Section: Miscellaneous

Original Research Article

BACTERIOLOGICAL PROFILE OF SURGICAL SITE WOUND INFECTION

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Abstract

Background: Surgical Site Infection (SSI) is the primary cause of all Healthcare Associated Infections in underdeveloped nations. Surgical site infections (SSIs) can result in illness and death among hospitalised patients. **Aim:** The aim of the present study to determine the bacteriological profile of surgical site wound infection. **Materials and Methods:** The research was conducted as a cross-sectional study at the Department of Microbiology. Aseptically, two wound swabs were taken from each patient suspected of having a surgical site infection using sterile cotton swabs. Gram-stained preparations were created from a single swab to provide a preliminary diagnosis. The second swab was introduced onto nutritional agar, 5% sheep blood agar (BA), and MacConkey agar (MA) plates. These plates were then placed in an incubator at a temperature of 37°C for a period of 24-48 hours. After this incubation period, the plates were examined and determined to be free of any microorganisms. The identification of growth on culture plates was determined based on the characteristics of the colonies and a set of standardised biochemical tests. The antimicrobial susceptibility of all the isolates was assessed using the Kirby Bauer disc diffusion method on Muller Hinton Agar. **Results:** Among the 470 samples analysed, 220 samples were positive for culture (46.81%). S. aureus was the most prevalent pathogen, accounting for 27.27% of the 220 culture positive samples. Escherichia coli followed closely behind at 21.82%, while Citrobacter spp. and Pseudomonas aeruginosa accounted for 13.64% and 10% of the samples, respectively. Among gramme negative bacilli, E. coli exhibited the highest susceptibility to Imipenem (87.5%), followed by Amikacin (77.08%) and Piperacillin Tazobactam (72.62%). Within the group of gramme positive organisms, S. aureus had the highest level of susceptibility to Linezolid (96.67%), followed by Vancomycin (91.67%) and Amikacin (85%). **Conclusions:** It is evident that despite the use of advanced surgical methods and the availability and utilisation of antimicrobial agents, surgical site infections (SSIs) remain prevalent among patients undergoing surgical procedures. Bacterial resistance poses a significant risk to the treatment of illnesses and is prevalent among widely accessible and frequently used antimicrobials.

INTRODUCTION

The skin, which is the biggest organ in the human body, performs vital functions in maintaining life, such as regulating water, controlling body temperature, and serving as the primary barrier against external factors like microorganisms.[1] The subcutaneous tissue becomes exposed when the skin is damaged, creating a wet, warm, and nutrient-rich environment that promotes the growth and spread of microorganisms.[2] Wound injuries are prevalent and severe forms of trauma that pose a significant public health issue. Various variables such as age, gender, diabetes, stress, diet, and oxygenation might potentially contribute to the intricate process of wound healing, leading to delays in the healing process. Wound infections mostly occur as a result of the rapid growth of microorganisms that invade the wound site after skin injury. Localised inflammation leads to the development of pus, which is composed of white blood cells, injured cells, and dead tissue.[3,4] Various factors, including age, malnutrition, obesity, endocrine or metabolic problems, microbial load, and host defence systems, have an impact on the occurrence of wound infection. The prevalence of wound sepsis in India in 2015 ranged from 10% to 33%.[5,6] In addition to trauma, additional factors that may lead to wound infections include SSI and diabetic ulcers. The occurrence of SSI is a serious issue in hospitals, as it leads to longer hospital stays, higher treatment expenses, and in some circumstances, results in severe illness and death.[7] Wound infections usually include many types of microorganisms, including bacteria, fungi, parasites, and viruses, which may thrive in both oxygen-rich and oxygen-poor environments.

The primary pathogens responsible for the infection are Staphylococcus aureus, which accounts for 20-40% of cases, followed by methicillin-resistant S. aureus. Pseudomonas aeruginosa is also a prominent causative agent, accounting for 5-15% of cases. Other pathogens that may cause the infection include Escherichia coli, Enterococcus species, Proteus species, and Klebsiella species.[8,9] The choice of antibiotics should be based on the specific causative agent, the underlying pathophysiology, as well as the drug's pharmacokinetics and pharmacodynamics. The rising problem of increased antibiotic resistance has heightened the amount of complexity with regard to appropriate treatment procedures, particularly for Gram negative organisms.[10,11] In light of the current issue of antibiotic resistance, it is crucial to follow a procedure that involves testing and analysing microorganisms via culture and sensitivity assessment at the early stage. This is essential in order to provide the correct medication and avoid any potential consequences. The resistance patterns of bacteria linked with SSI differ worldwide, influenced by factors such as geographical location, local epidemiological data, and the methods used for susceptibility testing. Bacterial resistances provide a formidable challenge and complicate the management of SSI. The majority of data on medication resistance were acquired from countries with high income.[10] Nevertheless, there were just a few publications available about the frequency and occurrence of antibiotic-resistant bacteria causing SSI, particularly in poor nations.[7]In recent years, there has been a significant rise in the incidence of SSI cases, as reported by hospitals. It has been noted that a substantial proportion of these cases, which were classified as severe, were attributed to gram-negative organisms. In addition, the excessive and indiscriminate use of potent antibiotics and the development of resistance to antimicrobial agents have further hastened this situation.[12] In nations such as India, which have underdeveloped healthcare infrastructure, insufficient infection control measures, congested hospital wards, and a tendency to misuse antimicrobial drugs, the issue of surgical site infections (SSIs) becomes even more complex. The objective of this research is to determine the bacterial cause of surgical site infections and their antibiotic susceptibility in order to select effective drugs for empirical therapy.

MATERIALS AND METHODS

Among the 470 samples analysed, 220 samples were positive for culture (46.81%) (Table 1). Out of the 220 samples that tested positive, 119 of them were males, which accounts for 54.09% of the total (Table 1). The table 2 displays the distribution of gender by age, indicating that the highest number of culture positive samples were found in the age group of 20-30 years (31.82%), followed by the age group of 30-40 years (16.36%), and then the age group of 40-50 years (15%). S.aureus was the most prevalent pathogen, accounting for 27.27% of the 220 culture positive samples. Escherichia coli followed closely behind at 21.82%, while Citrobacter spp. and Pseudomonas aeruginosa accounted for 13.64% and 10% of the samples, respectively (Table 3). Among gramme negative bacilli, E.coli exhibited the highest susceptibility to Imipenem (87.5%), followed by Amikacin (77.08%) and Piperacillin Tazobactam (72.62%). For Citrobacter spp., Imipenem (73.33%) was the most effective drug, followed by Gentamicin (43.33%) and Ciprofloxacin (40%). Similarly, for Klebsiella spp., Imipenem (75%) was the most preferred drug, followed by Gentamicin (50%) and Amikacin (50%). Regarding Pseudomonas aeruginosa, the most effective medicine was Imipenem with a sensitivity rate of 68.18%, followed by Piperacillin Tazobactam with a sensitivity rate of 59.09%, and Gentamicin with a sensitivity rate of 54.55%. As for Enterobacter spp., the most effective drug was Imipenem with a sensitivity rate of 78.57%, followed by Amikacin with a sensitivity rate of 57.14%, and Piperacillin Tazobactam with a sensitivity rate of 50%. These findings are summarised in Table 4. Within the group of gramme positive organisms, S.aureus had the highest level of susceptibility to Linezolid (96.67%), followed by Vancomycin (91.67%) and Amikacin (85%). Conversely, CONS shown sensitivity to Linezolid (93.75%), followed by Vancomycin (87.5%) and Gentamicin (81.25%) (Table 5).

RESULTS

A grand total of 110 wound swabs were obtained from the post-operative patients who were hospitalised in the surgery department. Out of the total, 100 specimens (90.91%) showed growth, whereas 10 samples (9.09%) were sterile. Pseudomonas aeruginosa was found in 22.73% of the samples, followed by Escherichia coli in 20%, Klebsiella pneumonia in 18.18%, Staphylococcus aureus in 16.36%, Proteus mirabilis in 4.55%, and Acinetobacter baumannii in 3.64%. A co-infection was identified in 5.45% of the samples. (Table 1)

Pseudomonas aeruginosa was found to be present in the largest number of infected wound swabs, accounting for 25 cases (22.73%). Additionally, a somewhat greater proportion of male patients (61.53%) tested positive for this bacterium. (Table 2). The results were found to be highly significant (p-value=0.01). The patients in which higher number of P. aeruginosa isolates were detected belonged to 60-80 years of age group (48 %). (Table 3)

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However, the results were not found to be significant (p value=1.74). The abscess drainage was the most common type of post-operative wound (44%) followed by surgery of diabetic foot (28%) and Cesarean section (12%). (Table 4)

The results were not found to be significant (p value= 0.88). P. aeruginosa revealed maximum susceptibility to colistin (92%) followed by meropenem (76%) and imipenem (72%). (Table 5)

Table 1: Gender wise distribution of Culture positive Patients

Gender	Number	percentage
Male	119	54.09
Female	101	45.91

Table 2: Age wise Distribution of Culture Positive Patients

Age in year	Number	percentage
Below 20	33	15
20-30	70	31.82
30-40	36	16.36
40-50	33	15
50-60	22	10
Above 60	26	11.82

Table 3: Distribution of Organisms Causing Surgical Site Infection

Organism	Number	Percentage
Staphylococcus aureus	60	27.27
Escherichia coli	48	21.82
Citrobacter spp.	30	13.64
Pseudomonas aeruginosa	22	10
Klebsiella spp.	20	9.09
CONS	16	7.27
Enterobacter spp.	14	6.36
Acinetobacter spp.	5	2.27
Proteus spp.	5	2.27
Total	220	100

Table 4: In-Vitro Antibiotic Sensitivity in Isolated Gram Negative Bacteria

Drugs	Escherichia coli (%)(n=48)	Citrobacter spp. (%) (n=30)	Klebsiella spp. (%) (n=20)	Pseudomonas aeruginosa (%) (n=22)	Enterobacter spp. (%) (n=14)
	S	S	S	S	S
Gentamicin	32 (66.67)	13(43.33)	10 (50)	12 (54.55)	5(35.71)
Ciprofloxacin	13. (27.08)	12 (40)	7(35)	11 (50)	6(42.86)
Piperacillin/ Tazobactam	35 (72.62)	10 (33.33)	6 (30)	13 (59.09)	7 (50)
Amikacin	37 (77.08)	12 (40)	10 (50)	12 (54.55)	8(57.14)
Ampicillin/ Sulbactam	16 (33.33)	7(23.33)	5 (25)	6 (27.27)	3 (21.43)
Impinem	42 (87.5)	22 (73.33)	15 (75)	15 (68.18)	11 (78.57)
Ceftriaxone	12 (25)	8 (26.67)	4 (20)	9 (40.91)	3 (21.43)

Table 5: In-Vitro Antibiotic Sensitivity in Isolated Gram Positive Bacteria

Drugs	Staphylococcus aureus =60		CONS =16	
	Number	Percentage	Number	Percentage
Azithromycin	37	61.67	9	56.25
Vancomycin	55	91.67	14	87.5
Linezolid	58	96.67	15	93.75
Gentamicin	48	80	13	81.25
Ofloxacin	49	81.67	11	68.75
Cefoxitin	40	66.67	9	56.25
Amikacin	51	85	11	68.75

DISCUSSION

Although significant progress has been achieved in asepsis, antimicrobial medicines, sterilisation, and operating methods, SSI remains a significant issue across all surgical specialties in hospitals. These infections contribute to the rising expenses, illness, and death rates associated with surgical procedures. The occurrence of a wound infection during any specific surgical procedure results in a hospitalisation cost that is around twice as high as the cost without an infection. SSI not only increase hospitalisation expenses but also contribute to the development of antibiotic resistance in patients, which may then propagate to other persons in the community, hence impacting primary healthcare as well.[15,16] Managing infection, whether caused by a single microorganism (mono) or many microorganisms (polymicrobial), is a crucial component of wound care. Gaining knowledge about the microbial nature is a crucial component of an effective therapeutic plan. Antibiotic agents are a remarkable breakthrough of the 20th century. Hence, this research aimed to evaluate the bacteriological profile and antibiotic sensitivity patterns of individuals with wound infections.[17] The current investigation found that the rate of SSI with positive culture results was 46.81%. Several studies conducted in India have shown a range of SSI ranging from 6.1% to 38.7%.[18-20] The primary cause may stem from a lack of focus on infection control protocols, inadequate adherence to proper hand hygiene, and overcrowding in healthcare facilities. Our research found that the incidence of infection was much greater among male patients, with 54.09% of them being affected. The findings were consistent with a research conducted by Vikrant Negi et al, which indicated that men (74.6%) were more often impacted than females (25.5%).[21] Contrary to our research, Gangania P et al. found that 20% of females have almost identical distribution to 19% of males.[22]

The study's results indicated that the highest number of culture positive samples were seen in the age range of 20-30 years, accounting for 31.82% of the total. This was followed by the age group of 30-40 years, which accounted for 16.36%, and then the age group of 40-50 years, which accounted for 15%. Pooja Singh Gangania's study revealed that the highest number of surgical site infections (SSI) occurred in patients aged 16-45 years, accounting for 24% of the cases. This phenomenon might be attributed to a substantial workload, heightened stress levels among individuals in this age bracket, and a limited patient population.[22] S.aureus was the most prevalent pathogen, accounting for 27.27% of the 220 culture positive samples. Escherichia coli followed with a prevalence of 21.82%, Citrobacter spp. with 13.64%, and Pseudomonas aeruginosa with 10%. This outcome aligns with findings from previous research. Lilani, and Mulu W. S. aureus infection is mostly linked to endogenous sources, since it is part of the skin and nasal microbial.[18,23] However, it may also be caused by contamination from the environment, surgical tools, or the hands of healthcare workers.[21] Among the gramme negative organisms analysed in this research, E.coli exhibited the highest sensitivity to Imipenem (87.5%), followed by Amikacin (77.08%) and Piperacillin Tazobactam (72.62%). The results align with the prior research done by M. Saleem et al, which similarly shown that E. coli had a significant susceptibility to Imipenem.[24] The research found that Citrobacter spp. showed the highest susceptibility to Imipenem (73.33%), followed by Gentamicin (43.33%) and Ciprofloxacin (40%). For Klebsiella spp., Imipenem (75%) was the most effective antibiotic, followed by Gentamicin (50%) and Amikacin (50%). The results align with the research done by Jyoti Sonawane et al, which also shown that Citrobacter and Klebsiella exhibited a significant susceptibility to Imipenem.[25] The predominant bacteria found was Pseudomonas aeruginosa. The most effective antibiotic was Imipenem, with a success rate of 68.18%, followed by Piperacillin Tazobactam at 59.09%. Gentamicin was also a viable option, with a success rate of 54.55%. Jyoti Sonawane et al. demonstrated comparable findings.[25]

Imipenem, Piperacillin/Tazobactam, Gentamicin, and Amikacin shown superior efficacy as antibiotics against gram-negative bacilli. M. Saleem et al. concluded that Amikacin, Imipenem, and Piperacillin/Tazobactam were more effective antibiotics against gram-negative bacilli, as shown in their study.[24] S.aureus, a gramme positive bacterium, had the highest susceptibility to Linezolid (96.67%), followed by Vancomycin (91.67%) and Amikacin (85%). This finding is similar with the research conducted by Prem Prakash Singh et al. in 2015, which also revealed that S. aureus showed 100% sensitivity to Vancomycin and Linezolid.[26] Linezolid and Vancomycin shown superior efficacy as antibiotics against gramme positive cocci. These results align with the research done by Vikrant Negi et al., 2015, which also concluded that Vancomycin and Linezolid are more effective antibiotics against gramme positive cocci.[21] The absence of microbiology laboratory facilities limits throughout the research period prevented the inclusion of anaerobic microorganisms.

CONCLUSION

It is evident that despite the use of advanced surgical methods and the availability and utilisation of antimicrobial agents, surgical site infections (SSIs) remain prevalent among patients undergoing surgical procedures. Bacterial resistance poses a significant risk to the treatment of illnesses and is prevalent among widely accessible and frequently used antimicrobials.

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