RESEARCH PAPER | Medical Science | Volume : 4 | Issue : 1 | Jan 2014 | ISSN - 2249-555X

Bacteriological Profile of Surgical Site Infection From A Tertiary Care Hospital, From Western India

KEYWORDS : Post operative wound Infection, Staphylococcus aureus, E.coli, P. aeruginosa, drug resistance

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ABSTRACT *BACKGROUND:*

In developing countries, surgical site infections (SSIs) are imposing a heavy and potentially preventable burden on both patients and healthcare providers. The aim of this Study was to isolated & identify organisms from SSI and to study their antibiotic resistance pattern.

METHODS AND MATERIALS:

This Prospective study was conducted in the microbiology laboratory attached to a tertiary care Centre, over a period of 18 months (1st February 2012 to 31st July 2013). 100 cases were randomly included from culture positive post-operative wound infection cases. Standard microbiological techniques were used to isolate and identify the organisms and to study antibiotic resistance pattern.

RESULTS:

SSI rate was 6.97%, Staphylococcus aureus, E.coli, P. aeruginosa, Acinetobacter baumannii were the most commonly isolated organisms. All staphylococci were susceptible to Vancomycin and Teicoplanin. All Gram negative bacilli were 100% sensitive to Colistin and Polymyxin-B.

CONCLUSION:

The incidence of multidrug resistance pathogens as a cause of SSI is rising. Rapid and accurate detection of these pathogens and their antibiogram is important for prevention of morbidity and mortality associated with SSI.

INTRODUCTION:

Post- operative wound infection still remains a nightmare to all surgeons even in this era of much advanced medical science. [1] Inspite of advances in surgical techniques, better operating room environment, antibiotic prophylaxis, it still occurs in significant number of patients.

In 1992, the US Centers for Disease Control (CDC) revised its definition of 'wound infection', by creating the definition, 'surgical site infection' (SSI). [2]

Surgical site infection (SSI) is defined as an infection occurring within 30 or 90 days after a surgical operation (or within 1 year if an implant is left in place after procedure) and affecting either incision or deep tissues at the operation site. These infections may be superficial or deep incisional infection or infections involving organ or body space. [3]These infections are usually caused by the exogenous or endogenous microorganisms that enter the operative wound during the course of surgery. [4]

Based on National Nosocomial Infection Surveillance (NNIS) system reports, SSIs are the third most frequently reported nosocomial infections. They account for 14% to 16% of all nosocomial infections among hospitalized patients.[5]

Incidence of SSI in India reported to vary from 3.6% to 22.5%. [6,7,8,9]

Each hospital has its own unique bacterial flora to which patients are at risk for acquiring infection during hospitalization. In such situations; microorganisms exhibit unique pattern of antimicrobial activity during a certain period of time. Only when such epidemiological data are available can the surgeon employ a logical approach towards surgical site infection control. Also resistance to antimicrobials has become a serious problem necessitating in depth study of SSI to prevent the future complications in operated cases.

This study was conducted with an objective to identify the organisms causing SSIs and evaluate the antibiotic resistance pattern among the most common bacteria which are associated with SSIs.

MATERIAL AND METHODS:

Ethics committee approval was taken for this study (BVDU/MC/42).

The total 100 samples were randomly selected in this prospective study from 423 culture positive SSI cases.

The samples were collected from patients who have undergone surgery and developed Signs & Symptoms of infection within 30 days.

Inclusion criteria:
Cases of wound class I-IV Surgeries, conducted in the General surgery, Orthopedics, Obstetrics & Gynecology specialty. Patients of all age groups except neonates were included.

Exclusion criteria:
Procedures in which healthy skin was not incised, such as opening of an abscess, neonates, burn injuries and donor sites of split skin grafts.

Sample collection:
The exudate was collected from the depth of the wound using two sterile cotton swabs one in Nutrient broth for aerobic

Volume : 4 | Issue : 1 | Jan 2014 | ISSN - 2249-555X

and other into a freshly prepared Robertson's cooked meat broth.

Standard methods for isolation and identification of aerobic and anaerobic bacteria were used. [10]

Antibiotic susceptibility testing was done by Kirby-Bauer's disc diffusion method according to the CLSI guidelines.

All strict anaerobes were identified according to the Wadsworth anaerobic manual. [11]

RESULTS:

This Prospective study was conducted in the microbiology laboratory attached to a tertiary care centre, over a period of 18 months (1st February 2012 to 31st July 2013). A total 6059 surgeries performed in General Surgery, Orthopedics, Obstetrics & Gynecology department were included in the study.

423 samples, received from cases of SSI were culture positive. Out of these cases, 100 cases were randomly included in our study.

Maximum number of patients were in the age group of 21 to 30 years (25%), followed by age group 41 to 50 years (14.0%). There were only 4.0 % patients who were <10 years. Out of 100 SSIs patients studied 66 were males & 34 were females. Out of 100 cases, 69 cases were from clean class, 11 from Clean- contaminated class, 7 from contaminated class and 13 from Dirty class. SSIs rate in our study was 6.97%. For surgery wards infection rate was 5.4%, 1.08% for Orthopedics & 0.49 % for Obstetrics & Gynecology wards.

Total aerobic organisms isolated were 139. Gram negative bacilli (n=91) were more common than Gram positive cocci (n=48). The percentages of most frequently isolated microorganisms in SSIs were as follows: *Staphylococcus aureus* 37(26.6%), *Escherichia coli* 35(25.1%) and *Pseudomonas aeruginosa* 19 (13.6%) (Table No.1). Total anaerobic organisms isolated were 4. Out of 100 cases studied, monomicrobial infection was present in 61% cases and polymicrobial infection was observed in 39% cases.

Table No.1: Numbers of aerobic bacteria isolated from SSIs

Isolated Organisms	No. of aerobic	Percentage
Gram-positive cocci		
Staphylococcus aureus	37	26.6
Enterococcus faecalis	8	5.7
Streptococcus pyogenes	3	2.1
Subtotal	48	34.5
Gram-negative bacilli		
Escherichia coli	35	25.1
Pseudomonas aeruginosa	19	13.6
Acinetobacter baumannii	10	7.1
Klebsiella pneumoniae	8	5.7
Enterobacter cloacae	6	4.3
Unidentified GNB	5	3.5
Citrobacter fruendii	4	2.8
Proteus vulgaris	3	2.1
Serretia spp	1	0.7
Subtotal	91	65.5
Total isolate	139	100.0

Table No 2: Antibiotic resistance pattern of the predominant Gram negative bacilli isolated from SSIs

Organisms	No	PI %	PIT %	AMC %	CAZ %	CTR %	CPM %	AT %	IMP %	GEN %	TOB %	CIP %	CL %	PB %
Escherichia coli	35	74.2	34.2	85.7	71.4	74.2	77.1	65.7	22.8	31.4	28.5	62.8	0.0	0.0
Pseudomonas aeruginosa	19	31.5	21.0	84.2	78.9	84.2	84.2	78.9	10.5	52.6	42.5	57.8	0.0	0.0
Acinetobacter baumannii	10	80.0	70.0	80.0	80.0	80.0	70.0	70.0	20.0	80.0	70.0	100	0.0	0.0
Klebsiella pneumoniae	8	87.5	75.0	87.5	87.5	75.0	75.0	75.0	62.5	62.5	62.5	62.5	0.0	0.0
Enterobacter cloacae	6	66.0	50.0	83.3	83.3	83.3	83.3	50.0	0.0	66.0	33.3	66.0	0.0	0.0
Unidentified GNB	5	20.0	0.0	80.0	80.0	80.0	40.0	40.0	0.0	40.0	40.0	40.0	0.0	0.0
Citrobacter fruendii	4	75.0	75.0	75.0	75.0	75.0	25.0	25.0	0.0	50.0	50.0	50.0	0.0	0.0
Proteus vulgaris	3	66.6	33.3	66.6	66.6	66.6	33.3	66.6	0.0	33.3	33.3	33.3	0.0	0.0
Serratia spp.	1	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

PI=P **PI**= Piperacillin; **PIT=** Piperacillin/Tazobactam**;AMC=**Amoxicillin/clavulanicacid**;CAZ=**Ceftazidime**;CTR=**Ceftriaxone; **CPM=**Cefepime**;AT=**Aztreonam; **IMP=**Imipenem**; GEN=**Gentamicin**; TOB=**Tobramycin; **CIP=**Ciprofloxacin; **CL=**Colistin; **PB=**Polymyxin-B.

Volume : 4 | Issue : 1 | Jan 2014 | ISSN - 2249-555X

Table No.3 : Antibiotic resistance pattern of the predominant Gram positive cocci isolated from SSIs

Organisms		No	P %	O %	E %	VA%	TEI %	CD %	GEN%	TE %	RIF %	LE %	CIP %	LZ %
Staphylococcus aureus (*n* =37)	MSSA	22	80.0	0.0	36.3	0.0	0.0	31.8	22.7	31.8	31.8	0.0	31.8	0.0
	MRSA	15	100	100	66.6	0.0	0.0	53.3	33.3	66.6	33.3	26.6	53.3	0.0
Enterococcus faecalis		8	87.5	87.5	50.0	12.5	12.5	62.5	37.5	62.5	50.0	25.0	37.5	0.0

P=Penicillin-G; **O=**Oxacillin; **E=**Erythromycin; **VA=**Vancomycin; **TEI=**Teicoplanin; **CD=**Clindamycin; **GEN=**Gentamicin; **TE=**Tetracycline; **RIF=**Rifampicin; **LE=**Levofloxacin; **CIP=**Ciprofloxacin; **LZ=**Linezolid.

DISCUSSION:

SSI has always been a major problem to the surgical team. Despite the advances made in asepsis, antimicrobial drugs, sterilization and operative techniques, SSI continue to be a major problem in all branches of surgery in the hospitals. They are responsible for the increasing cost, morbidity and mortality related to surgical operations.

In our study overall SSI rate was 6.97%. In similar other studies infection rate reported was3.6%, 9.81%, and 22.5% [8, 9,7]

In our study, 139 aerobic organisms were isolated from 100 SSIs patients (Table No.1). Out of 139 aerobic isolates, 48 were Gram positive cocci and 91 were Gram negative bacilli. The similar finding was observed by other workers. [7,12]

Many studies have reported *Staphylococcus aureus* as the commonest isolate followed by *Escherichia coli* from the SSI. [7, 12] In present study, *Staphylococcus aureus* was the common Gram positive isolate (26.6%). *Escherichia coli* was second common 25.1%, followed by *Pseudomonas aeruginosa* (13.6%), (TableNo.1) and we have isolated only 4 anaerobic organisms; two *Peptostreptococcus spp.* and two *Clostridium spp.*

In the present study very few anaerobic organisms were isolated, probably because the patients were treated with prophylactic and therapeutic antibiotics against anaerobes.

In this study, *E.coli* showed high resistance to Amoxicillin/clavulanic acid (85.7%), Cefepime (77.1%), Piperacillin (74.2%), Ceftriaxone (74.2%), Ceftazidime (71.4%), Ciprofloxacin (62.8%) and less resistance was noted for Piperacillin/ Tazobactam (34.2%), Gentamicin (32.3%) and Tobramycin (28.5%) while Colistin and Polymixin-B were 100% sensitive (Table No.2). 42.8% ESBL E.coli were isolated. Similar finding were observed by other workers.[8,13]

Pseudomonas aeruginosa isolates in this study showed high resistance to Amoxicillin/ clavulanic acid (84.2%), Ceftriaxone (84.2%) and Cefepime (84.2%) and less resistance was noted for Piperacillin/Tazobactam (21%) and Imipenem (10.5%) while Colistin and Polymyxin-B were 100% sensitive (Refer Table No.2).Similar observation was reported by Aratikalakutakar, Vishwanath L. yemul.[13]

In our study, all MRSA strains were uniformly sensitive to Vancomycin, Teicoplanin, and Linezolid (Table No.3). Similar results were reported by other author. [14]

Vancomycin remains the first choice of treatment for MRSA and to preserve its value, its use should be limited to those cases where there are clear indications. Also Teicoplanin and Linezolid use should be restricted to selective cases of MRSA. In our study there was good sensitivity of MRSA for Rifampicin and Levofloxacin, so these drugs are also useful for SSIs by MRSA.

It is important to select antibiotic carefully for prevention and therapy, based on culture findings and the antimicrobial sensitivity patterns of the isolates. From our results, it is obvious that Amoxicillin/Clavulanic acid and Ceftazidime cannot be recommended for use as an empirical therapy in SSIs because these drugs were inactive against most strains of pathogens found in these infections. For severe infections initiate therapy with broad- spectrum agents such as Imipenem or Piperacillin/Tazobactam. Over all, none of the Gram negative isolates showed resistance to Colistin and Polymxyn-B (Table No.2). These two drugs seem to be the most effective in our study with very good sensitivity. Because there is little information on the pharmacokinetic and pharmaco-dynamic properties of Colistin and Polymyxin-B, It should be used judiciously. [15]

From our antimicrobial susceptibility data, we suggest that Imipenem, Piperacillin/Tazobactam, Linezolid, Teicoplanin and Vancomycin to be the most effective agents against most of bacteria isolated in SSIs.

The high rates of antibiotic resistance observed in the present study may be due to the widespread usage of broad spectrum antibiotics. While deciding antibiotic therapy many factors must be considered, including previous antibiotic therapy, knowledge of the usual causative organisms in these infections and their antibiotic susceptibilities. As many of the SSIs are polymicrobial, empirical therapy should include relatively broad spectrum antibiotics, especially for patients with severe infections and those who are immunocompromised.

CONCLUSION:

The findings of the present study suggest that prospective multi-Centre studies are required to assess the appropriate empirical antibiotic regimen in SSIs. SSIs are polymicrobial in nature. *E.coli* was the most frequent isolate among the Gram-negative pathogens and *Staphylococcus aureus* was the most common among Gram-positive organisms. Imipenem, Piperacillin / Tazobactam, Linezolid, Teicoplanin and Vancomycin would be appropriate for empiric treatment of SSIs.

Volume : 4 | Issue : 1 | Jan 2014 | ISSN - 2249-555X

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