Original Article

Common Organisms in Surgical Ward and Their Sensitivity: A Cross Sectional Study in a Tertiary Care Hospital, Bogura, Bangladesh.

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Abstract

Background: Surgical site infections (SSIs) are a significant concern in healthcare, contributing to increased morbidity, prolonged hospital stays, and higher healthcare costs. The prevalence of antibiotic-resistant pathogens further complicates the management of SSIs. This study aims to investigate the distribution of pathogens and their antibiotic resistance patterns in a surgical ward and find out the appropriate antibiotic for treatment in Bangladesh.

Materials and Methods: This cross-sectional study was conducted at the Department of Surgery, Bogura, Bangladesh from 01.01.2023 to 31.12.2023. The study included a total of 102 patients who had undergone surgical procedures and had given informed consent for participation in the study. Specimens for culture and sensitivity tests were collected from patients presenting with signs of surgical site infections (SSIs). These specimens included pus, wound swabs, and urine samples, which were then analyzed to identify the bacterial pathogens and their antibiotic resistance profiles.

Results: The study population consisted of 102 individuals, with 36.27% aged 50 years and above, and a mean age of 40.41 years (SD ± 18.4). Gender distribution was relatively balanced, with 55.88% males and 44.12% females. Most specimens for culture and sensitivity tests were pus samples (65.69%), followed by wound swabs (31.37%) and urine samples (2.94%). Staphylococcus aureus was the most frequently isolated organism (28.43%), followed by Klebsiella spp. (23.53%), Pseudomonas spp. (21.57%), and Escherichia coli (11.76%). All specimens exhibited profuse bacterial growth. Notably, high antibiotic resistance rates were observed: Linezolid (70.59%), Ceftazidime (60.78%), Ceftriaxone (57.84%), Amoxiclave (58.82%), Ciprofloxacin (55.88%), Levofloxacin (48.04%), Vancomycin (44.12%), Colistin (45.10%), and Co-Trimoxazole (56.86%). Lower resistance rates were found for Meropenem (18.63%), Tigecycline (31.37%), Moxifloxacin (1.96%), and Nitrofurantoin (4.90%).

Conclusion: The study highlights a high prevalence of SSIs and significant antibiotic resistance among common pathogens in the surgical ward. These findings underscore the urgent need for robust antibiotic stewardship and stringent infection control measures to combat the spread of resistant bacteria and improve patient outcomes. Public education on the rational use of antibiotics and adherence to medical advice is also essential to mitigate the issue of antibiotic resistance.

Keywords: Surgical Site Infections, Antibiotic Resistance, Infection Control

Introduction

Surgical site infections (SSIs) are a major concern globally, contributing significantly to patient morbidity, extended hospital stays, and increased healthcare costs. The importance of effective infection control measures in surgical wards cannot be overstated, as they play a crucial role in improving patient outcomes and reducing mortality rates. Globally, the incidence of SSIs varies, with a systematic review and meta-analysis estimating a pooled 30-day cumulative incidence of 11% among general surgical patients.[1] Another study found a global pooled incidence of SSIs to be 2.5%, with the highest rates observed in the African region.[2] These statistics underscore the need for stringent infection control practices across healthcare settings worldwide. Infection control practices in surgical wards are critical in minimizing the risk of SSIs. Effective infection control not only reduces the incidence of these infections but also mitigates the burden on healthcare systems. A study conducted by Loveday et al. highlighted significant improvements in infection control practices in Bangladeshi government health facilities, though persistent shortages in infrastructure and equipment remain a challenge.[3] Similarly, a survey by Alam et al. revealed inadequate facilities and poor adherence to infection control protocols in both academic and private hospitals in Dhaka, Bangladesh.[4] These findings highlight the need for continuous improvement in infection control measures to ensure patient safety. The healthcare infrastructure in Bangladesh faces numerous challenges, particularly in surgical wards. A study by LeBrun et al. assessed surgical and anesthesia infrastructure in Bangladesh, revealing significant shortages in clinical human resources and physical infrastructure.[5] Rimi et al. described the physical structure and environmental contamination in selected hospital wards, highlighting infrastructure deficiencies conducive to the spread of infection.[6] These infrastructural challenges, coupled with inadequate infection control practices, contribute to the high prevalence of SSIs in Bangladeshi hospitals. Antibiotic resistance further complicates the management of SSIs, leading to prolonged hospital stays and increased healthcare costs. Globally, antibiotic resistance is a critical health issue, driven by the overuse and misuse of antibiotics in healthcare settings. In the study of Sipahi, he discussed the economic burden of antibiotic resistance, highlighting increased morbidity, longer hospital stays, and higher costs associated with resistant infections.[7] Nwobodo et al. summarized the adverse effects of antibiotic resistance on clinical and therapeutic outcomes, including treatment failures and increased healthcare costs.[8] These studies underscore the urgent need for effective antibiotic stewardship programs to combat resistance. In Bangladesh, antibiotic resistance among surgical pathogens is a significant concern. Islam et al. identified common pathogens in the surgical wards of Dhaka Medical College Hospital and their resistance patterns, including high resistance to commonly used antibiotics.[9] Amin & Nahar conducted a cross-sectional study investigating the prevalence and risk factors of hospital-acquired infections in a Bangladeshi military hospital, identifying Escherichia coli as the most common pathogen.[10] These findings highlight the critical need for targeted interventions to manage antibiotic resistance in Bangladeshi healthcare settings. Globally, the most common pathogens found in surgical wards include Staphylococcus aureus, Escherichia coli, and Klebsiella spp. A systematic review and meta-analysis by Gillespie et al.[1] identified these pathogens as significant contributors to SSIs.[1] Similarly, a study by Curcio et al. estimated the overall prevalence of SSIs in elective clean and clean-contaminated surgeries in developing countries to be 6%, with higher rates observed in regions with inadequate infection control measures.[11] These pathogens pose a significant challenge to infection control efforts and require continuous monitoring and targeted interventions. The burden of SSIs in Bangladesh mirrors global trends, with a significant prevalence observed in various healthcare settings. Afroz et al. reported a prevalence of SSIs of 9.8% in a tertiary care hospital in Bangladesh, underscoring the need for effective infection control measures.[12] Regional studies, such as those conducted by Awoke et al.[13] in Ethiopia, provide comparative data that can inform infection control practices in similar settings.[13] These studies highlight the importance of regional and global collaborations in addressing the challenge of SSIs. In conclusion, SSIs remain a significant healthcare challenge globally and in Bangladesh. Effective infection control measures, robust healthcare infrastructure, and targeted antibiotic stewardship programs are essential to reducing the incidence of SSIs and managing antibiotic resistance. Continuous monitoring, research, and implementation of best practices are crucial to improving patient outcomes and ensuring healthcare safety.

Materials and Methods

This cross-sectional study was conducted at the Department of Surgery, Bogura, Bangladesh from January 2023 to December 2023. The study aimed to investigate the distribution of pathogens and their antibiotic resistance patterns in the surgical ward. The inclusion criteria included patients who had undergone surgical procedures and had given informed consent to participate in the study. Exclusion criteria were mentally ill patients, those unable to provide informed consent, and those with other chronic diseases. Specimens for culture and sensitivity tests were collected from patients presenting with signs of surgical site infections (SSIs). These specimens included pus, wound swabs, and urine samples, which were then analyzed to identify the bacterial pathogens and their antibiotic resistance profiles. Standard microbiological techniques were employed to isolate and identify the organisms, and antibiotic susceptibility testing was performed using the disc diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines. The data collected included patient demographics, type of specimen, isolated organisms, and their antibiotic resistance patterns. The results were statistically analyzed using SPSS version 26 to determine the prevalence of different pathogens and the resistance rates to various antibiotics, providing insights into the current state of antibiotic resistance in the surgical ward.

Results

Table I: Distribution of study population based on baseline characteristics (N=102)

Basic Characteristics	N (percentage)
Age	
<20	15 (14.71)
20-29	14 (13.73)
30-39	18 (17.65)
40-49	18 (17.65)
≥50	37 (36.27)
Mean±SD age	40.41±18.4
Gender	
Male	57 (55.88)
Female	45 (44.12)

The age distribution revealed that the largest group of participants was aged 50 years and above, accounting for 36.27% of the population. Participants aged 30-39 and 40-49 each represented 17.65% of the study population. Those aged 20-29 made up 13.73%, while the smallest group, aged less than 20 years, constituted 14.71% of the participants. The mean age of the study population was 40.41 years, with a standard deviation of 18.4 years, indicating a relatively broad age range among participants. In terms of gender distribution, males were slightly more prevalent than females. There were 57 males, making up 55.88% of the population, while females accounted for 44.12% with a total of 45 participants. This gender distribution reflects a relatively balanced representation of both sexes in the study (Table I).

Table II: Distribution of study population specimen sent for culture and sensitivity test (N=102)

Specimen Test	N (percentage)
Specimen	
Pus for C/S	67 (65.69)
Urine for C/S	3 (2.94)
Wound Swab	32 (31.37)
Organism	
Acinetobacter spp.	8 (7.84)
Enterococcus	1 (0.98)
Enterococcus spp.	1(0.98)
Escherichia	3 (2.94)
Escherichia Coli	12 (11.76)
Klebsiella spp	24 (23.53)
Proteus	3 (2.94)
Pseudomonas spp.	22 (21.57)
Staphylococcus aureus	29 (28.43)
Type of Growth	
Profuse	102 (100.00%)

A total of 102 specimens were analyzed, with the majority being pus samples, which accounted for 65.69% of the specimens. Wound swabs constituted 31.37% of the specimens, while urine samples were the least common, making up only 2.94%. Regarding the organisms isolated from these specimens, Staphylococcus aureus was the most frequently identified, found in 28.43% of the cases. Klebsiella spp. was the second most common organism, present in 23.53% of the samples. Pseudomonas spp. and

Escherichia coli were also prevalent, identified in 21.57% and 11.76% of the specimens, respectively. Acinetobacter spp. was found in 7.84% of the samples. Other organisms, such as Enterococcus, Enterococcus spp., and Proteus, were less frequently encountered, each accounting for less than 3% of the total. All specimens exhibited profuse growth of organisms, indicating a high degree of bacterial presence in the samples (Table II).

Table III: Distribution of study population based on antibiotic resistance (N=102)

Name of the Antibiotics	N (percentage)
Amoxiclave	60 (58.82)
Piperacillin + Tazobactam	28 (27.45)
Flucoxacilin	46 (45.10)
Cefuroxime	71 (69.61)
Ceftriaxone	59 (57.84)
Ceftazidime	62 (60.78)
Cefepime	45 (44.12)
Ciprofloxacin	57 (55.88)
Levofloxacin	49 (48.04)
Clarithromycin	42 (41.18)
Amikacin	22 (21.57)
Gentamicin	28 (27.45)
Vancomycin	45 (44.12)
Aztreonam	49 (48.04%)
Colistin	46 (45.10%)
Co-Trimoxazole	58 (56.86%)
Mereopenem	19 (18.63%)
Linezolid	72 (70.59%)
Tigecycline	32 (31.37%)
Moxifloxacin	2 (1.96%)
Nitrofurantoin	5 (4.90%)

Cefuroxime exhibited the highest resistance, with 69.61% of the organisms showing resistance to this antibiotic. Linezolid followed closely, with 70.59% resistance. Other cephalosporins also demonstrated high resistance levels, including Ceftazidime (60.78%), Ceftriaxone (57.84%), and Cefepime (44.12%). Amoxiclave showed resistance in 58.82% of cases, indicating a substantial degree of ineffectiveness. Resistance to fluoroquinolones was also notable, with Ciprofloxacin and Levofloxacin exhibiting resistance rates of 55.88% and 48.04%, respectively. Similarly, high resistance rates were observed for Piperacillin + Tazobactam (27.45%), Flucoxacillin (45.10%), and Clarithromycin (41.18%). Aminoglycosides such as Amikacin and Gentamicin had relatively lower resistance rates at 21.57% and 27.45%, respectively. Vancomycin and Colistin, often used as last-resort antibiotics, also showed significant resistance levels at 44.12% and 45.10%, respectively. Resistance to Co-Trimoxazole was observed in 56.86% of the cases, while Aztreonam showed a resistance rate of 48.04%. Meropenem and Tigecycline, antibiotics typically reserved for severe infections, exhibited resistance rates of 18.63% and 31.37%, respectively. Moxifloxacin and Nitrofurantoin had the lowest resistance rates among the tested antibiotics, at 1.96% and 4.90%, respectively (Table III**).**

Discussion

The current study highlights significant findings regarding the distribution of surgical infections, the prevalence of common pathogens, and the patterns of antibiotic resistance in a Bangladeshi surgical ward. Our findings are consistent with global and regional data, emphasizing the critical need for effective infection control and antibiotic stewardship strategies. Antibiotic resistance is the ability of bacteria to withstand the effects of an antibiotic that would normally kill them or stop their growth. This phenomenon occurs due to several mechanisms, such as genetic mutations, horizontal gene transfer, and selective pressure from antibiotic use. When bacteria are exposed to antibiotics, susceptible bacteria are killed, but resistant ones survive and multiply. This selective process leads to the predominance of resistant strains, making infections harder to treat.[14] The age distribution of the study population, with 36.27% aged 50 years and above and a mean age of 40.41 years, aligns with previous research indicating higher susceptibility to surgical infections among older adults due to comorbidities and weakened immune responses.[15, 16] Similarly, the relatively balanced gender distribution (55.88% male and 44.12% female) reflects findings from other studies that suggest no significant gender disparity in surgical infection rates.[17] Our study found that the majority of specimens sent for culture and sensitivity tests were pus samples (65.69%), followed by wound swabs (31.37%) and urine samples (2.94%). This distribution is comparable to other studies where wound swabs and pus samples are commonly used to diagnose surgical site infections.[18] The high prevalence of Staphylococcus aureus (28.43%) as the most frequently isolated organism is consistent with global and regional data, underscoring its dominant role in surgical infections.[19, 20] Klebsiella spp. (23.53%) and Pseudomonas spp. (21.57%) were also prevalent, corroborating findings from studies in similar settings that highlight these pathogens as significant contributors to surgical site infections. [20, 21] Escherichia coli was found in 11.76% of the specimens, indicating its substantial presence among the bacterial isolates, which aligns with the results of other studies reporting E. coli as a common pathogen in surgical infections.[9] The observation that all specimens exhibited profuse bacterial growth further emphasizes the severity and high bacterial load in surgical site infections, necessitating rigorous infection control measures. Antibiotic resistance patterns observed in this study reveal alarming resistance rates to several commonly used antibiotics. Linezolid resistance was notably high at 70.59%, which is concerning given its role as a critical antibiotic for treating resistant gram-positive infections. This high resistance rate is higher than the global averages reported in previous studies but highlights the increasing prevalence of resistance in our setting.[14] Similarly, high resistance rates were observed for Ceftazidime (60.78%), Ceftriaxone (57.84%), and Amoxiclave (58.82%), which are consistent with global trends indicating rising resistance to these antibiotics.[22, 24] The adverse impacts of antibiotic resistance on health are profound. It leads to longer hospital stays, higher medical costs, increased mortality, and limited treatment options for patients. When infections are resistant to first-line antibiotics, treatment becomes more complex, often requiring the use of more expensive or toxic alternatives. The mortality rate for resistant infections is significantly higher compared to non-resistant infections, reflecting the urgent need for effective measures to combat this issue.[25, 26] Resistance to fluoroquinolones, including Ciprofloxacin (55.88%) and Levofloxacin (48.04%), reflects similar findings in other studies, where these antibiotics show diminished efficacy against surgical pathogens.[27] The resistance rates for Vancomycin (44.12%) and Colistin (45.10%), both considered last-resort antibiotics, are particularly troubling and highlight the urgent need for effective antibiotic stewardship programs.[18] Co-Trimoxazole exhibited a resistance rate of 56.86%, indicating widespread resistance to this commonly used antibiotic, which is consistent with the findings of Begum et al.[19] The irrational use of antibiotics significantly contributes to the problem of antibiotic resistance. Factors such as self-medication, incomplete antibiotic courses, and the use of antibiotics without a doctor's prescription exacerbate this issue. When antibiotics are used inappropriately, it provides more opportunities for bacteria to develop and propagate resistance. This misuse is prevalent in many regions, including Bangladesh, where access to antibiotics without a prescription is common, and patients often do not complete their prescribed antibiotic courses. Meropenem and Tigecycline, typically reserved for severe infections, showed resistance rates of 18.63% and 31.37%, respectively. These rates, while lower than those for other antibiotics, still pose significant challenges for treating multidrug-resistant infections. The lowest resistance rates were observed for Moxifloxacin (1.96%) and Nitrofurantoin (4.90%), suggesting their potential effectiveness against some infections. These findings underscore the critical need for ongoing surveillance and tailored antibiotic policies to manage resistance effectively. In summary, our study's findings are in line with global and regional data, highlighting the critical issues of high antibiotic resistance and the prevalence of common pathogens in surgical site infections. Antibiotic resistance occurs through mechanisms such as genetic mutations and selective pressure from antibiotic use, leading to significant adverse health impacts, including longer hospital stays, higher costs, and increased mortality. The irrational use of antibiotics, including self-medication and incomplete courses, exacerbates this problem. The high resistance rates observed necessitate the implementation of robust infection control measures and antibiotic stewardship programs to mitigate the spread of resistant bacteria and improve patient outcomes. Further research and continuous monitoring are essential to adapt and optimize treatment strategies in response to evolving resistance patterns.

Conclusion

The current study reveals a high prevalence of surgical site infections in a Bangladeshi surgical ward, with significant antibiotic resistance observed among common pathogens. The findings underscore the critical issue of antibiotic resistance, which is exacerbated by factors such as the irrational use of antibiotics, including self-medication and incomplete courses. The study highlights the dominance of pathogens such as Staphylococcus aureus, Klebsiella spp., Pseudomonas spp., and Escherichia coli in surgical infections, all exhibiting concerning resistance patterns. The high resistance rates to key antibiotics, including Linezolid, Ceftazidime, and Vancomycin, emphasize the urgent need for effective antibiotic stewardship and robust infection control measures. These results align with global and regional data, reflecting the broader challenge of managing antibiotic resistance and ensuring patient safety in healthcare settings.

Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

Recommendation

To address the critical issue of antibiotic resistance and improve patient outcomes, several measures are recommended. First, there is an urgent need for the implementation of robust antibiotic stewardship programs to ensure the rational use of antibiotics. Healthcare providers should be trained on the importance of prescribing antibiotics only when necessary and ensuring that patients complete their prescribed courses. Public awareness campaigns should be launched to educate the community about the dangers of self-medication and the importance of adhering to medical advice. Additionally, infection control practices should be strengthened, including regular monitoring and surveillance of infection rates and resistance patterns. Investment in healthcare infrastructure is essential to support these efforts, ensuring that facilities are adequately equipped to prevent and manage infections. Finally, continuous research and monitoring are crucial to adapt treatment strategies in response to evolving resistance patterns, ensuring that healthcare practices remain effective in combating surgical site infections and antibiotic resistance.

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