Original Article

Spectrum of surgical site infection on the surgical floor; Increasing resistance to routine antibiotics

Muhammad Iqbal[1], Naveed Akhtar Malik[2], Muhammad Hanif[3]

[1] Assistant Professor, Department of Surgery, Benazir Bhutto Hospital, Rawalpindi.
[2] Associate Professor, Department of Surgery, Benazir Bhutto Hospital, Rawalpindi.
[3] Professor & HOD, Surgical Unit-II, Benazir Bhutto Hospital, Rawalpindi.

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[1,2] Conception of study
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Corresponding Author

Dr. Muhammad Iqbal,
Assistant Professor,
Department of Surgery,
Benazir Bhutto Hospital, Rawalpindi
Email: iqbalnazir1976@gmail.com

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Abstract

Objective: To know the spectrum of surgical site infections in general surgical patients so that specific strategies can be developed to decrease the morbidity caused by these infections.

Material and Methods: All the patients who underwent general surgical operations on an emergency basis at the surgical unit of the District headquarters teaching hospital Rawalpindi from 01-01-2016 to 31-12-2017 were evaluated for surgical site infections. Surgical site infections suspected clinically were confirmed by culture and sensitivity. Involved flora and their sensitivity to various antibiotics were also determined.

Results: Among 2202 emergency operated patients, two hundred and thirty-seven patients (10.76%) had surgical site infection confirmed on culture and sensitivity (C/S) report. About sixty-five percent of patients were male. Of two hundred and thirty-seven positive patients, the twenty-nine patient underwent laparotomy for penetrating and blunt abdominal trauma. Staph aureus was present in one hundred and forty-five (79.67%) patients. E.coli was the commonest Gram-ve micro-organism (70.95%). Forty-six patients (19.40%) were sensitive to Cefoperazone sodium followed by twenty patients (8.43%) to Piperacillin sodium and twenty-one (8.86%) each to Amikacin and Linezolid.

Conclusion: Surgical site infection causes a significant rise in morbidity on the surgical floor. Most of the causative microorganisms are becoming resistant to routine antibiotics. Sensitivity to the broader spectrum of antibiotics like Cefoperazone and Linezolid is increasing.

Keywords: Major surgical operations, surgical site infection, Staph aureus, Cefoperazone, Methicillin-resistant staph aureus.

Introduction

Surgical site infections (SSIs) are defined as infections occurring up to 30 days after surgery (or up to one year after surgery in patients receiving implants) and affecting either the incision or deep tissue at the operation site.[1] SSI may present as redness, delayed healing, fever, pain, tenderness, warmth, swelling, or discharge of pus.

Surgical site infections (SSI) are commonest nosocomial infections after urinary tract infections (UTI), responsible for increasing cost, substantial morbidity, and occasional mortality related to surgical operations and continue to be the major problem even in hospital with most modern facilities and standard protocols of pre-operative preparation and antibiotic prophylaxis.[2,3,16] SSI rate varies from 2.5% to 41.9% and accounts for some 20% of healthcare-associated infections.[2,4] Patients with severe shock at the time of presentation, anemia, poorly controlled diabetes and other systemic illnesses are at great risk of developing SSI.[5] Presence of contamination also increases the risk of SSI.[6,7] Causative pathogens are acquired endogenously from the patient's flora or exogenously from contact with operative room personnel or the environment.[8] Most SSIs are caused by Staphylococcus aureus, E.coli, and Enterococci.[8,9] Antimicrobial resistance among these and other clinically important pathogens is an increasing problem.[10]

Antimicrobial resistance poses a serious threat to human health and requires rational use of antibiotics to curb further spreading.[11] Consistent with proper antimicrobial stewardship, antibiotic prophylaxis should use an appropriate drug and optimize the dose and duration of treatment to minimize toxicity and conditions for the selection of resistant bacterial strains.[12,13] Methicillin-resistant Staphylococcus aureus is on the rise nowadays. This strain of Staph aureus is resistant to most of the commonly used antibiotics.[14] Many resistant strains of bacterial pathogens are sensitive to new broad-spectrum antibiotics like Cefoperazone, linezolid, and Tigecyclin.[15] Surgical site infections (SSI) are a major cause of morbidity in surgical patients and they increase health care costs considerably due to prolonged stay in hospital and extra usage of the hospital facilities like costly antibiotics, use of ventilator support, etc.[16]

We must adhere to guidelines for the prevention of SSIs in form of good patient preparation, aseptic practice, attention to surgical technique, and rational antimicrobial prophylaxis.[17]

Materials and Methods

Purpose of the study: This study was conducted at our teaching hospital to know the spectrum of SSI in general surgical patients so that we can develop specific strategies to decrease the morbidity and mortality caused by SSIs.

This observational study was conducted in the surgical department of the DHQ Teaching hospital Rawalpindi from 01-01-2016 to 31-12-2017. All the patients admitted to surgical wards after emergency surgery were included in the study. Elective surgeries were excluded from the study as most of t such cases are clean surgeries. Informed consent was taken from all the patients or their attendants. Before the start of the study, the pathological department of the same hospital was taken into a liaison.

Clinical specimen of apparent pus and wound discharge from clinically suspected SSI patients was taken under full aseptic measures in a sterile container. They were sent to the pathological department with a patient profile under sterile conditions for culture and sensitivity examination. In the laboratory, these samples were inoculated on blood, chocolate, and MacConkey agar and were then incubated at 37^0C for 24 hours. Isolates were identified by their colony morphology, Gram reaction, catalase test, and Oxidase test. A coagulation test was done for the identification of Staphylococcus(S) aureus. Species identification of Gram –ve bacilli was done by using API 20E (BioMerieux). Methicillin-resistant Staph aureus was detected by using Cefoxitin disc (30µg). Bacterial suspensions of isolates equivalent to 0.5McFarland, s turbidity standard were prepared and inoculated on Mueller-Hinton agar plates. It was followed by the application of various antibiotic discs (Oxoid, UK) as per the manufacturer's instructions. The plates were then incubated at 37^oC aerobically for 24 hours. Zone diameters for each antibiotic were measured and interpreted as susceptible or resistant, according to Clinical and Laboratory Standards Institute (CLSI) guidelines. Statistical analysis of data was done using Statistical Package for Social Sciences version 21 (SPSS 21). Frequencies and percentages were calculated for qualitative data like sensitivity, resistance, and frequency.

Results

Out of the total 2202 operated patients, 237(10.76%) developed surgical site infection (SSI).

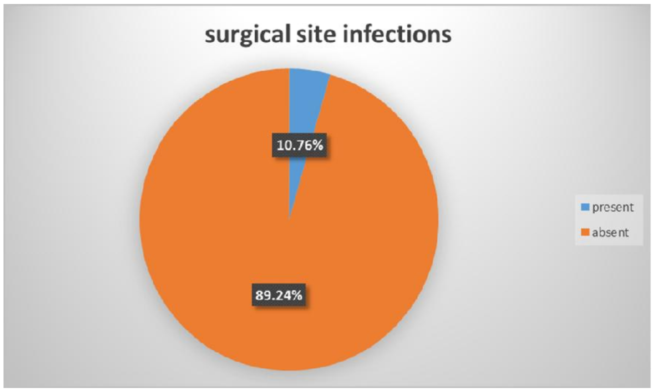

Figure: Surgical site infections

One hundred and fifty-five (65.40%) SSI patients were male and eighty-two (35.59%) were female. The most involved age groups were 11-20 and 21-30years (30.80% and 27.00%) respectively. Of the total 237 patients with SSI, fifty (21.09%) had laparotomy for acute abdomen, seventy (29.09%) had laparotomy for penetrating and blunt abdominal trauma and thirty-five (14.76%) had appendectomy. (Table 1)

Table 1: Demographic and pathological characteristics of SSI cases

Serial No.	*Age group range(years)*	*No. of patients(n)*	*Percentage (%)*
Age	11-20	73	30.80
	21-30	64	27.00
	31-40	40	16.87
	41-50	37	15.61
	51-60	23	09.70
Gender	Male	155	65.40
	Female	82	35.50
Surgery	Laparotomy acute abdomen	50	21.09
	Laparotomy penetrating and blunt trauma	70	29.09
	appendectomy	35	14.76
	Vascular injury repair	09	3.79
	Open fractures	20	8.43
	Debridement of infected and gangrenous wounds	27	11.39
	Below-knee amputations	9	14.76
	Above-knee amputations	4	01.68
	Repair of obstructed hernia repair	7	02.94
	Fasciotomy	2	0.84
	Miscellaneous	4	01.68
Growth	Mono growth	152	64.13
	Poly growth	85	35.86

One hundred and thirty-nine (58.64%) patients' wounds were contaminated at the time of surgery while forty-nine (20.67%) were dirty. (Table 2)

Table 2: Distribution of SSI cases according to the presence of contamination

Serial No	*Procedure*	*clean*	*Clean contaminated*	*contaminated*	*dirty*	*Total*
1	Laparotomy for blunt and penetrating abdominal trauma	0	15	50	5	70
2	Laparotomy for acute abdomen	0	2	35	13	50
3	Appendicectomy	0	14	16	5	35
4	Debridement of Gangrenous wounds	0	2	12	13	27
5	Management of type 3 & 4 open fractures	0	9	8	3	20
6	Below knee amputation	0	0	5	4	09
7	Above knee amputation	0	0	2	2	04
8	Surgeries for complicated hernias	0	2	3	2	07
9	Fasciotomies	0	1	1	0	02

10	Miscellaneous	0	0	2	2	04
11	Total	**0 (0.00%)**	**49 (20.67%)**	**139 (58.64%)**	**49 (20.67%)**	**237 (100.00%)**

Gram-positive organisms were identified in seventy-three percent of SSI patients and Gram-negative organisms were reported in twenty-six percent. Staph aureus was the commonest organism detected. (Table 3)

Table 3: Micro-organisms distribution

Serial no.	*Micro-organism*	*No of patients*	*Percentage (%)*
Gram positive n= 182(76.79%)	Staph aureus	145	79.67
	Enterococcus	18	9.80
	Streptococcus	11	6.04
	Clostridium	06	3.29
	Acinobacter	2	0.84
Gram negative n= 55(23.20%)	E.coli	39	70.90
	Klebsiella	10	18.18
	Pseudomonas	06	10.90

Most of the organisms were resistant to the commonly used antibiotics like Ceftriaxone and Ciprofloxacin. Twelve out of one hundred and eighty-two (6.59%) Staph aureus cultures were Methicillin-resistant Staph aureus (MRSA) while two patients (1.09%) had Vancomycin-resistant Staph aureus (VRSA). Six (50%) MRSA patients were sensitive to Linezolid and six (50%) MRSA patients were sensitive to Vancomycin. Two (0.84%) patients were sensitive to Tigecyclin. (Table 4)

Table 4: Antibiotics to which the organisms were found to be sensitive after report of C/S

Sr. No.	*Medicine*	*No of patients(n)*	*Percentage (%)*
1	Cefoperazone	46	19.40
2	Amoxicillin	16	6.75
3	Ceftriaxone	09	3.79
4	Ciprofloxacin	09	3.79
5	Piperacillin	20	8.43
6	Clarithromycin	09	3.79
7	Metronidazole	43	18.40
8	Amikacin	21	8.86
9	Tigecyclin	02	0.84
10	Linezolid	21	8.86
11	Doxycycline	09	3.79
12	Vancomycin	09	3.79
13	Mixed sensitivity	23	9.70

Discussion

The present study was conducted on 2,202 patients who underwent emergency surgeries. The incidence of surgical site infection varies worldwide from 2.5% to 41.9% as per different studies.[6] Incidence of SSI in our study was 10.76%, Cruse P et al reported incidence of 04.7%.[18] While Anvikar AR et al reported a rate of 6.1%.[4] About sixty-five percent of patients in our study were male. The preponderance is also reported by many other studies like Hafeez A et al (60.7%).[19,20,21] This might be due to the more incidence of penetrating and blunt abdominal trauma that occurs in males. The incidence of SSI was higher in younger age groups. This might be because most of our study population was young due to the high poly trauma rate in young people. Kayel KS et al recorded higher older age incidence.[22] In our study 21.09% of SSI cases underwent laparotomies for acute abdomen. Most of the acute abdomen causes were perforated peptic ulcer, perforated appendix, enteric perforation, and intestinal perforation proximal to obstructed gut due to ileocecal tuberculosis and rectosigmoid tumors. Such patients were mostly in sepsis due to contamination and shock due to multisystem injury at the time of presentation. This fact jeopardizes the immune system of the patients.[23] Such an observation was also noticed by Lilani et al[6], Cruse PJE et al[7], Prospero E et al.[24] In our study 29.53% of SSI patients underwent laparotomy for penetrating and blunt abdominal trauma. Most of these patients had multiple gut injuries and solid viscera injuries like liver or splenic laceration causing feculent and chemical peritonitis. These contaminating factors increase the chance of the development of SSI. Such findings were also observed by Anvikar AR[4] and Lilani et al.[6] In our study mono microbial flora was 64.13% while polymicrobial flora was 35.86%. Rolston KV et al[9] found a monomicrobial rate of 42% while in another study Bowler PG et al[25] found more incidence of polymicrobial flora.

In our study Staph aureus was the commonest Gram +ve organism observed in one hundred and forty-five (79.67%) patients, followed by Enterococcus and streptococcus. Such finding was also observed by Chamber D et al[26] Anderson DJ et al[27], Lilani SP et al[6].

E.coli was the commonest Gram-ve organism in our study present in thirty-nine (70.67%) patients, followed by Klebsiella and P.aeruginosa. Similar findings were reported by Madappa T.[28]

The most commonly used empirical antibiotics were Co-amoxiclave, Ceftriaxone, Ciprofloxacin, and Cefoperazone used either monotherapy or in different combinations. Metronidazole was prescribed for anaerobic coverage. These medicines were used because they were available in the hospital pharmacy.

In our study 19.40% of patients were sensitive to Cefoperazone, 8.86% to Amikacin and Linezolid each, 8.43% to Piperacillin followed by 3.79% to Vancomycin, Doxycyclin, Ciprofloxacin Clarithromycin, and Ceftriaxone each and 6.75% to Co-amoxiclav. 9.70% of patients had mixed sensitivity. This trend shows that isolated bacteria are becoming resistant to the commonly used empirical antibiotics as stated earlier. These strains are sensitive to new broad-spectrum antibiotics as Linezolid and Piperacillin. Such a drug resistance pattern was also observed by Kamath N et al[29], Anvikar AR et al[4,] and Lilani SP et al[6]. Most of the newer antibiotics are much costly and generally not available in the hospital pharmacy of our hospital. They have to be purchased from private pharmacies at a high cost putting an extra financial burden on the hospital resources which is also shown by other studies like Jenks PJ et al.[30]

Twelve out of one hundred and eighty-two (6.59%) Staph aureus cultures were Methicillin-resistant Staph aureus (MRSA) while two patients (1.09%) had Vancomycin-resistant Staph aureus (VRSA). Six (50%) MRSA patients were sensitive to Linezolid and six (50%) MRSA patients were sensitive to Vancomycin. Two VRSA (Vancomycin-resistant Staph aureus) strains were sensitive to Linezolid. This shows the good efficacy of these new antibiotics. Dodds ES et al[32], Moore M[33,] and Marin H[34] also observed such sensitivity against MRSA.

In two (0.84%) SSI patients managed in intensive care unit after surgery, Acinetobacter was found which was sensitive to Tigecyclin.[35]

Conclusion

Increased incidence of blunt abdominal trauma increases the chances of SSI, so every possible effort should be made to decrease this incidence by better traffic regulations. Adequate pre-op resuscitation and peri-operative sterilization can decrease the incidence of surgical site infections. Thorough per operative wound wash decreases the spread of contamination which can lead to a decrease incidence of SSI. The spread of Staph aureus can be decreased by avoiding direct contact with an infected wound and wearing gloves and masks by all healthcare providers. Routine antibiotics like Co-Amoxiclave, Ceftriaxone, and Ciprofloxacin can be prescribed in clean-contaminated cases. Newer broad-spectrum antibiotics like Piperacillin, Cefoperazone, and Linezolid should be prescribed to cover all strains of pathogens especially emerging strains of MRSA more commonly reported in contaminated and dirty cases. Antibiotics like Tigecyclin and Fosfomycin can be considered in post-operative patients being managed in intensive care units who are not responding to other antibiotics.

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