ORIGINAL ARTICLE

Causative organisms of surgical site infections and their antimicrobial susceptibility patterns in a general surgical ward in Peshawar"

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Abstract:
Objective: To determine the micro-organisms responsible for surgical site infections and their antibiotic susceptibility patterns in a general surgical ward in Peshawar.
Material and Methods: This retrospective chart review was conducted at Surgical B Unit KTH, Peshawar from March 2017 to March 2018. During this period, culture reports of patients who presented to the surgical ward with infected wounds were analyzed. Frequencies and percentages of common micro-organisms were calculated and their susceptibility patterns to different antibiotics were determined. SPSS 23 was used for data analysis.
Results: Out of the 357 swab reports analyzed, 270 (75.6%) showed growth of which 130(48.1%) isolates were gram-positive and 140(51.9%) were gram-negative bacteria. S.aureus was isolated in 48.1% cases followed by E.coli(23.3%), Pseudomonas(10.7%), Enterobacter (10.4%), Citrobacter (4.4%), Proteus (1.9%) and Klebsiella (1.1%).Gram positive organisms showed highest sensitivity to Piperacillin-tazobactam (97.7%), Linezolid (96.9%) and Vancomycin (94.6%) whereas gram negative organisms showed highest sensitivity to Imipenem (88.5%), Cefoperazone-sulbactam(86.4%) and Piperacillin-tazobactam(85%). One-third (33.3%) of the growths were multidrug resistant. Among the cultures positive for S.aureus, 5(1.9%) were methicillin-resistant and 3(1.1%) were vancomycin-resistant. ESBL resistant strains comprised 24.8% and carbapenem resistant strains 2.6% of the total growths.
Conclusion: The rising incidence of multi-drug resistance among bacterial isolates mandates routine antimicrobial sensitivity testing for proper management of infections and to avoid spread of resistance.

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Introduction:
Surgical Site Infections (SSIs) are defined as infections that occur at the incision site or in organs or deep spaces within one month after surgery. They are the second most common nosocomial infection, making up about 14-16% of all infections among hospitalized patients.[1] In surgical patients, they constitute about 38% of all nosocomial infections.[2] SSIs are the most common complication following any surgery and result in significant morbidity and mortality.[3]

In developing countries, SSIs are becoming increasingly difficult to manage, owing to the generation of multi-drug resistant organisms.[4,5] A local study showed that 74% of Gram positive bacterial isolates were multi-drug resistant (MDR) and 77.1-100% Gram-negative bacterial isolates were resistant to between two and seven classes of antimicrobials tested.[6] The improper use of antibiotics has greatly aided microbes in generating multidrug resistance. Furthermore, microbial resistance patterns vary from time to time and change between geographical areas. Therefore, wound infection has, to this day not been completely cured even though tons of advancements have been made in the pharmaceutical industry.[7]

Table 1: *Frequency of Micro-organisms and Their Distribution among Different Gender and Age Groups & ESBL, MDR*

S. No	Organisms Isolated	Gender (n)		Age (n)			Frequency of different MDR strains (n)		
		males	females	Young adults	Middle aged adults	Old age adults	ESBL strains	Carbapenem resistant strains	MDR
1	Staphylococcus aureus	46	84	58	50	22	--	--	16
2	Escherichia coli	23	40	28	18	17	35	6	35
3	Pseudomonas	17	12	17	6	6	12	--	16
4	Enterobacter	13	15	12	9	7	9	1	15
5	Citrobacter	3	9	5	5	2	7	--	5
6	Proteus	2	3	4	1	0	3	--	2
7	Klebsiella	0	3	2	1	0	1	--	1
	Total	104	166	126	90	54	67	7	90
	P values:								

P Value<0.05 is taken as statistically significant.
MDR is defined as resistance to three or more than three drug classes
ESBL: Extended spectrum beta-lactamase

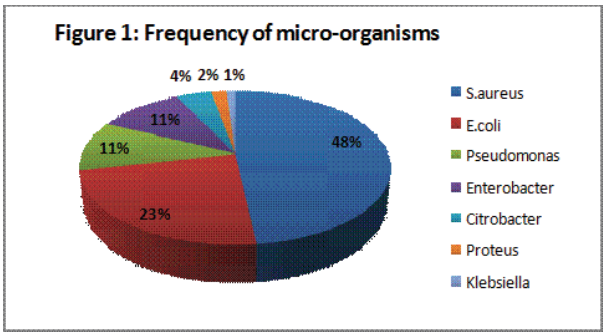

Figure 1: Frequency of micro-organisms

Empiric therapy to combat infectious diseases in Pakistan is poor due to deficiency of evidence based research and failure of clinicians to carry out drug susceptibility testing on a regular basis.[8] We conducted this study to provide data about the local prevalence of common organisms responsible for SSIs and their different anti-microbial susceptibility patterns, in order to help our clinicians in making fruitful decisions regarding appropriate empirical therapy for patients with wound infections, thereby saving time and money and aiding both the patient and the health care facility.

Material and Methods:

This study was conducted at Surgical B Unit after obtaining approval from the institutional review board of Khyber Teaching Hospital, Peshawar from March 2017 to March 2018. Using non- probability consecutive sampling technique, a total of 357 culture reports of hospitalized patients belonging to both genders, between the ages of 16 to 75 years presenting with a surgical site infection were included in the study. Micro-organisms were identified via gram staining and other biochemical tests and their frequencies were noted. Susceptibility testing was done by Kirby Bauer Disc diffusion method and minimum inhibitory concentration (MIC) method on Mueller-Hinton agar according to Clinical Laboratory Standard Institute (CLSI) guidelines 2014.[9] Multidrug resistant organisms were defined as those resistant to three or more than three classes of antibiotics tested. Culture reports showing mixed growth or no growth were excluded from the study as were patients who were on antibiotics for 48 hours prior to specimen collection. All swab cultures were performed and reported by microbiology department of Khyber Teaching Hospital, Peshawar. Only those antibiotics (both oral and intravenous) which were tested for all the organisms were included in the study. SPSS 23 was used for data analysis. Chi square test was used to compare between different variables and $p<0.05$ was considered statistically significant.

Results:

The mean age of patients in the study was 34±18.5 SD. More organisms were isolated from wounds of female patients (61.5%) than from males (38.5%). SSIs were more frequent in the young age group (16-35 years, 46.7%) than in middle age (35-55 years, 33.3%) and old age group (55-75 years, 20%). Out of the 357 culture reports, 270 (75.6%) showed growth of microorganisms. A total of 130(48.1%) isolates were gram-positive and 140 (51.9%) were gram-negative organisms. Staphylococcus aureus was isolated in 48.1% cases followed by Escherichia coli(23.3%), Pseudomonas (10.7%), Entero-

Table 1: *Frequency of Micro-organisms and their distribution among different dender and age groups & ESBL, MDR*

	Antibiotic	Gram positive		Antibiotic	Gram negative	
		Sensitive	Resistant		Sensitive	Resistant
1	**Amoxicillin-Clavulanate**	108 (83.1%)	22 **(16.9%)**	Amoxicillin-Clavulanate	39 (27.8%)	101 (72.2%)
2	Ampicillin	6 (4.6%)	124 (95.4%)	Ceftriaxone	22 (15.7%)	118 (84.3%)
3	**Vancomycin**	123 (94.6%)	7 (5.4%)	Ceftazidime	41 (29.2%)	99 (70.7%)
4	**Clindamycin**	104 (80%)	26 (20%)	Imipenem	124 (88.5%)	16 (11.4%)
5	**Linezolid**	126 (96.9%)	4 (3.1%)	Meropenem	112 (80%)	17 (20%)
6	**Clarithromycin**	103 (79.2%)	27 (20.8%)	Gentamicin	72 (51.4 %)	68 (48.6)
7	**Doxycycline**	117 (90%)	13 (10%)	Doxycycline	62 (44.3%)	78 (55.7%)
8	**Amikacin**	112 (86.2%)	18 (13.8%)	Amikacin	116 (82.8%)	24 (17.1%)
9	**Cefoperazone-sulbactam**	122 (93.8%)	8 (6.2%)	Cefoperazone-sulbactam	121 (86.4%)	19 (13.6)
10	**Piperacillin-tazobactam**	127 (97.7%)	3 (2.3%)	Piperacillin-tazobactam	119 (85%)	21 (15%)
11	**Ciprofloxacin**	58 (44.6%)	72 (55.4%)	Ciprofloxacin	47 (33.6%)	93 (66.4%)
12	**Fusidic acid**	109 (83.8%)	21 (16.2%)	Fosfomycin	118 (84.3%)	22 (66.4%)
	Total	130		Total	140	

bacter (10.4%), Citrobacter (4.4%), Proteus (1.9%) and Klebsiella (1.1%) as shown in figure 1.

Table-I shows the age and gender-wise data regarding the prevalence of micro-organisms as well as the frequency of multi-drug resistance among individual organisms. Among the 270 isolates, 90(33.3%) were multidrug resistant with same distribution among males and females of all ages (p>0.05). E.coli (38.8%) was more multidrug resistant than other organisms (p<0.05). Among the cultures positive for S.aureus, 5(1.9%) were methicillin-resistant (MRSA) and 3(1.1%) were vancomycin-resistant (VRSA). ESBL resistant strains comprised 24.8% and carbapenem resistant strains 2.6% of the total growths. Irrespective of age and gender, among the different micro-organisms, E.coli (53.8%) and Pseudomonas (17.9%) were the most prevalent ESBL producers (p<0.01) whereas E.coli (85.7%) alone accounted for the majority of carbapenem resistant strains (p<0.01). All of these strains were multidrug resistant.

Table II shows the antimicrobial susceptibilities of the different gram negative and gram positive organisms. Among the Gram positive organisms, the most effective antibiotics were Piperacillin-tazobactam(97.7%), Linezolid (96.9%) and Vancomycin (94.6%) with the least effective being Ampicillin (95.4%) and Ciprofloxacin (55.4%). Similarly, among the gram negative organisms, Imipenem (88.5%), Cefoperazone-sulbactam (86.4%) and Piperacillin-tazobactam (85%) were the most effective antibiotics whereas Ceftriaxone (84.3%) the least effective. The antibiotics tested showed similar sensitivity and resistance patterns among males and females of all age groups (p>0.05).

Among the S.aureus strains, MRSA were susceptible only to Linezolid (100%) and Doxycycline (100%) whereas VRSA isolates to Piperacillin-tazobactam (100%), Imipenem (75%) and Meropenem (75%) and resistant to all other tested antibiotics. Similarly, among E.coli, the ESBL resistant strains of were highly susceptible to Imipenem (86.6%) and Cefoperazone-sulbactam (83.5%).

Discussion:

Surgical site infections are notorious for their associated morbidity and burden on the healthcare system in terms of cost and time spent on patients.[10] The major concern for today's surgeon is a patient who develops a surgical site infection by an organism which is resistant to a huge list of available antimicrobials.[11] In our study, the most common organism isolated was S.aureus(48.1%) followed by E.coli(23.3%). These findings are supported by results reported by A Samad et al[12] who conducted a similar study in the same locality. They reported S.aureus as the causative organism in 51.8% of cases followed by E.coli(25.9%). According to the Center for Disease Control and Prevention

(CDC), both these organisms are a major cause of nosocomial infections with S.aureus especially linked with SSIs.[13]

In our study, 75.6% of the isolates were positive for growth of microorganisms compared to a study by Jan WA et al, who reported a similar infection rate (77%). However, E.coli was the commonest pathogen (46%)and S.aureus, the least common (4%) in their study.[14] Similarly, our reported figures of gram positive (48.1%) and gram negative bacteria (51.9%) were comparable to a study conducted by Mohammed A et al (gram positive: 43%, gram negative: 57%).[7]

Our analysis revealed that 33.3% of the bacterial isolates were multidrug resistant (MDR) independent of gender and types of patients. Comparable to 37.2% reported by Zahran WA et al[15] whereas, Khan I et al[16] reported higher figures of MDR strains (74% of gram positive and 82% of gram negative isolates). Our study also showed that among the S.aureus strains, 5(1.9%) were methicillin-resistant (MRSA) and 3(1.1%) were vancomycin-resistant (VRSA) as opposed to 1.5 and 2% reported by Khan I et al[16] but similar to the 5% prevalence of MRSA shown by Jan WA et al.[14]

Our results show that ESBL resistant strains comprised 24.8% and carbapenem resistant strains 2.6% of the total growths with E.coli (53.8%) and Pseudomonas (17.9%) being the most prevalent ESBL producers. In contrast, another study showed Extended spectrum β-lactamases were detected in 65.1% of Enterobacteriaceae isolates with Klebsiella(23.8%) being responsible for the majority of them followed by E.coli (19%).[15]

Our analysis highlighted the most effective antibiotics for gram positive organisms were Piperacillin-tazobactam(97.7%), Linezolid (96.9%) and Vancomycin (94.6%) and for gram negative organisms, Imipenem (88.5%), Cefoperazone-sulbactam(86.4%) and Piperacillin-tazobactam(85%). One study showed that Imipenem was the most effective antibiotic for Gram negative bacteria from in-patients[17] whereas in another study showed it to be most effective against S.aureus.[18] The pattern of resistance to antimicrobials: Ampicillin (95.4%),Ciprofloxacin (55.4%)and Ceftriaxone (84.3%) as seen in our study was also illustrated by other studies with a few differences.[7,15,18]

Conclusion:
The alarming rate at which microbes are developing resistance to many available antibiotics mandates that regular surveillance studies be carried out to keep up to date with the microbial profile and patterns of resistance of a given locality. To limit the development of multidrug resistance, routine susceptibility testing should be performed before recommending broad-spectrum antibiotics on empirical basis.

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Role and contribution of authors:
Dr Hizbullah Jan, conception and design, helped in final approval.

Dr Misbah Riaz, conception and design, drafting of article.

Danish Shah, analysis & interpretation of data.

Dr Fazal Hussain, acquisition of data.

Dr Attaullah Khan, helped in final approval.

Dr Tufail Ahmad, acquisition of data and interpretation

Dr Mah Muneer Khan, critical evaluation of intellectual content.

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