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RESEARCH

MICROBIOLOGICAL PROFILE ASSESSMENT OF THE BACTERIAL ISOLATES FROM SURGICAL SITE INFECTIONS

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ABSTRACT

Monitoring of antibiotic resistance patterns continuously is required because of the evolution of new bacterial species and empirical antimicrobial therapy. A prospective study was conducted in a tertiary care teaching hospital with an inclusion of 688 patients. Among688patients314patients were found with Surgical Site Infections (SSIs) with an incidence of 45.6. SSIs were more common in females(51.6%) than males(48.4%), the infection rate was found to be higher in emergency procedures when compared to planned elective procedures ($P<0.05$, by using Chi-square test; OR=0.08). The surgical procedures of <45min has led to the development of more SSIs. Out of 314 SSIs, 328 organisms were isolated, of which Staphylococcus–97 was highest and majority of it were highly resistant to Ceftriaxone (84.5%) and highly sensitive to Gentamicin (92.8%). Streptococcus isolates were highly resistant to Ciprofloxacin (63.04%) and highly sensitive to Gentamicin (91.3%). Gentamicin showed good activity against most of the organisms, Ceftriaxone was commonly used before and after surgery but it was ineffective against most organisms. There is a need to emphasize the use of antimicrobials rationally to minimize the misuse of available antimicrobials. In addition to that there is an essentiality for regular antimicrobial susceptibility surveillance among area-wise monitoring of resistance patterns.

Keywords: Surgical site infection, Pathogens, Susceptibility, Gentamicin, Antimicrobial resistance.

I. INTRODUCTION

Surgical site infection (SSI) is an infection which occurs within a month after any surgical operation.[1]Surgical site infection is a type of health care associated infection in which a wound infection occurs after an invasive (surgical) procedure.[2]Surgical site infections are the third most common health care associated infection, accounting for 14 - 16% of all the infections.[3]Evidence is overpowering that increased antibiotic use is linked with rising antimicrobial resistance in the society.[4-10] Anti-microbial resistance patterns can vary regionally and even among different hospitals within the same community.[11] Prophylactic antibiotic use in some hospitals remains a problem[12]; however, inappropriate prescribing and use of antimicrobial agents prolong to be global problems. The following are the reasons involve public hope and demand for medication and lack of understanding on the ineffectiveness of antibiotics against viral illness, the worldwide ease of access to antibiotics, the clinician's desire to satisfy the patient, and pressure to evaluate the safety of individual patients against the whole public health benefit.[13–15]

One of the most important activities performed by a clinical microbiology laboratory is the reporting of cumulative and ongoing summaries of institutional patterns of antimicrobial susceptibilities, which can be called as antibiograms. The hospital antibiogram is a periodic summary of antimicrobial susceptibilities of local bacterial isolates submitted to the hospital's clinical microbiology laboratory.[16]

However, many bacteria have developed resistance to several classes of antibiotics, and difficult to manage. The bacterial isolate includes Staphylococcus species, Streptococcus species, Enterococus species and Enterobacter.[17]This case is especially seen in vulnerable patients, such as immunocompromised patients and patients in the intensive care units. When these patients develop "hospital-acquired" (or "nosocomial") pneumonia, highly resistant bacteria like Psedomonasaeruginosa are potentially involved. Treatment is then generally initiated on the basis of surveillance data about potentially involved local pathogens. This initial treatment, which is based on statistical information from former patients, and aimed at a large group of potentially involved microbes, is called empirical treatment.[18, 19] It is crucial tocreatean efficient therapeutic technique against multi-drug resistant pathogens in this era of increased bacterial resistance and infectious disease outbreaks.[20]

MATERIALS AND METHODS

A prospective cross-sectional study of all patients who underwent surgery at the department of General Surgery at Govt hospital, Nellore was conducted. The study included 688patients of which 314 were found to be affected with SSI. Patients infected with burns and surgical patients with community acquired infections such as furuncle and patients with infections of an episiotomy were excluded from the study. A standard self-designed data collection form was implemented in collecting the required information from the subjects.

Data including demographic details, associated risks factors (i.e., obesity, diabetes, and etc), use of prophylactic antimicrobial agents, the type and length of surgery, clinical evaluation of wound (considered infected if there was pus discharge or erythema and inflammation with fever) were collected and recorded on a customized data sheet. After collection of all the data, the infected site of the patient was cleaned by using normal saline and sterile gauze. Swabs have been screened for antibacterial activities using agar well

diffusion method.[21] Then two wound swabs were gathered from each patient. One swab was used to build smear for detection of pus cells and microorganisms. The test organism was uniformly spread over the agar surface and incubated for 24 hours at 37^0C. Bacteria were identified by standard microbiological technique.

The other swab was for culture and sensitivity of the organisms. Susceptibility testing was performed by Kirby-Bauer technique. The test organism was uniformly spread over the agar surface and antibiotic discs were placed into the agar medium. The isolate was then incubated at 37^oC for 24 hours. Antibiotic sensitivity pattern was determined with the zone of inhibition.[22] The results were then recorded and assessed.

Statistical Analysis: The association of clinical demographic characteristics was statistically analyzed by using ODDs ratio and Chi-square test.

RESULTS AND DISCUSSION

A total number of 688 patients details were collected, in which314patients found to be affected with Surgical Site Infections. The overall incidence of the surgical site infections in the present study was 45.6.

Table 1: Association of clinical demographics with and without bacterial isolates

Variable	Total no. of patients n=688	No SSI events n= 374	SSI events n=314
I. Patient age (years)			
Below 20	110	61	49
20-30	129	85	44
30-40	227	152	75
40-50	109	61	48
Above 50	113	79	34
II. Patient gender			
Female	388	226	162
Male	300	148	152
III. Hospital stays			
Below 10 days	214	90	124
Above 10 days	474	284	190
IV. Department			
General surgery	303	204	99
Gynaecology	166	65	101
Orthopaedics	98	52	46
Ophthalmology	65	35	30
ENT	56	18	38
V. Type of surgery			
Elective	608	352	256
Emergency	80	22	58
VI. Duration of surgery			
$\leq$45 mins	312	209	103

45 mins to 1 hour	201	48	153
≥1 hour	175	117	58
VII. Preoperative antibiotic prophylaxis			
Given	536	313	223
Not given	152	61	91
VIII. Postoperative antibiotic treatment			
Given	562	343	219
Not given	126	31	95

As shown in table-1, based on age wise categorization, 30-40 years age group patients are more prone to SSIs than other age groups. As per the statistical analysis, there was no strong clinical association between SSIs and age group ($P > 0.05$, by using Chi-square test). The present study was opposed by Jeremiah Seni et.al., and J.Andhoga et.al., studies.

The incidence of SSI was more common in females (51.6%) than in males (48.4%) as the risk was high in Gynecology department. As per the statistical analysis, there was a strong clinical association between SSIs and gender ($P < 0.05$, by using Chi-square test; OR = 1.2745). Contraversely, MohammedamanMame et.al., stated that males were more prone than females, in their study conducted among patients.

In the present study, the infection rate is more in patients who stayed below 10 days in hospital than the patients who stayed above 10 days. As per the statistical analysis, there was strong clinical association between SSIs and hospital stay ($P < 0.05$, by using Chi-square test). The patients were recruited from General surgery, Gynecology, Orthopaedics, Ophthalmology, ENT departments. Patients recruited from the ENT (67.8% of SSI's from total ENT cases) had shown more risk to SSI followed by Gynaecology department (60.8% of SSI's from total Gynaecology cases). As per the statistical analysis, there was a strong clinical association between SSIs and department ($P < 0.05$, by using Chi-square test).

It was evident that SSI increases with an increase in the degree of contamination of the wounds operated upon. The infection rate was found to be almost higher in emergency procedures than planned elective procedures. As per the statistical analysis, there was a strong clinical association between SSIs and type of surgery ($P < 0.05$, by using Chi-square test; OR = 0.08). In a study conducted by BarnaliKakati et.al., the infection rate encountered in emergency surgeries was triple the rate of elective surgeries. Several other studies also collaborate the evidence that emergency surgeries are more prone to wound infections. In this study, the numbers of SSIs were found to be influenced by the duration of surgery. The surgical patients with the duration <45mins were found to be more prone to SSI. As per the statistical analysis, there was a strong clinical association between SSIs and duration of surgery ($P < 0.05$, by using Chi-square test).

The study revealed that the patients who don't received antibiotic prophylaxis were more prone to infection.

Incidence of surgical site infections in relation to different types of surgical procedures

In the present study, Hysterectomy (81.8%) has more SSIs followed by Tympanoplasty (80%), Tubectomy (73.9%) which is presented in table-2.

Table 2: Incidence of surgical site infections in relation to different types of surgical procedures

Type of surgical procedures	No. of patients (688)	Frequency of surgical site infections (314)
Appendicectomy	121	43
Hydrocelectomy	36	10
Hysterectomy	22	18
Surgical debridement	40	23
Herniotomy	54	15
Tubectomy	92	68
Mastectomy	20	2
Tendon repair	52	28
Knee replacement	46	18
SICS + PCIOL	65	30
Caesarian	52	15
Tonsillectomy	36	22
Tympanoplasty	20	16
Others	32	6

Organisms isolated from various clinical samples

Table-3 shows out of 314 SSI's, 328 organisms were isolated from various clinical samples (blood, pus, fluid, urine, ear swab and corneal scrapping) such as Staphylococcus – 97, Streptococcus – 46,E.coli– 68, Klebsiella – 33, Pseudomonas – 50, Gonococci – 10, Pneumococci – 11 and Proteus – 13.

Table 3: Distribution of Organisms isolated from various clinical samples

Specimen type	Staphylococcus	Streptococcus	E. coli	Klebsiella	Pseudomonas	Gonococci	Pneumococci	Proteus
Blood	42	14	32	12	12	4	4	6
Pus	12	12	10	6	4	2	4	
Fluid	9	2	2	4	8			3

Urine	24	13	24	11	3	2		
Ear swab	2				11			4
Corneal scrapping	8	5			12	2	3	
Total	97	46	68	33	50	10	11	13

On Culture Sensitivity test, the most common bacteria isolated was Staphylococcus(29.6%) followed by E.coli (20.7%), Pseudomonas (15.2%), Streptococcus (14.02%), Klebsiella (10.06%), Proteus (3.10%), Pneumococci (3.3%) and Gonococci (3%).This study was supported by various studies i.e., SyedaSitwat et.al, and Fatima et.al., stated in their studies that Staphylococcuswas the commonly isolated pathogen.

Bacterial Distribution of Microorganisms from Various Departments

Table-4 presents that in the current study, in surgical department; Staphylococus was the most isolatedorganism where as in Gynaecology department; E.coli was the most, in Orthopaedics department; Staphylococcus was the most, in Ophthalmology and in ENT department; Pseudomonas was the most identified pathogen.

Table 4: Bacterial Distribution of Microorganisms from Various Departments

Microorganism Isolated	**Departments**				
	Surgical	Gynaecology	Orthopaedics	Ophthalmology	ENT
Pseudomonas	7	0	14	12	17
Klebsiella	6	23	4	0	0
E. Coli	16	50	2	0	0
Proteus	0	0	3	0	10
Pneumococci	2	6	0	3	0
Gonococci	8	0	0	2	0
Staphylococcus	38	22	15	8	14
Streptococcus	27	3	11	5	0

Antimicrobial susceptibility pattern of bacterial pathogens isolated from Surgical Site Infections

As per table-5, Ceftriaxone is becoming resistant in recent past as stated in the studies conducted in the US and in our study too, ceftriaxone showed resistant to most of the pathogens isolated. Gentamicin, Ceftazidime is highly sensitive to most of the isolated bacterial pathogens. Susceptibility outcome revealed that Gentamycin was the most effective antibiotic.

Table- 5: Antimicrobial susceptibility pattern of bacterial pathogens isolated from SSI

Organism	Antimicrobial Agents								
	Pattern	**Ceftriaxone**	**Amikacin**	**Gentamicin**	**Ampicillin**	**Ciprofloxacin**	**Ceftazidine**	**Penicillin**	**Metronidazole**
Staphylococcus n= 97	**R** **S**	**82** **15**	**NT**	**07** **90**	**NT**	**59** **38**	**17** **80**	**69** **28**	**71** **26**
Streptococcus n= 46	**R** **S**	**24** **22**	**31** **15**	**04** **42**	**NT**	**29** **17**	**15** **31**	**12** **34**	**29** **17**
E. coli n= 68	**R** **S**	**58** **10**	**42** **26**	**08** **60**	**64** **04**	**51** **17**	**20** **48**	**53** **15**	**NT**
Klebsiella n= 33	**R** **S**	**14** **19**	**11** **22**	**11** **22**	**13** **20**	**10** **23**	**08** **25**	**NT**	**14** **19**
Pseudomonas n= 50	**R** **S**	**26** **24**	**27** **23**	**13** **37**	**NT**	**27** **23**	**22** **28**	**32** **18**	**NT**
Pneumococci n= 11	**R** **S**	**07** **04**	**08** **03**	**NT**	**03** **08**	**00** **11**	**NT**	**06** **05**	**NT**
Gonococci n= 10	**R** **S**	**03** **07**	**06** **04**	**NT**	**06** **04**	**03** **07**	**NT**	**NT**	**NT**
Proteus n= 13	**R** **S**	**06** **07**	**13** **00**	**00** **13**	**08** **05**	**NT**	**NT**	**NT**	**08** **05**

CONCLUSION

The indiscriminate use of antibiotics and lack of consistent antibiotic policy leads to the emergence of resistant bacterial strains. In this study, it was revealed a strong clinical association of SSI with gender, department, type of surgery, type of SSI and duration of surgery. In our study, Staphylococcus was the most prevalent pathogen associated with SSI followed by E.coli, Pseudomonas, Streptococcus, Klebsiella, Proteus, Pneumococci and Gonococci. These isolates exhibit high occurrence of resistance to Ceftriaxone, Ampicillin, and Metronidazole. Ceftriaxone was commonly used before and after surgery to prevent SSIs, which was found to be ineffective against most organisms. Gentamicin shows good activity

against most of the organisms. This issue highlights the need for a rampant review of the current antibiotics' policy and there is also an urgent need to accentuate the rational use of antimicrobials to diminish the misuse of available antimicrobials. In addition, regular antimicrobial susceptibility surveillance is crucial for area-wise monitoring of resistance patterns. Hence, it is imperative that all the health care professionals should take the onus in infective control programs. Finally, there is a need to develop an effective national and state level antibiotic policy and draft guidelines to preserve the effectiveness of antibiotics for better patient management.

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