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**Prevalence and clinicopathological features of surgical site infection- experience from surgery unit of a tertiary care center**

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**ABSTRACT**

**Introduction:** Surgical Site Infection can complicate the post-surgical recovery of patients in approximately 10% of general surgery cases despite adherence to standard guidelines on infection control and aseptic procedures.

**Objective:** To determine the prevalence of surgical site infection and its associated clinicopathological features.

**Materials & Methods:** This Cross-sectional descriptive study was done in Khyber Teaching Hospital for a duration of six months i.e. from 1st October 2023 to 31st March 2024 after obtaining ethical approval from the Institutional ethical board. Patients referred to surgical unit for surgical intervention, of both the genders and all ages were included in the study after obtaining informed consent. Wound swab samples from infected wounds were sent to Pathology department for culture sensitivity. Blood samples were sent for hematology parameters and chemistry. Quantitative data was analyzed by mean and standard deviation, while qualitative data was analyzed with frequency and percentages using SPSS 20; a p≤0.05 denoted significance.

**Results:** Mean age of 179 patients was 54±22.3 (Range:34-75) years. There were 40 (22.3%) male and 139 (77.7%) female patients. Only 13 (7.3%) patients had surgical site infection. Mean age of these 13 patients was 63±42.3 (Range:52-72) years with 9 (69.2%) males and 4 (30.8%) female patients. Only 6 (46%) cases had diabetes mellitus. Bacterial growth was seen only in 11 (84.6%) cases while in 2 (15.4%) cases, no growth was detected. The commonest pathogen growth detected was that of E. Coli which was seen in 3 (27%) cases, followed by Proteus, Citrobacter species, and Staphylococcus Aureus which were seen in 2 (18.2 %) cases each.

**Conclusions:** Occurrence of surgical site infection was low and attributed to good perioperative surgical wound care.

**Keywords:** Citrobacter; Diabetes Mellitus Type 2; Escherichia coli; Pseudomonas aeruginosa; Staphylococcus aureus; Surgical Wound Infection.

29

*The authors declared no conflict of interest. All authors contributed substantially to the planning of research, data collection, data analysis, and write-up of the article, and agreed to be accountable for all aspects of the work.*

**INTRODUCTION**

Surgical Site Infection (SSI) is referred to as infection in the surgical wound that happens within one month after surgical procedure.[1](#_ENREF_1) Usually, the surgical wound heals uneventfully by primary intention where the edges of the wound are approximated with the help of surgical suture.[2](#_ENREF_2) However, due to SSI, there is undue delay in wound healing. SSI is the healthcare associated infection that causes increased morbidity, mortality and cost on the part of patient.[3-5](#_ENREF_3)

The burden of SSI is high throughout the world despite the advances in aseptic surgical techniques and extensive guidelines on infection control.[6](#_ENREF_6) The prevalence of SSI is highly variable in different parts of the world.[7](#_ENREF_7),[8](#_ENREF_8) according to an estimate, the rates of SSI vary from 1.4% to 41.9%.[9](#_ENREF_9) According to a metanalysis, 1 out of 10 general surgery patients suffer from SSI.[1](#_ENREF_1) The common documented risk factors for developing SSI include prolonged duration of surgery, diabetes mellitus, smoking, and obesity.[10](#_ENREF_10)

There is scanty data regarding burden of SSI in general surgery from Peshawar. Therefore, it is necessary to determine the prevalence of SSI and associated clinicopathological features of patients in general surgery in this area. This data will help in decision making by the policy makers and health care administrators to tackle the problem of SSI.

**MATERIALS & METHODS**

This cross-sectional descriptive study was conducted from 1st October 2023 to 31st March 2024, in Khyber Teaching Hospital, Peshawar, Khyber Pakhtunkhwa, after obtaining ethical approval from the Ethical Review Board of the hospital.

Patients of both genders and all ages referred to the General Surgery unit for surgical intervention, were included in the study. Non-consenting patients were excluded. Surgical intervention was administered by consultant surgeons in the operation theatre under general and/or local anesthesia depending on the case. Patients were kept in the surgical ward for follow up observation. Post surgical wound infection was confirmed by wound discharge, oozing, erythema around the wound and/or wound dehiscence.

Wound swab sample was sent to Pathology department for culture sensitivity in cases of surgical site infection in order to determine the causative agent. A 2 ml blood sample was sent to the hematology department for complete blood counts showing hemoglobin levels, total leukocyte count, and platelet counts. 2 ml blood sample was collected in gel tube and sent to chemical pathology department to determine serum glucose (random), serum bilirubin, serum electrolytes, and renal function tests.

Original Article | Prevalence and clinicopathological features of surgical site infection- experience from surgery unit of a tertiary care center

Data were analyzed using SPSS 20. Quantitative data were analyzed by mean and standard deviation, while qualitative data were analyzed with frequency and percentages.

**RESULTS**

The characteristics of 179 patients included in the study are shown in table 1. Table 1 shows that most of the patients were in the age range of 34 to 75 years age. Female population was predominant.

**Table 1: Characteristics of study sample (n=179).**

|  |  |
| --- | --- |
| Population characteristics | Values |
| **Age (Years)** | Mean: 54±22.3 (Range:34-75) |
| **Gender** | Male:40 (22.3%)  Female:139 (77.7%) |
| **Surgical site infection** | Yes: 13 (7.3%)  No: 166 (92.7%) |
| **Hematological parameters**  Hemoglobin (gm/dl)  Total leukocyte count (/mm3)  Platelet counts (/mm3) | Mean = 11.08 ± 1.57 (Range: 5-15)  Mean = 9.38 ± 3.08 (Range: 3-36)  Mean = 284 ± 73.29 (Range:79-471) |
| **Chemistry**  Alkaline phosphatase (U/L)  Alanine aminotransferases (U/L)  Bilirubin (mg/dl)  Urea (mg/dl)  Creatinine (mg/dl)  Random blood sugar (mg/dl) | Mean = 101.33 ± 89 (Range:20-1157)  Mean = 34.43 ± 30 (Range:1.69-199)  Mean = 1.14 ± 5.19 (Range:0.1-41)  Mean = 27 ± 23 (Range:2.8-228)  Mean = 0.945 ± 4.46 (Range:0.03-60)  Mean = 106 ± 38.3 (Range:68-474) |
| **Serum electrolytes**  Sodium (mEq/L)  Potassium (mEq/L)  Chloride (mEq/L) | Mean = 145 ± 26.7 (Range:119-260)  Mean = 3.9 ± 2.34 (Range:2-34)  Mean = 102 ± 5.09 (Range: 88-130) |

The overall characteristics of 13 patients having surgical site infection is given in Table 2.

Table 2 shows that patients having surgical site infection were above 50 years of age. The SSI was common in male population as compared to females. Only 11(84.6%) cases showed positive growth on culture media out of which, Escherichia Coli growth was the commonest.

**Table 2: Overall characteristics of patients having surgical site infection (n=13).**

30

|  |  |
| --- | --- |
| Population characteristics | Values |
| **Age (Years)** | Mean: 63±42.3 (Range:52-72) |
| **Gender** | Male: 9 (69.2%)  Female: 4 (30.8%) |
| **Diabetes mellitus** | Yes: 6 (46%)  No: 7 (54%) |
| **Growth (culture sensitivity report)** | Yes: 11 (84.6%)  No growth: 2 (15.4%) |
| **Culture report (n=11)** | Citrobacter species: 2 (18.2 %)  Escherichia Coli:3 (27%)  Proteus: 2 (18.2%)  Pseudomonas Aeruginosa:1 (9% )  Serratia species:1 (9%)  Staphylococcus Aureus: 2 (18.2% ) |
| **Hematological parameters**  Hemoglobin (gm/dl)  Total leukocyte count (/mm3)  Platelet counts (/mm3) | Mean = 10.27 ± 2.08 (Range: 5.10-12)  Mean = 14.95 ± 7.5 (Range: 7.9-36)  Mean = 317 ± 60. 9 (Range:234-414) |
| **Chemistry**  Alkaline phosphatase (U/L)  Alanine aminotransferases (U/L)  Bilirubin (mg/dl)  Urea (mg/dl)  Creatinine (mg/dl)  Random blood sugar (mg/dl) | Mean = 131 ± 94 (Range:44-341)  Mean = 41 ± 38.5 (Range: 9.4-121)  Mean = 0.605 ± 0.04 (Range: 0.17-2.48)  Mean = 40 ± 33.7 (Range: 8.2-132)  Mean = 1.08 ± 0.97 (Range: 0.32-3.98)  Mean = 136 ± 58.3 (Range:99-654) |
| **Serum electrolytes**  Sodium (mEq/L)  Potassium (mEq/L)  Chloride (mEq/L) | Mean = 141.7 ± 19.6 (Range:119-202)  Mean = 3.84 ± 0.61 (Range:2.9-4.7)  Mean = 101 ± 6.24 (Range: 89-115) |

The individual characteristics of 13 patients having surgical site infection is given in Table 3. The ages of patients ranged from 52-75 years, and most of them (9, 69.2%) were males. Microbial growth was obtained in 11(84.6%), the majority of reported organisms being E. coli in 3/11(27.7%), followed by Staph aureus, Citrobacter, and Proteus in 2 patients each (18.2% each); the TLC was raised in 6/9 (66.67%) of males, and 02/4(50%) females.

JRMI | Journal of Rehman Medical Institute, Vol. 10, No. 4, 2024

**Table 3: Individual characteristic of patients having surgical site infection (n=13).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| # | Age  (Years) | Gender | Indication for surgery | C/S report | Hb | TLC | Platelet count | ALP | ALT | Bil | Creat | RBS | Na+ | K+ | Cl- |
| 1 | 56 | Male | Perianal Abscess | No growth | 10.7 | 9.20 | 263.0 | 123.0 | 26.00 | .50 | 1.86 | 120.0 | 140.0 | 4.7 | 115.0 |
| 2 | 52 | Male | Perianal Abscess | E. coli | 9.80 | 7.90 | 234.0 | 81.00 | 12.00 | .17 | .82 | 98.00 | 136.0 | 3.8 | 100.0 |
| 3 | 57 | Male | Diabetic foot | Staph. Aureus | 10.9 | 13.0 | 354.0 | 101.0 | 15.5 | .25 | 1.5 | 96.00 | 135.0 | 3.7 | 89.00 |
| 4 | 53 | Female | Below Knee Amputation for diabetic foot | Staph Aureus | 9.20 | 15.5 | 315.0 | 341.0 | 13.00 | 2.48 | 0.72 | 98.00 | 139.0 | 3.5 | 102.0 |
| 5 | 59 | Male | Diabetic Foot | Proteus species | 10.6 | 18.8 | 264.0 | 80.00 | 16.00 | .18 | .62 | 474.0 | 137.0 | 4.4 | 103.0 |
| 6 | 58 | Female | Appendectomy | No growth | 5.10 | 22.0 | 376.0 | 201.0 | 9.40 | 1.20 | .74 | 153.0 | 131.0 | 3.4 | 99.0 |
| 7 | 67 | Male | Post Injection Cellulitis of left arm | E. coli | 12.4 | 17.2 | 236.0 | 106.0 | 9.50 | .34 | .70 | 91.00 | 135.0 | 4.1 | 100.0 |
| 8 | 70 | Female | Left Below Knee Amputation | Proteus species | 12.0 | 9.50 | 401.4 | 77.00 | 67.00 | .31 | .42 | 210.0 | 154.2 | 4.0 | 100.0 |
| 9 | - | Male | Diabetic Foot | Citrobacter species | 12.0 | 11.0 | 321.0 | 89.00 | 68.00 | .25 | .43 | 222.0 | 138.2 | 2.9 | 97.60 |
| 10 | 72 | Male | Necrotic Patches on Abdomen &Thigh | Pseudomonas Aeruginosa & Klebsiella | 12.0 | 12.8 | 356.0 | 84.00 | 121.0 | .32 | .98 | 100.0 | 202.3 | 3.3 | 99.0 |
| 11 | 70 | Male | Exploratory Laparotomy | E. coli | 12.0 | 10.0 | 267.0 | 44.00 | 98.00 | 1.02 | .95 | 145.0 | 138.2 | 3.0 | 110.0 |
| 12 | 59 | Female | Incision and Drainage for flank abscess | Serratia & Enterobacter Species | 8.00 | 11.0 | 321.0 | 73.00 | 68.00 | .26 | 3.98 | 90.00 | 138.0 | 4.6 | 103.0 |
| 13 | 65 | Male | Below Knee Amputation | Citrobacter Species | 8.90 | 36.0 | 414.00 | 312.0 | 10.90 | .59 | .32 | 200.0 | 119.0 | 4.6 | 97.0 |

Hb: Hemoglobin, TLC: Total leukocyte count, ALP: Alkaline phosphatase, ALT: Alanine aminotransferase, Bil: Bilirubin, Creat: Creatinine, RBS: Random blood sugar, Na+: Serum sodium, K+: Serum potassium, Cl-: Serum chloride.

31

**DISCUSSION**

Original Article | Prevalence and clinicopathological features of surgical site infection- experience from surgery unit of a tertiary care center

Surgical site infection is a surgical complication that is associated with significant morbidity and financial losses on part of patients[5](#_ENREF_5). It is associated with prolonged hospital stay that in turn increases risk of hospital associated infections. The increased stay in hospital in such cases lays burden on health care system especially in low-income countries like Pakistan. Patients that are prone to develop surgical site infections are those who have comorbid conditions like diabetes mellitus, smokers, obesity. As these factors are difficult to modify, so current approach to prevent SSI rely on aseptic surgical techniques and use of antibiotics.[5](#_ENREF_5)

In the current study, the rate of SSI was 7.3%, Escherichia Coli being the most common pathogen in culture growth media. The SSI rate in the current study is quite low as compared to various international and local studies. A study from Nigeria reports SSI rate of 18.6%.[11](#_ENREF_11) However, Fields et al.,7 have reported a lower rate of 0.9%. Similarly, a very low rate of 0.96% is reported from California.[12](#_ENREF_12) Several studies report a high rate of SSI i.e. 9.8% as reported from Tunisia,[13](#_ENREF_13) 15.4% from Mexico,[8](#_ENREF_8) 3.9% from Switzerland,[14](#_ENREF_14)10.3% from Baltimore,[15](#_ENREF_15) 14.4% from Poland,[16](#_ENREF_16) and 12.2% from Belgium17. Surprisingly, a very high rate of 43.3% is reported from Mexico.[8](#_ENREF_8) Similarly, a very high rate of 33.7% is reported from the United Kingdom.[18](#_ENREF_18) A higher rate of 14.4% is reported from China,[19](#_ENREF_19) and 10.4% from Portugal20. SSI rate of 6.5% was reported from Kuwait.[18](#_ENREF_18) Higher SSI rated of 20.3% and 24% are reported from Chicago,[21](#_ENREF_21) and North Carolina22. Similarly, a higher SSI rate of 29.8% is reported from Pakistan.[23](#_ENREF_23) In the same study the commonest pathogen reported was Pseudomonas aeruginosa.[23](#_ENREF_23) The rates of SSI reported in our study are quite lower as compared to the studies mentioned. This is attributed to highly sophisticated perioperative surgical care provided to the patients and improved patient care post operatively. Postoperative wound care is of utmost importance in this regard.

In hospitals with high rates of SSI, it is recommended to develop and implement strict guidelines for sterile surgical techniques and to ensure postoperative wound care. This is indeed a challenging task especially for poor countries like Pakistan.[24](#_ENREF_24) Yet, it is worth it as SSI are preventable complications.[1](#_ENREF_1)

**CONCLUSION**

The rate of SSI is low in our setup as compared to other studies. This is attributed to sterile surgical techniques and better post operative surgical wound care in our setup.

**LIMITATIONS OF THE STUDY**

The current study did not consider the risk factors associated with the development of SSI.

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32

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JRMI | Journal of Rehman Medical Institute, Vol. 10, No. 4, 2024

33