al.,* 2008)

From the tabulated risk factors, it was noted that diabetes mellitus was associated with SSI in 74 (37%) and correlates with other studies (Alicia J. Mangram *et al.,* 1999; Suchitra Joyce *et al.,* 2009), prior hospitalization in 75 (37.5%) (Alicia J. Mangram *et al.,* 1999), emergency surgery in 82 (41%). (Alicia J. Mangram *et al.,* 1999) Other risk factors like immunosuppression, steroid therapy, malnutrition and anemia were seen in only a minority. The study gives us insight into the bacterial flora isolated and their resistance pattern in postoperative patients in this institution. This study can be further extended to other elective and emergency surgical procedures for a considerable duration. Surveillance of SSI with feedback of appropriate data to surgeons would be desirable to reduce the SSI rate.

This study has certain limitations. The most important is that we used for microbiological sampling, double skin swabs in most cases instead of tissue or aspiration sampling of infected tissue. Also follow up cultures and molecular typing of isolates was not done.

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With the increase in incidence of nosocomial infections and multi drug resistance, a meticulous and periodic surveillance of various hospital acquired infections is called for. Periodic surveillance of SSI will guide the Infection Control Committee in laying down strict guidelines to further decrease the SSI in hospitals, which is an indicator of health care.

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