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Research Article

CLINICAL AND BACTERIOLOGICAL PROFILE OF SURGICAL SITE INFECTIONS (SSIs) FROM A TERTIARY CARE CENTRE

Kumari Neha Singh, Kanne Padmaja*, Sukanya Sudhaharan and Vijay D.Teja

Dept of Microbiology, Nizams Institute of Medical Sciences, Hyderabad, Telangana

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A B S T R A C T

Introduction: Surgical site infection (SSI) is a health care associated infection (HCAI) that occurs at or near the incision site within 30 days of surgery or within one year if an implant was placed, and the infection develops after surgery leading to morbidity and mortality.

Objectives: a) To study the prevalence, risk factors and microbiological profile of SSI in our hospital.

Materials and methods: A retrospective study was undertaken for a period of 2 years from March 1st 2019 to March 31st 2021 at Nizams Institute of Medical Sciences, Hyderabad Telangana. Data was collected from the medical records of the patients who have undergone surgeries from various departments .The clinical samples included in the study were pus, wound swabs, and tissues which were processed as per standard microbiological methods.

Results: Among 2,115 surgeries, a total of 185(8.74%) SSIs were observed, of which 148 (80%) were elective and 37(20%) had undergone emergency surgeries. Majority of the patients were in the age group of 40-60 years (40%). Infections from Orthopedic surgeries were 66/185(36%), Surgical gastroenterology 34/185 (18%),Neurosurgery 13/185(7%), Cardiothoracic surgery 34/185(18%), and Plastic surgery were 38/185 (20%). As per CDC wound classification 55/185(30%) were clean, 45/185(24%) were clean contaminated, 73/185(40%) were contaminated and 12/185(6%) were Dirty wounds.

Mono microbial growth was observed in 150 /185 (81%) patients and growth of two organisms was observed in 10/185 (5.4%)of patients which makes a total of 160/185 culture positives. Poly microbial growth was observed in 25/185 (13.5%) of the SSI cases as the sample was not collected properly and repeat sample was not sent for these patients. But still all 185 cases were analysed as clinically they were symptomatic and responded to antibiotics empirically. The predominant organism isolated was *Escherichia coli* 48 (30%) followed by *Staphylococcus aureus* 39 (24.3%) of which 28 (71.7%) were Methicillin Resistant *Staphylococcus aureus* (MRSA) and 11(28.2%) were Methicillin sensitive *Staphylococcus aureus* (MSSA). Multidrug resistant organisms (MDROs) observed were 44(24%) of this ESBL producers were 24(13%).

Conclusion: The post operative complications of SSIs can be controlled by implementation of strict infection control practices during and after surgery and also by rational use of antimicrobial therapy that helps to limit the spread of multidrug resistance and occurrence of SSIs.

INTRODUCTION

The Surgical site infection (SSI) is a Health care associated infection that occurs either within 30 days after surgery or within one year if an implant was placed and the infection is related to surgery. [1] It is ranked as the second most commonest cause of Healthcare associated infections. [2] These infections have a major influence on morbidity and mortality as it increases the risk of patient's death after surgery. Based on their anatomical site of location SSIs are classified into Superficial (involving skin & subcutaneous tissue), Deep (muscle & fascia) and Organ /space(any other space).[3] The National Academy of Sciences Research has classified the surgical wounds based on the degree of contamination into Clean, Clean contaminated, Contaminated and Dirty wounds.[4,5]SSI in India shows the prevalence range of 5-30% depending on the surgical procedures performed, risk factors involved, hospital stay.[6,7]The most commonly isolated Gram-negative bacterial pathogens of SSI are *Klebsiella pneumonia*, *Escherichia coli*, *Acinetobacter* spp. and *Pseudomonas aeruginosa*.[1]

The risk of developing SSI depends upon the patient characteristics, age, gender, nutrition, smoking, alcoholism,

Corresponding author:* **Kanne Padmaja
Dept of Microbiology, Nizams Institute of Medical Sciences, Hyderabad, Telangana

co-morbidities, length of the surgical procedure, type and site of surgery, length of hospital stay, amount and type of local skin bacteria, preoperative glucose levels, body temperature fluctuations, and incorrect or lack of antibiotic prophylaxis .[8] Though with the improvement of techniques in surgery, operating room practices, sterilization of instruments and multiple prevention strategies, SSIs are still a major cause of nosocomial infections and the rates are increasing globally in health care facilities with standard protocols . [1,9]

Not choosing an appropriate antibiotic, infusion of the prophylactic antibiotic for prolonged duration, may cause complications and also increases the cost of treatment over the patient and produce more resistance against pathogens.[10] Henceforth appropriate use of antibiotics and close monitoring of antimicrobial resistance (AMR) in postoperative patients with SSI are needed to prevent the emerging spread of antimicrobial resistance among the bacterial isolates by implementing stringent Infection control measures and training of health care professionals. [11]

The present study was undertaken to detect the prevalence, risk factors and microbiological profile of SSI in our hospital.

MATERIAL AND METHODS

A retrospective study was undertaken for a period of 2 years from March 1st 2019 to March 31st 2021) at Nizams Institute of Medical Sciences, Hyderabad. All the demographic data and clinical data was collected from the medical records of the patients who have undergone surgeries from the Departments of Orthopedics, Surgical Gastroenterology, Neurosurgery, Cardiothoracic surgery, Plastic surgery. The clinical samples included in the study were pus, wound swabs, tissues and were processed as per standard microbiological methods.

Microbiology workup

Preliminary Gram staining was done for all samples and they were inoculated on chromogenic agar and 5% sheep blood agar (biomeriux, France, Marcy'l Etoile) and incubated in aerobic conditions at 37°C for18-24hours.Culture showing growth of significant growth were subjected to routine biochemical testing. Identification and susceptibility testing was done by using Vitek 2 compact system. IDGN, N280 and N281 panels were used for identification of Gram negative pathogens and IDGP and P628 panels were used for identification of Gram positive pathogens

Statistical analysis: All the variables such as demographic profile, risk factors, wound classification, and Bacteriological profile of SSIs were analysed as percentages in the present study.

RESULTS

Among 2,115 surgeries, a total of 185 (8.74%) SSIs were observed, of which 148 (80%) were elective and 37 (20%) had undergone emergency surgeries. Majority of the patients were in the age group of 40-60 years (40%) (Fig:1) with the male preponderance.(Fig:2) Surgeries undertaken in various Departments were shown in Table:1 Risk factors were analyzed. (Fig:3) Antibiotic prophylaxis given for various surgeries were analysed.

As per CDC wound classification, types of wounds were classified (Fig:4) Mono microbial growth was observed in 150 /185 (81%) patients and growth of two organisms was observed in 10/185 (5.4%) patients which makes a total of 160/185 culture positives. Poly microbial growth was observed in 25/185 (13.5%) of the SSI cases as the sample was not collected properly and repeat sample was not sent for these patients. But still all 185 cases were analysed as clinically they were symptomatic and responded to antibiotics empirically. The predominant organism isolated are shown in Table: 2. Multidrug resistant organisms (MDROs) observed were 44(24%) of this ESBL producers were 24(13%).

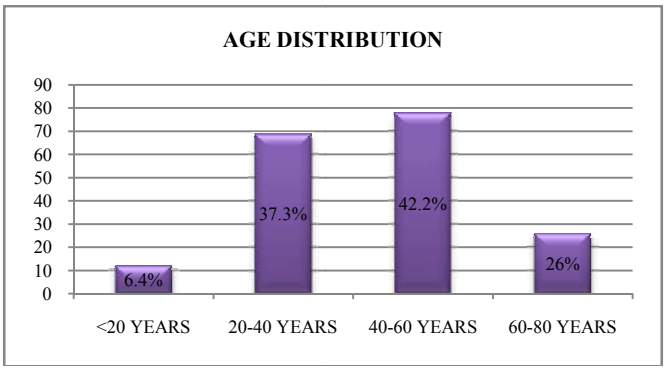

Fig 1 Age wise distribution of SSI patients(n=185)

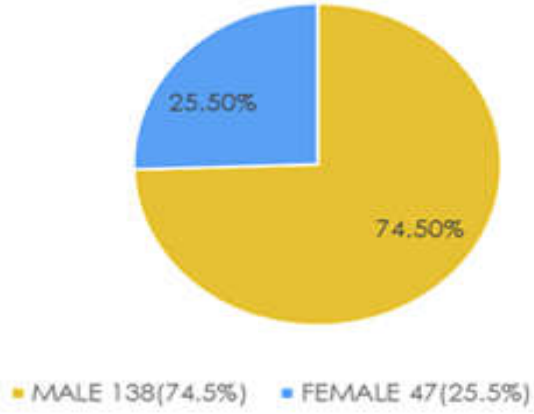

Fig 2 Gender wise distribution of SSIs (n=185)

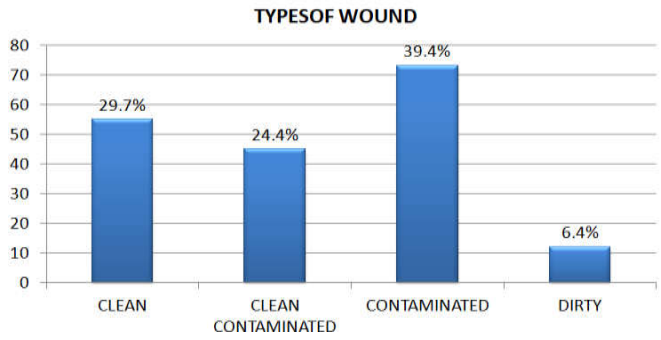

Fig 3 Types of SSI wounds (n-=185)

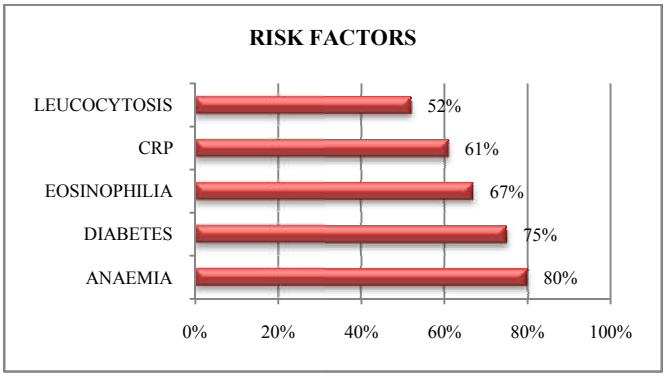

Fig 4 Risk factors of SSIs

Table 1 Department wise Distribution of SSI Surgeries (n=185)

Dept & Types of Surgery	Number (n= 185)	Percentage
Surgical Gastroenterology (n=34)		**18%**
Cholecystectomy	3	8.8
Laparotomy	11	32.35
Whipples procedure	4	11.76
Radical gastrectomy	4	11.76
Nephrostomy	2	5.8
Pancreatectomy	2	5.8
Necrosectomy	1	2.9
Colostomy	1	2.9
Appendectomy	2	5.8
Radical Hysterectomy	1	2.9
Radical cystectomy	3	8.8
Orthopedic (n=66)		36%
Arthroplasty	6	9.09
Total knee replacement	3	4.5
Implants	34	51.5
Total Hip replacement	6	9.09
Amputation	17	25.75
Cardiothoracic (n=34)		18%
CABG	19	55.88
Lobectomy	2	5.8
Thoracotomy	2	5.8
Pace maker Implant	11	32.3
Neurosurgery (n=13)		7%
Decompressive craniotomy	13	100
Plastic Surgery (n=38)		20%
Fasicotomy	13	34.2
Skin grafting	23	60.5
Mandibulectomy	2	5.2

Table 2 Distribution of SSI Pathogens (n=160)

Type of pathogen	Number (n=160)	Percentage(%)
Gram Negative Pathogens (n= 110)		**68.75%**
Escherichia coli	48	30
Klebsiella pneumonia	21	13.1
Enterobacter cloacae	6	3.75
Proteus mirabilis	4	2.5
Acinetobacter baumannii	13	8.1
Pseudomonas aeruginosa	18	11.25
Gram positive pathogens (n=50)		31.25%
Staphylococcus aureus	39	24.3
MRSA	28	71.7
MSSA	11	28.2
Streptococcus pyogenes	4	2.5
Enterococcus faecalis	7	4.3

DISCUSSION

Surgical site infection is defined as infection that occur in the wound created by an invasive surgical procedure. As skin is colonized with wider range of pathogens that could cause infection, defining SSI criteria requires evidence of clinical signs and symptoms of infection rather than SSI microbiological evidence [1]

Prevalance of SSI in the present study was found to be 8.74%. In a study by Mezemir *et al* [12] the overall prevalence of surgical site infections was found to be 24.5%. Akhtar *et al*. [13] study showed a SSI rate of 11%.

Few studies have consistently identified male gender are at increased risk for SSIs than females [12,14] Neumeyer *et al* stated that majority of males had surgical site infections because of vascular problems than females. [15]In the present study SSIs were predominantly seen in male patients 138,74.5% compared to females 47 (24.5%) In a study by Mezimer *et al* the percentage of females (59.8%) were high compared to males (40.2%)[12]

SSI rates are increased with age, it might be due to a poorer immune response and coexistence of other comorbidities. [1] Majority of the patients in the present study were in the age group of 40-60 years (40%)

Numerous risk factors may contribute to the development of SSI. Severely anemic patients had the highest risk of getting SSI. A study by Abubaker *et al* showed that SSIs were found more commonly among patients with anemia and a study by Aurab *et al* showed that 20.8% of his patients are diabetic .Our study also showed that anemia (80%) was the major risk factor for SSI followed by diabetes mellitus (75%).[9]

The most common Gram negative pathogens isolated from SSIs in the present study were *Escherichia coli* (30%) and *Klebsiella pneumoniae* (13.1%) followed by *Staphylococcus aureus* (24.3%) of which 28 (72%) were MRSA and 11(28%) were MSSA. In a study by Shah S *et al Klebsiella pneumoniae* (19%) was the most common pathogen isolated followed by *Escherichia coli* (17%), *Pseudomonas aeruginosa* (13%), *Staphylococcus aureus* (12%) and *Enterococcus* spp (10%). [16] The possible reasons for reporting various pathogens among SSIs might be due to the variations in the geographical location, type of population studied, nosocomial pathogens inhabiting the surgical procedures, resistance patterns of the organisms, infection control and prevention policies.[2]

In majority of SSI cases, the pathogen source is the native flora of the patient's skin, mucous membranes, or hollow viscera. Incision into hollow viscera exposes surrounding tissue to gram-negative bacilli such as *Escherichia coli* poses a risk, [18] where same pathogen was observed predominantly in the present study. Underlying tissue is exposed to overlying endogenous flora usually when skin is incised leading to increased proportion of infections with *Staphylococcus aureus* especially with resistant pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA), [18]which was a similar finding to our study.

Patients with contaminated wounds have nearly three-fold increased risk of SSI compared to non-contaminated wounds. [2]The present study showed increased percentage of contaminated wounds 73/185(40%) similar to Ansari *et al* study where contaminated wounds (12.4%) percentage was high. [19]

The major surgeries done in the present study were Laparotomy (32.35%), Orthopedic implants (51.5%) Amputation (25.7%) CABG (55.8%) Pacemaker implant (32.35%) Decompressive craniotomy (100%), Skin grafting (60.5%). Aurab *et al* study showed the most frequent type of surgery was laparoscopic cholecystectomy (111 procedures [32.9%]), followed by hernia repair (67 [19.9%]) and bariatric surgery (56 [16.6%]). [9]

Most of the patients in the present study received cefaperazone sulbactam (56.2%), amikacin (39.1%) followed by metronidazole 500mg (37.8%) as prophylactic therapy.A study by Kefale B *et al* showed that ceftriaxone and metronidazole (45.4%), and ceftriaxone (33.3%) were the most frequently used prophylactic antibiotics. [20] Misganaw D *et al* showed combination of ceftriaxone and metronidazole (47.46%) prophylaxis. [21]

The spread of multi drug-resistant organisms is an emerging global threat and is considered as an inevitable genetic response to the strong selective pressure imposed by

antimicrobial therapy, that plays a major role in the existence of antibiotic-resistant bacteria and is challenging the clinicians leaving only few choices of drugs in treating SSIs [22]. Antibiotic susceptibility results showed high resistance for the majority of Gram-negative bacterial isolates in this study including carbapenems. In the current study Multidrug resistant organisms (MDROs) observed were 44 (24%) of this ESBL producers were 24 (13%). Shah S *et al* showed ESBL rates were 85%, susceptibility rates to beta-lactam–beta-lactamase inhibitor (BL-BLI) combinations were 57% and carbapenems 79% and 44% of *S.aureus* were methicillin resistant. [17]

CONCLUSION

The consequences of SSIs greatly impact patients and the healthcare facilities. The prevalance of infection rate was found to be 8.74% in the present study. *Escherichia coli* and *Staphylococcus aureus* were the predominant causative pathogens of SSI and majority of SSIs were associated with anemia and diabetes. Sulbactam/cefaperazone, Amikacin and metrogyl were the potent antibiotics used against SSIs. Strict adherence to infection control measures and the practice of proper aseptic techniques during and after the surgery and the use of rational antimicrobial therapy will help to limit the spread of resistance and occurrence of infection with a a long term surveillance system established in place to detect the pre, intra and post operative risk factors.

Limitations of the study: As the study is a retrospective study, postoperative treatment and outcome were not assessed.

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References

1. Mukagendaneza MJ, Munyaneza E, Muhawenayo E *et al* .2019. Incidence, root causes, and outcomes of surgical site infections in a tertiary care hospital in Rwanda: a prospective observational cohort study. Patient Saf in Surg., 13(10) :2-8.
2. Pathak A, Mahadik K, Swami MB, Roy PK, Sharma M, Mahadik VK, Lundborg CS. 2017. Incidence and risk factors for surgical site infections in obstetric and gynecological surgeries from a teaching hospital in rural India. Antimicrob Resist Infect Control., 6:66.
3. Horan TC, Andrus M, Dudeck MA .2008.CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control., 36:309-32.
4. Shahane V, Bhawal S, Lele U. 2012. Surgical site infections: A one year prospective study in a tertiary care center. Int J Health Sci., 6(1):79-84.
5. Costa ACD, Santa-Cruz F, Ferraz ÁAB2020. What's New In Infection On Surgical Site And Antibioticoprophylaxis In Surgery? Arq Bras Cir Dig.,33(4):e1558.
6. Mamo T, Abebe TW, Chichiabellu TY, Anjulo AA.2017. Risk factors for surgical site infections in obstetrics: a retrospective study in an Ethiopian referral hospital. Patient Saf Surg., 19(11):24.
7. Fiani B, Cathel A, Sarhadi KJ, Cohen J, Siddiqi J.2020. Neurosurgical Post-operative Wound Infections:Retrospective study on surgical site infections for quality improvement.Int wound J.,17(4): 1039-1046.
8. Alverdy JC, Gilbert JA, Hyman N.2020. Surgical site infections following elective surgery - Authors' reply. Lancet Infect Dis., 20(8):899.
9. Alkaaki A, Al-Radi OO, Khoja A, Alnawawi A, Alnawawi A, Maghrabi A, Altaf A, Aljiffry M.2019. Surgical site infection following abdominal surgery: a prospective cohort study. Can J Surg., 62(2):111-117.
10. Yang J, Zhang X, Liang W.2020.A retrospective analysis of factors affecting surgical site infection in orthopaedic patients. J Int Med Res., 48(4):3.
11. Mekhla, Borle FR.2019.Determinants of superficial surgical site infections in abdominal surgeries at a Rural Teaching Hospital in Central India: A prospective study. J Family Med Prim Care ., 8 (7) :2258-2263.
12. Mezemir R, Seid A, Gishu T *et al*.2020. Prevalence and root causes of surgical site infections at an academic trauma and burn center in Ethiopia: a cross-sectional study. Patient Saf Surg., 7 (14):3.
13. Akhter MS, Verma R, Madhukar KP *et al*. 2016.Incidence of surgical site infection in postoperative patients at a tertiary care centre in India. J Wound Care.,25(4):210-2, 214-7.
14. Manyahi J, Matee MI, Majigo M,*et al*.2014. Predominance of multi-drug resistant bacterial pathogens causing surgical site infections in Muhimbili National Hospital, Tanzania. BMC Res Notes., 7(7):500.
15. Neumayer L, Hosokawa P, Itani K, ElTamer M, Henderson WG, Khuri SF.2007. Multivariable predictors of postoperative surgical site infection after general and vascular surgery: Results from the patient safety in surgery study. J Am Coll Surg.,204: 1178-1187.
16. Lubega A, Joel B, Justina Lucy N. 2017.Incidence and Etiology of Surgical Site Infections among Emergency Postoperative Patients in Mbarara Regional Referral Hospital, South Western Uganda. Surg Res Pract., 6365172.
17. Shah S, Singhal T, Naik R *et al*.2020. Predominance of multidrug-resistant Gram-negative organisms as cause of surgical site infections at a private tertiary care hospital in Mumbai, India. Indian J Med Microbiol., 38:344-50.
18. Reichman DE, Greenberg JA. 2009. Reducing surgical site infections: a review. Rev Obstet Gynecol., 2(4):212-21.
19. Ansari S, Hassan M, Barry HD *et al*.2019. Risk Factors Associated with Surgical Site Infections: A Retrospective Report from a Developing Country. Cureus., 11(6): e4801.
20. Kefale B, Tegegne GT, Degu A,*et al* .2020.Surgical Site Infections and Prophylaxis Antibiotic Use in the Surgical Ward of Public Hospital in Western Ethiopia: A Hospital-Based Retrospective Cross-Sectional Study. Infect Drug Resist.,13:3627-3635.
21. Misganaw D, Linger B, Abesha A.2020.Surgical Antibiotic Prophylaxis Use and Surgical Site Infection Pattern in Dessie Referral Hospital, Dessie, Northeast of Ethiopia. Biomed Res Int., 1695683.
22. Negi V, Pal S, Juyal D, Sharma MK, Sharma N.2015. Bacteriological Profile of Surgical Site Infections and Their Antibiogram: A Study From Resource Constrained Rural Setting of Uttarakhand State, India. J Clin Diagn Res., 9(10):DC17-20.