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A STUDY OF CLINICAL AND MICROBIOLOGICAL ASSESSMENT OF POST SURGICAL WOUND INFECTION OF PATIENTS ADMITTED IN TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Infection of a wound may be defined as invasion of organisms through tissues following a breakdown of local and systemic host defenses. A major wound infection is seen when a wound discharges pus and it may need a secondary procedure to be sure of an adequate drainage; there may be systemic signs or a delay in returning home. **Aims:** Assessment of microbiological and clinical profile of post-operative wound in postoperative patient of NRSMCH.
Materials and Methods: The present study was a longitudinal observational study. This Study was conducted 18 months at Nil RatanSircar Medical College and Hospital (NRSMCH), Kolkata. Total 152 patients were included in this study.
Result: The analysis of serous discharge in post-surgical patients shows that 43.4% (66 cases) experienced serous discharge, while 56.6% (86 cases) had no such complication. The value of z is 2.2942. The value of p is .02202. The result is significant at $p < .05$.
Conclusion: We substantial frequency of post-surgical wound infections among patients admitted to a tertiary care hospital is highlighted by this study's findings. The results show that Pseudomonas aeruginosa and Staphylococcus aureus are the most frequent bacteria that cause these infections.
Keywords: Infection, Diabetes mellitus, Hyperglycemia and Antimicrobial effects.

INTRODUCTION

Wound infection is defined as the invasion of microorganisms into tissues following disruption of local and systemic host defenses. It is one of the most common and troublesome complications affecting wound healing. A major wound infection is characterized by purulent discharge, requirement of secondary intervention for adequate drainage, systemic manifestations, or delayed recovery, whereas minor infections may present with pus or serous discharge without significant discomfort or systemic signs.[1] Surgical site infections (SSIs) continue to remain a major postoperative concern despite advances in surgical techniques, antimicrobial therapy, and perioperative care. Early hospital discharge and increasing outpatient procedures have made surveillance and detection of SSIs more challenging.[2]A study by Dr. K. Sreedhar Rao et al. on postoperative wound infections following laparotomies reported an incidence of 22.2%, with Methicillin-resistant Staphylococcus aureus (MRSA) being the most frequently isolated organism (25%), followed by Escherichia coli (23%) and Klebsiella species (18%). Diabetes mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia resulting from impaired insulin secretion, insulin action, or both.[4]The global prevalence of diabetes is increasing rapidly, with approximately 425 million individuals affected worldwide and projections

suggesting further rise in the coming decades.[3]Chronic hyperglycemia in diabetic patients contributes to long-term tissue damage, impaired immune function, and increased susceptibility to infections. Diabetes is also associated with a higher prevalence and severity of periodontal disease compared with non-diabetic individuals.[5] The degree of metabolic control plays an important role in periodontal health, as poor glycemic control is linked with increased periodontal destruction and reduced treatment response.[6] Studies suggest that periodontal therapy outcomes are influenced by diabetes status. Kaur et al,[7] observed that patients with well-controlled diabetes showed periodontal treatment responses comparable to healthy individuals, whereas poor metabolic control was associated with less favorable outcomes. Hyperglycemia may alter gingival crevicular fluid composition, providing favorable conditions for the growth of pathogenic subgingival microorganisms. Additionally, impaired immune responses in diabetic patients may promote bacterial overgrowth and periodontal tissue damage. However, evidence regarding the influence of type 2 diabetes mellitus on periodontal microbiota remains inconsistent. Some studies have demonstrated differences in bacterial composition between diabetic and non-diabetic individuals, while others have reported similar microbial profiles. Traditional culture-based methods have been considered the gold standard for detection and quantification of microbial pathogens in clinical samples and have been widely used in periodontal research.[9]These methods are reproducible and useful for evaluating changes in bacterial counts after periodontal treatment.[10]However, culture techniques have limitations, including the requirement of specialized equipment, technical expertise, and difficulty in cultivating anaerobic bacteria. As a result, microorganisms that cannot grow under laboratory conditions may remain undetected. Molecular diagnostic techniques, particularly quantitative polymerase chain reaction (qPCR), have emerged as sensitive and rapid methods for detecting and quantifying bacterial species. qPCR allows simultaneous identification of multiple microorganisms with high sensitivity and specificity. However, a major limitation of qPCR is its inability to differentiate between viable and dead bacterial cells because DNA from dead microorganisms may persist and amplify for prolonged periods, potentially affecting results.[11] Several studies using qPCR have failed to demonstrate significant microbial changes after periodontal therapy despite clinical improvement, possibly due to this limitation.[12]PropidiumMonoazide (PMA)-based qPCR has been introduced as an improved molecular approach for microbial analysis. PMA is a DNA-binding dye that selectively penetrates damaged bacterial cells and prevents amplification of DNA from dead microorganisms. Therefore, PMA treatment before qPCR enables selective detection and quantification of viable bacterial populations, providing more accurate information regarding microbial changes associated with disease progression and treatment response.[13]

MATERIALS AND METHODS

Study design: Longitudinal observational study.
Place of study: Department of General Surgery, Nil RatanSircar Medical College and Hospital (NRSMCH), Kolkata.
Duration of study: 18-month period.
Study Population: Post-surgical patient admitted at In-patient Department of General Surgery, Nil RatanSircar Medical College and Hospital.
Sample size: 152 patients.
Inclusion Criteria

- Aged between 18 to 65 years.
- Patient with given consent.

Exclusion Criteria

- Patients in immunosupresants.
- Patients with comorbidities.

Study Variable

- Age, Gender, Residence, Socio-economic status, and Occupation
- Addiction history and associated Comorbidities
- Microbiological agents isolated from wound samples
- Antibiotic sensitivity pattern and response to treatment

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values $\leq$ 0.05 were considered statistically significant.

RESULTS

Table1: Association between Demographic Characteristics (Age Group, Mean Age, and Sex) and Growth Status among Study Participants

Variable	Category	Growth n (%)	No Growth n (%)	Total n (%)	p-value
Age Group (years)	≤30	2 (3.9%)	0 (0.0%)	2 (1.3%)	0.1803
	31–40	7 (13.7%)	7 (6.9%)	14 (9.2%)	
	41–50	10 (19.6%)	23 (22.8%)	33 (21.7%)	
	51–60	18 (35.3%)	43 (42.6%)	61 (40.1%)	
	61–70	14 (27.5%)	28 (27.7%)	42 (27.6%)	
	Total	**51 (100.0%)**	**101 (100.0%)**	**152 (100.0%)**	
	Mean ± SD	52.73 ± 9.92	55.34 ± 8.91	-	**0.1026**
Sex	Female	26 (51.0%)	66 (65.3%)	92 (60.5%)	0.087
	Male	25 (49.0%)	35 (34.7%)	60 (39.5%)	
	Total	**51 (100.0%)**	**101 (100.0%)**	**152 (100.0%)**	

Table 2: Association between Addiction and Microbiological Growth

Addiction	Growth n (%)	No Growth n (%)	Total n (%)	p-value
Alcohol	7 (13.7%)	4 (4.0%)	11 (7.2%)	0.0047
Betel	3 (5.9%)	2 (2.0%)	5 (3.3%)	
No	19 (37.3%)	59 (58.4%)	78 (51.3%)	
Paan	4 (7.8%)	10 (9.9%)	14 (9.2%)	
Smoking	10 (19.6%)	23 (22.8%)	33 (21.7%)	
Tobacco	8 (15.7%)	3 (3.0%)	11 (7.2%)	
Total	**51 (100.0%)**	**101 (100.0%)**	**152 (100.0%)**	

Table 3: Association between Comorbidities and Microbiological Growth

Comorbidities	Growth n (%)	No Growth n (%)	Total n (%)	p-value
CLD	3 (5.9%)	0 (0.0%)	3 (2.0%)	<0.0001
CLD, Hypertension	1 (2.0%)	0 (0.0%)	1 (0.7%)	
COPD	3 (5.9%)	11 (11.0%)	14 (9.3%)	
COPD, CLD	3 (5.9%)	0 (0.0%)	3 (2.0%)	
COPD, Hypertension	0 (0.0%)	3 (3.0%)	3 (2.0%)	
Diabetes	2 (3.9%)	11 (11.0%)	13 (8.6%)	
Diabetes, Hypertension	13 (25.5%)	0 (0.0%)	13 (8.6%)	
Hypertension	4 (7.8%)	30 (30.0%)	34 (22.5%)	
Hypertension, COPD	3 (5.9%)	5 (5.0%)	8 (5.3%)	
Hypertension, Diabetes	1 (2.0%)	0 (0.0%)	1 (0.7%)	
Hypertension, Diabetes	2 (3.9%)	0 (0.0%)	2 (1.3%)	
Hypertensive, COPD	0 (0.0%)	4 (4.0%)	4 (2.6%)	
Hypothyroidism	0 (0.0%)	4 (4.0%)	4 (2.6%)	
No	16 (31.4%)	32 (32.0%)	48 (31.8%)	
Total	**51 (100.0%)**	**100 (100.0%)**	**151 (100.0%)**	

Table 4: Association between Postoperative Wound Findings and Microbiological Growth

Variable	Category	Growth n (%)	No Growth n (%)	Total n (%)	p-value
Serous Discharge	Absent	1 (2.0%)	85 (84.2%)	86 (56.6%)	<0.0001
	Present	50 (98.0%)	16 (15.8%)	66 (43.4%)	
	Total	**51 (100.0%)**	**101 (100.0%)**	**152 (100.0%)**	
Erythema	Absent	33 (64.7%)	100 (99.0%)	133 (87.5%)	<0.0001
	Present	18 (35.3%)	1 (1.0%)	19 (12.5%)	
	Total	**51 (100.0%)**	**101 (100.0%)**	**152 (100.0%)**	
Purulent Discharge	Absent	21 (41.2%)	101 (100.0%)	122 (80.3%)	<0.0001
	Present	30 (58.8%)	0 (0.0%)	30 (19.7%)	
	Total	**51 (100.0%)**	**101 (100.0%)**	**152 (100.0%)**	
Wound Dehiscence	Absent	15 (29.4%)	101 (100.0%)	116 (76.3%)	<0.0001
	Present	36 (70.6%)	0 (0.0%)	36 (23.7%)	
	Total	**51 (100.0%)**	**101 (100.0%)**	**152 (100.0%)**	

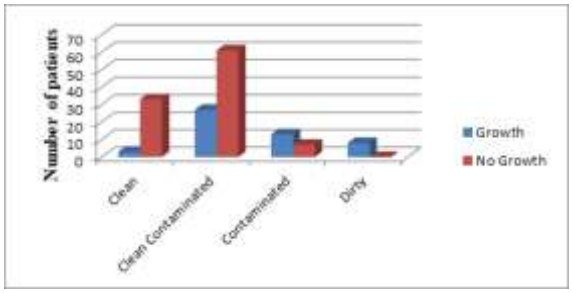

Figure 1: Association between Surgical Wound Classification and Microbiological Growth

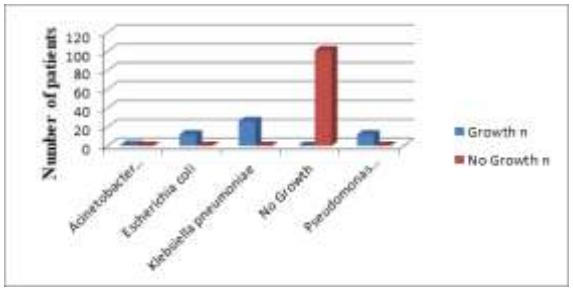

Figure 2: Distribution of Microbiological Agent and Microbiological Growth

The distribution of microbial growth across different age groups shows that younger patients (≤30 years) had a 100% growth rate (3.9% of total cases), whereas older age groups had a more variable distribution. The highest frequency of infection was observed in the 51-60 years group (35.3%), followed by the 61-70 years group (27.5%). Notably, as age increases, the proportion of patients with no microbial growth remains consistently higher, with 70.5% of patients in the 51-60 years group and 66.7% in the 61-70 years group showing no bacterial growth. Association of Age in group with Microbiological was not statistically significant (p=0.1803). The mean age of patients with growth was 52.73 ± 9.92 years, while those with no growth had a slightly higher mean age of 55.34 ± 8.91 years. Although there is a numerical difference, the pvalue (0.1026) suggests that this difference is not statistically significant. The distribution of microbial growth by sex shows that females had a lower infection rate (28.3%) compared to males (41.7%). Among females, 65.3% of cases showed no microbial growth, indicating a lower susceptibility to infection, while in males, only 34.7% had no growth, suggesting a higher risk of infection. Despite the nearly equal proportion of infected cases (51.0% females vs. 49.0% males), the higher infection rate in males may indicate gender-related factors such as immune response, hygiene practices, or comorbidities influencing wound contamination. Association of Sex with Microbiological was not statistically significant (p=0.0870). [Table 1]

In our study, the association between addiction status and growth status was assessed. Alcohol addiction was observed in 7 (13.7%) patients in the growth group and 4 (4.0%) patients in the no growth group. Betel use was reported among 3 (5.9%) patients in the growth group and 2 (2.0%) patients in the no growth group. Patients with no addiction included 19 (37.3%) in the growth group and 59 (58.4%) in the no growth group. Paan use was present in 4 (7.8%) patients in the growth group and 10 (9.9%) patients in the no growth group. Smoking was reported in 10 (19.6%) patients in the growth group and 23 (22.8%) patients in the no growth group. Tobacco use was observed in 8 (15.7%) patients in the growth group and 3 (3.0%) patients in the no growth group. A statistically significant association was found between addiction status and growth status (p=0.0047). [Table 2]

In our study, the association between comorbidities and growth status was assessed. CLD was observed in 3 (5.9%) patients in the growth group. CLD with hypertension was present in 1 (2.0%) patient in the growth group. COPD was reported in 3 (5.9%) patients in the growth group and 11 (11.0%) patients in the no growth group. COPD with CLD was observed in 3 (5.9%) patients in the growth group. COPD with hypertension was present in 3 (3.0%) patients in the no growth group. Diabetes was observed in 2 (3.9%) patients in the growth group and 11 (11.0%) patients in the no growth group. Diabetes with hypertension was present in 13 (25.5%) patients in the growth group. Hypertension alone was observed in 4 (7.8%) patients in the growth group and 30 (30.0%) patients in the no growth group. Hypertension with COPD was present in 3 (5.9%) patients in the growth group and 5 (5.0%) patients in the no growth group. Hypertension with diabetes was observed in 1 (2.0%) patient and 2 (3.9%) patients in the growth group. Hypothyroidism was observed in 4 (4.0%) patients in the no growth group. Patients without any comorbidity included 16 (31.4%) in the growth group and 32 (32.0%) in the no growth group. A statistically significant association was found between comorbidities and growth status (p<0.0001). [Table 3]

In our study, a significant association was observed between clinical wound characteristics and growth status. Serous discharge was present in 50 (98.0%) patients in the growth group compared to 16 (15.8%) patients in the no growth group, while absence of serous discharge was noted in 1 (2.0%) patient in the growth group and 85 (84.2%) patients in the no growth group. This association was statistically significant (p<0.0001). Erythema was present in 18 (35.3%) patients in the growth group and 1 (1.0%) patient in the no growth group, whereas absence of erythema was observed in 33 (64.7%) patients in the growth group and 100 (99.0%) patients in the no growth group. The association was statistically significant (p<0.0001). Purulent discharge was present in 30 (58.8%) patients in the growth group, while absence of purulent discharge was observed in 21 (41.2%) patients in the growth group and 101 (100.0%) patients in the no growth group. A highly significant association was found between purulent discharge

and growth status (p<0.0001). Similarly, wound dehiscence was present in 36 (70.6%) patients in the growth group, whereas absence of wound dehiscence was noted in 15 (29.4%) patients in the growth group and 101 (100.0%) patients in the no growth group. This association was also statistically significant (p<0.0001). [Table 4]

In our study, the association between surgical wound classification and growth status was assessed. Clean wounds were observed in 3 (5.9%) patients in the growth group and 33 (32.7%) patients in the no growth group. Clean-contaminated wounds constituted the largest category, accounting for 27 (52.9%) patients in the growth group and 61 (60.4%) patients in the no growth group. Contaminated wounds were present in 13 (25.5%) patients in the growth group and 7 (6.9%) patients in the no growth group. Dirty wounds were observed in 8 (15.7%) patients in the growth group. A statistically significant association was found between surgical wound classification and growth status (p<0.0001). [Figure 1]

In our study, the association between microbiological agents and growth status was assessed. Klebsiellapneumoniae was the most commonly isolated organism, identified in 26 (51.0%) patients in the growth group. Escherichia coli and Pseudomonas aeruginosa were each isolated in 12 (23.5%) patients in the growth group. Acinetobacterbaumannii complex was identified in 1 (2.0%) patient in the growth group. In the no growth group, 101 (100.0%) patients demonstrated no microbial growth. A highly statistically significant association was observed between microbiological agent and growth status (p<0.0001). [Figure 2]

DISCUSSION

The age-wise distribution demonstrated that younger patients (≤30 years) had a 100% growth rate, accounting for 2 (3.9%) cases in the growth group, while no patient in this age category belonged to the no-growth group. The highest frequency of infection was observed among patients aged 51–60 years, comprising 18 (35.3%) patients in the growth group, followed by patients aged 61–70 years with 14 (27.5%) cases. In comparison, the no-growth group was dominated by patients aged 51–60 years [43 (42.6%)] and 61–70 years [28 (27.7%)]. The mean age of patients with microbial growth was 52.73 ± 9.92 years, whereas the mean age of patients without growth was 55.34 ± 8.91 years. Despite these numerical differences, the association between age and microbial growth was not statistically significant (p=0.1803), suggesting that age alone may not be a major determinant of postoperative wound infection in the present study population. Similar observations have been reported by Leaper and Edmiston et al,[14] and Allegranzi et al,[15]who noted that patient age alone is not consistently associated with surgical site infections when other risk factors are considered.Sex-wise analysis revealed that females constituted 26 (51.0%) of the growth group and 66 (65.3%) of the no-growth group, whereas males accounted for 25 (49.0%) and 35 (34.7%) cases, respectively. Although males appeared to have a relatively higher proportion of microbial growth compared with females, the association between sex and microbial growth was not statistically significant (p=0.087). This finding indicates that gender may not independently influence the occurrence of postoperative wound infection, which is in agreement with the observations of Leaper and Edmiston et al,[14] and Allegranzi et al.[15]

Addiction status demonstrated a statistically significant association with microbial growth (p=0.0047). Alcohol addiction was observed in 7 (13.7%) patients with growth compared to 4 (4.0%) patients without growth. Betel use was reported in 3 (5.9%) patients with growth and 2 (2.0%) patients without growth. Paan consumption was present in 4 (7.8%) patients with growth and 10 (9.9%) patients without growth. Smoking was observed in 10 (19.6%) patients with growth and 23 (22.8%) patients without growth. Tobacco use was substantially higher among patients with growth [8 (15.7%)] than among those without growth [3 (3.0%)]. Patients without any addiction constituted 19 (37.3%) of the growth group and 59 (58.4%) of the no-growth group. These findings suggest that addictive habits, particularly alcohol and tobacco consumption, may adversely affect wound healing and predispose patients to postoperative infections. Sørensen et al,[16] demonstrated that smoking significantly impairs wound healing and increases postoperative infection risk, while Hawn et al,[17] reported a higher incidence of surgical complications among smokers.

Comorbid conditions showed a highly significant association with microbial growth (p<0.0001). Chronic liver disease (CLD) was observed in 3 (5.9%) patients with microbial growth, while CLD with hypertension was present in 1 (2.0%) patient. COPD was reported in 3 (5.9%) patients with growth and 11 (11.0%) patients without growth. COPD with CLD was observed in 3 (5.9%) patients with growth. Diabetes was present in 2 (3.9%) patients with growth and 11 (11.0%) patients without growth. Diabetes with hypertension represented the largest comorbidity among patients with growth, accounting for 13 (25.5%) cases. Hypertension alone was observed in 4 (7.8%) patients with growth and 30 (30.0%) patients without growth. Hypertension with COPD was present in 3 (5.9%) patients with growth and 5 (5.0%) patients without growth. Hypertension with diabetes was observed in 1 (2.0%) and 2 (3.9%) patients with growth. Hypothyroidism was observed in 4 (4.0%) patients in the no-growth group. Patients without any comorbidity accounted for 16 (31.4%) cases in the growth group and 32 (32.0%) cases in

the no-growth group. These findings indicate that systemic illnesses, particularly combinations of diabetes and hypertension, may significantly increase susceptibility to postoperative wound infections. Similar findings were reported by Allegranziet al,[15]while Martin et al,[18] demonstrated that diabetes is an important independent risk factor for surgical site infections.

Clinical wound characteristics demonstrated a strong association with microbial growth. Serous discharge was present in 50 (98.0%) patients with microbial growth compared to only 16 (15.8%) patients without growth, whereas absence of serous discharge was observed in 1 (2.0%) patient with growth and 85 (84.2%) patients without growth ($p<0.0001$). Erythema was present in 18 (35.3%) patients with growth and 1 (1.0%) patient without growth, while absence of erythema was observed in 33 (64.7%) and 100 (99.0%) patients respectively ($p<0.0001$). Purulent discharge was present in 30 (58.8%) patients with microbial growth, whereas 21 (41.2%) patients with growth and all 101 (100.0%) patients without growth had no purulent discharge ($p<0.0001$). Wound dehiscence was observed in 36 (70.6%) patients with growth, while absence of wound dehiscence was recorded in 15 (29.4%) patients with growth and all 101 (100.0%) patients without growth ($p<0.0001$). These findings confirm that classical signs of wound infection are strongly associated with positive microbial cultures. Similar conclusions were drawn by Leaper and Edmiston et al,[14]and more recently by Seidelman et al,[19] who emphasized the importance of clinical indicators in the diagnosis of surgical site infections.

Surgical wound classification also demonstrated a highly significant association with microbial growth ($p<0.0001$). Clean wounds accounted for 3 (5.9%) patients in the growth group and 33 (32.7%) patients in the no-growth group. Clean-contaminated wounds constituted the largest category, comprising 27 (52.9%) patients with growth and 61 (60.4%) patients without growth. Contaminated wounds were observed in 13 (25.5%) patients with growth and 7 (6.9%) patients without growth. Dirty wounds were present in 8 (15.7%) patients with microbial growth and were not observed among patients without growth. The increasing prevalence of microbial growth from clean to dirty wounds highlights the influence of wound contamination on postoperative infection risk. This observation is consistent with the reports of Leaper and Edmiston et al,[14]and Martin et al,[18]who demonstrated that contamination level is a major determinant of surgical site infection.

The microbiological profile revealed a predominance of Gram-negative organisms among infected wounds. Klebsiellapneumoniae was the most frequently isolated pathogen, identified in 26 (51.0%) patients with microbial growth. Escherichia coli and Pseudomonas aeruginosa were each isolated in 12 (23.5%) patients with growth. Acinetobacterbaumannii complex was isolated in 1 (2.0%) patient with growth. In contrast, all 101 (100.0%) patients in the no-growth group demonstrated no microbial growth. The association between microbiological agents and growth status was highly significant ($p<0.0001$). The predominance of Klebsiellapneumoniae, Escherichia coli, and Pseudomonas aeruginosa suggests that Gram-negative bacteria remain the major pathogens responsible for postoperative wound infections in the present setting. Similar microbiological trends have been described by Seidelman et al,[19] and Magill et al,[20]who reported Gram-negative organisms among the leading pathogens associated with healthcare-associated and surgical site infections.

CONCLUSION

The substantial frequency of post-surgical wound infections among patients admitted to a tertiary care hospital is highlighted by this study's findings. The results show that Pseudomonas aeruginosa and Staphylococcus aureus are the most frequent bacteria that cause these infections. It has been discovered that comorbid illnesses including diabetes, extended hospital stays, and inadequate cleanliness all raise the risk of infection. Effective management depends on prompt identification of the pathogenic organisms and the use of the right antibiotic therapy. To lower the incidence and enhance patient outcomes, preventive measures—such as strict infection control procedures and appropriate wound care—are crucial.

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