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POSTOPERATIVE WOUND INFECTION RATES FOLLOWING ELECTIVE VS. EMERGENCY LAPAROTOMIES: A COMPARATIVE STUDY

Original Article

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ABSTRACT

Background: Wound infection after surgery is a leading source of morbidity after abdominal surgery, especially laparotomies. The increased infection extends the hospital stays, discomfort of the patient, and healthcare expenses. Emergency surgeries are usually conducted under suboptimal conditions, which may increase the risk of acquiring surgical site infections (SSIs). The purpose of the study was to compare the postoperative wound infection in elective and emergency laparotomies and determine the important factors underlying these infections.

Methods: A prospective comparative analysis was conducted on 80 laparotomy patients in one of the tertiary healthcare centers for 3 months. The participants were categorized according to the surgical urgency into elective (n = 40) and emergency groups (n = 40). Patient demographics, comorbidities, wound type, operative time, American Society of Anesthesiologists (ASA) Physical Status Classification System scores, and antibiotic prophylaxis time were recorded. Surgical site infections were classified using the Centers for Disease Control and Prevention (CDC) guidelines and evaluated within 30 days after surgery. Statistical analysis was performed using the chi-square test and independent t-test with a level of significance at $p < 0.05$.

Results: Emergency laparotomies had a higher wound infection rate (30%) than elective ones 5 (12.5%, $p = 0.031$). In the emergency group, there were more incidences of anemia (16 (40%) vs. 6 (15%), $p = 0.008$), wound contamination (14 (35%) vs. 4 (10%), $p = 0.007$), long operation time (>2 hours), higher ASA grades, and delayed prophylactic antibiotic use (8 (20%) vs. 2 (5%), $p = 0.045$). These were significantly linked to a high risk of SSI.

Conclusion: There is a greater risk of postoperative wound infection after emergency laparotomies, and much of the risk is perioperative-related and modifiable. Intensive preoperative preparation, early antibiotic prophylaxis, and intensive infection control can contribute to mitigating the problem of SSIs in emergency abdominal surgery. It is necessary to define and tackle these risk factors to enhance surgical outcomes and patient recovery.

Keywords: Surgical Wound Infection, Laparotomy, Elective Surgical Procedures, Antibiotic Prophylaxis, Risk Factors.

INTRODUCTION

Surgical site infections (SSIs) or postoperative wound infections are one of the most frequent types of complications that occur after abdominal surgeries and become a significant cause of patient morbidity, prolonged hospitalization periods, and high healthcare expenditures (1). The prevalence of wound infections following laparotomies may be as high as 20-30% globally and up to 50% in low- and middle-income nations because of the inconsistency of perioperative practices and infection control (2). Current evidence supports that patient characteristics like diabetes and anemia, wound category, surgical length, and perioperative antibiotics administration are crucial modifiable factors that predispose patients to SSI risk during abdominal surgery (3).

There is a greater risk of SSIs with emergency laparotomies as patients usually arrive in an unstable hemodynamic condition, often contaminated, and sometimes insufficient time to optimize before the operation (4). Through traumatic coagulopathy, which is frequent in emergencies, inaccurate existing bleeding during surgery and recuperation may intensify infections through the development of infections (5). Urgent cases are often linked to nutritional deficits, such as anemia, leaving tissues with less oxygen and causing wound closure to take longer (6). There is a metabolic origin of immune response damages like liver malfunction; it puts patients at a predisposition to acquiring infections after surgery (7). Existing diseases, such as urinary tract infection, have also been identified as further causes of abdominal wound contamination by bacteria (8). Genetically influenced metabolic disorders can affect wound healing with respect to increased inflammatory pathways under stress (9). Even though smart healthcare products such as IoT monitoring devices can support improvements in perioperative care, they are seldom used inherently when it comes to infection prevention in emergency surgery (10). Contextual factors, patient behavior, and local healthcare decisions have remained predominant challenges to the successful implementation of infection control measures (11).

It has been demonstrated that emergency cases have more lesions during contamination, highlighting the necessity of rigorous wound care and aseptic measures (12). Even where the procedures are clear, timely antibiotic prophylaxis is often not administered, particularly in emergency contexts where procedures become more difficult to follow (13).

Though all the individual risk factors of SSIs are well-indexed, there is little comparative study quantifying the interaction effect between the urgency of the surgery and the risk factors on the local hospital-based infection rates. This study addressed the absence of context-specific evidence by comparing the post-operation wound infection rates of elective laparotomies with emergency laparotomies. The underlying reason is to find perioperative factors that can be altered to minimize the occurrence of infections, particularly within the emergency environment. This study hypothesized that avoidable perioperative factors may result in significantly higher rates of wound infections involving emergency laparotomy. These results may introduce focused interventions in terms of infection control and patient optimization will potentially diminish the risk of SSI.

The objective of this study was to compare the rate of wound infection in elective and emergency laparotomies. It also aimed to evaluate important modifiable perioperative factors that contribute to infections, including diabetes, anemia, wound class, and antibiotics timing, to provide recommendations for the practical and evidence-based steps to decrease SSIs in abdominal surgery.

METHODOLOGY

This study was prospective comparative research, which was undertaken in the Department of General Surgery in a tertiary care hospital FPGMI Lahore for 3 months. The research was conducted under ethical approval, which was granted by the institutional review board under (1322/22). To include all eligible cases, a non-probability consecutive sampling method was used to recruit patients. Sample size has been determined with OpenEpi version 3.0.0 (released 2013, Atlanta, GA, USA) based on a 15% difference in the rate of wound infection between elective laparotomy and emergency laparotomy, at 95% confidence, which came out as a total of 80 patients (40 patients in each group).

Eligible patients were 18 years and older and were scheduled to or needed an elective or emergency midline laparotomy to address any intra-abdominal condition. Patients who were re-operated, were under immunosuppressive treatment, had wound infections before the operation, or were lost to follow-up during the first 30 days after the operation were excluded from the study. The patients were separated into two groups; Group A comprised patients who underwent elective laparotomies, and Group B comprised patients who underwent emergency laparotomies.

All patients were subject to perioperative care as per the standard surgical procedures of the hospital. Factors of interest in exposure involved surgery (elective vs. emergency), comorbidities in patients (diabetes mellitus, anemia), the type of wound, length of surgery, American Society of Anesthesiologists (ASA) Physical Status Classification System scores, and timing of antibiotic prophylaxis. The compliance with antibiotic prophylaxis was confirmed by chart reviews and perioperative nursing records. The surgical site infection was defined according to the Centers for Disease Control and Prevention (CDC) criteria and evaluated within 30 days after the surgery, using wound observation and patient follow-up.

A structured proforma was used to collect data, including perioperative, clinical, and demographic information. SPSS version 26.0 (released 2019, IBM Corp., Armonk, NY) was used to analyze the data. The independent t-test was used to analyze continuous variables, and the chi-square test was used to compare categorical variables. The p-value <0.05 was considered significant.

RESULTS

Eighty patients were recruited to determine the difference in postoperative wound infection between elective (n=40) and emergency laparotomies (n=40). The combined rate of wound infection was higher in emergency cases (12 (30%)) compared to elective cases (5 (12.5%)). The significant risk factors were the presence of diabetes, anemia, and contaminated or dirty wounds, a long operative time, and late antibiotic prophylaxis. The emergency group resulted in an extended mean operative time and more cases of anemia. These results indicate that modifiable factors can contribute to the decrease in SSIs, primarily in emergency laparotomies. Table 1 summarizes the clinical and demographic characteristics.

Table 1: Clinical and demographic characteristics of study participants

Variable	Elective (n = 40)	Emergency (n = 40)	Statistical Test Used	Test Value	p-value
Mean Age (years) Mean ± SD	45.2 ± 12.1	47.8 ± 13.3	Independent t-test	t = -0.88	0.38
Gender (Male/Female)	24 (60%)/16 (40%)	26 (65%)/ 14 (35%)	Chi-square test	$\chi^2 = 0.22$	0.64
Diabetes Mellitus (%)	8 (20%)	14 (35%)	Chi-square test	$\chi^2 = 2.15$	0.14
Anemia (Hb <10 g/dL) (%)	6 (15%)	16 (40%)	Chi-square test	$\chi^2 = 7.11$	0.008*
Mean Preoperative Hb (g/dL)	12.3 ± 1.5	10.8 ± 1.7	Independent t-test	t = 4.14	<0.001*
Mean Operative Time (hrs)	1.8 ± 0.4	2.4 ± 0.6	Independent t-test	t = -5.14	<0.001*
ASA I–II (%)	36 (90%)	30 (75%)	Chi-square test	$\chi^2 = 3.04$	0.08
ASA III–IV (%)	4 (10%)	10 (25%)	Chi-square test	$\chi^2 = 3.04$	0.08
Contaminated/Dirty Wounds (%)	4 (10%)	14 (35%)	Chi-square test	$\chi^2 = 7.26$	0.007*
Delayed Antibiotic Prophylaxis (%)	2 (5%)	8 (20%)	Chi-square test	$\chi^2 = 4.11$	0.045*

*N = Number of participants, SD = Standard Deviation, % = Percentage, Hb = Hemoglobin, ASA = American Society of Anesthesiologists, physical status classification system, * = significance at p <0.05*

No significant difference was found in the mean age of groups (45.2 ± 12.1 vs 47.8 ± 13.3 years; p=0.38) and gender (p=0.64). There were significantly more anemia cases among the emergency group (16 (40%), vs. 6 (15%), p=0.008). There were also significant differences in the mean operative time between emergencies (2.4 ± 0.6 hrs) and electives (1.8 ± 0.4 hrs), respectively (p<0.001). Higher ASA III-IV scores were more frequent in emergencies (10 (25%) vs. 4 (10 %)), but this difference was not statistically significant (p=0.08). These findings suggest that patients selected emergency laparotomies and experienced worse clinical conditions and prolonged operations, potentially contributing to infection risk. The post-operative wound infection rate is given in Table 2.

Table 2: Post-operative wound infection rate

Variable	Elective (n = 40)	Emergency (n = 40)	Statistical Test Used	Test Value	p-value
Wound Infection Rate (%)	5 (12.5%)	12 (30%)	Chi-square test	$\chi^2 = 4.66$	0.031*

*N = Number of participants, % = Percentage, * = significance at p <0.05*

The proportion of wound infection was 12 (30%) in the emergency group and 5 (12.5%) in the elective group (p=0.031). This affirms the twofold increase in infection rate in emergency laparotomies. The outcome advocates the necessity to enhance perioperative care during emergencies. Preventive actions such as timely antibiotics, improved preoperative planning, and aseptic technique may help decrease these infections.

DISCUSSION

The aim of the study was to compare wound infection rates in elective and emergency laparotomies and to determine major clinical and perioperative modifiable factors that affect wound infection. Patients who experienced emergency laparotomies were at a much higher risk of developing SSIs when compared to patients participating in elective procedures. This observation concurs with current evidence. According to a study, emergency abdominal surgeries were associated with a doubled infection risk because of insufficient preoperative preparation and the increased prevalence of wound contamination (14). Another study showed that late initiation of antibiotic drugs and ineffective perioperative management were considered primary causes of higher SSI cases in unplanned surgeries (15). Likewise, it was demonstrated that emergency laparotomies tend to include patients in worse nutritional and physiological conditions, causing increased postoperative complications (16). These reports support our inference that adjustable preoperative elements should be given priority to minimize SSIs.

Anemia, surgery duration, late antibiotic prophylaxis, and infected wounds were observed to significantly correlate with increased rates of infection in the emergency group in our research. Previous literature demonstrated that accurate planning of diagnosis enhances treatment outcomes by comparing CT and MRI in the diagnosis of pituitary microadenoma, where early and accurate sensitivity improves surgical planning (17). Despite the differences in laparotomies, the principle of early diagnosis applies to abdominal pathology. Hormonal and metabolic factors are also unavoidable, and demonstrated that changes in LH decreased the likelihood of IUI success, which shows how minor physiological differences influence patient outcomes (18).

There may also be a role of genetic predisposition. It was demonstrated that specific HLA haplotypes are autoimmune risks, which can influence wound healing through changes in immune response (19). Although we did not test the presence of genetic markers, the discrepancy in the results of similar cases suggests that other mechanisms at work to be investigated in the future. Another variable includes body composition. ABO blood groups were also associated with obesity, and they could modify wound healing, under the influence of tissue perfusion and inflammatory response (20). We did not measure BMI, but this supports the requirement to examine patient-specific risks in greater detail.

Well-recognized predisposing factors of SSIs include nutritional and metabolic deficiencies. In a study, vitamin D deficiency and higher FGF-23 were predictive of metabolic syndrome and worse clinical outcomes, implying that at-risk patients with poor wound healing could potentially be identified by nutritional assessments (21). Iron also plays an important role. A study pointed out hepcidin dysregulation as a cause of iron imbalance during liver disease; in our cohort, anemia was also an important risk factor, making perioperative correction desirable where possible (22).

Surgical outcomes can also be indirectly influenced by the effects of medications. According to studies, sofosbuvir affected serum lipid and uric acid concentrations in animal models, which indicates how pharmacologic considerations can influence patient readiness to undergo surgery (23). Drug history was not evaluated in our research; however, this association implies the value of a comprehensive medication review. A study mentioned PROM2 as a prognostic biomarker of prognosis in other pathologies, indicating that comparable biomarkers might facilitate the stratification of the risk of SSI (24). Pan-cancer research on pseudogenes demonstrated the role of non-coding RNAs in indicating recovery patterns (25).

Local and environmental factors are also important. According to a study, pollutants worsened or aggravated respiratory disease; thus, environmental stressors could undermine wound healing potential (26). Tissue regeneration follows pathways similar to notch signaling, which a study demonstrated in oral cancer development, that it is applicable in surgical healing (27). Similarly, another study focused on the influence of adipokines on the infertility process related to PCOS, showing the importance of metabolic pathways in the healing process (28). Risk can be addressed early through screening tools. Research also discussed how salivary diagnostics, a non-invasive model, have the potential to personalize medicine that can be customized to select patients with increased risk of SSI (29). Uncommon disorders should also be remembered, for example, a published case of dual-mechanism thrombocytopenia indicated that even common processes may be interfered with by unexpected blood-related complications (30).

Comprehensively, our data aligns with these varied observations. The primary implication is enhanced pre-operative preparation, early initiation of antibiotics, and essential microbial decontamination procedures, which can achieve a diminished number of SSIs in emergency laparotomies.

This study has limitations, including a single center and a small number of participants, which may affect external validity. Obesity, micronutrient issues, and genetic diversity are confounding variables that were not determined but can affect outcomes. The future aspect should consider multicenter research design with larger groups, inclusion of molecular and environmental markers, and practical solutions to improve the process of perioperative infection control, especially in resource-constrained emergency surgical environments.

CONCLUSION

This research found that emergency laparotomy had a significantly higher rate of postoperative wound infection than elective surgery. Nonetheless, the main contributors to the higher rates of infections revealed key factors, including anemia, dirty or contaminated wounds, longer surgeries, and delayed antibiotic prophylaxis. These studies support the idea that the risk of SSIs is largely affected by the presence of surgical urgency and modifiable perioperative factors.

With the help of the target outcome, the specified study indicated that thorough patient optimization, early delivery of antibiotics, and intraoperative sterility can be used to mitigate wound infections, particularly under emergency conditions. By identifying these risk factors, surgeons and other healthcare professionals can have feasible quality improvement targets. The reinforcement of perioperative practices and patient education may contribute to bridging the gap between outcomes of emergency and scheduled surgeries, which in turn, will increase patient safety and well-being.

AUTHOR CONTRIBUTION

Author	Contribution
Kaneez Aisha	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Akram Khan*	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Rana Muhammad Umar Rizwan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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