Frequency of Surgical Site Infection Following Open Appendectomy in A Tertiary Care Hospital.

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ABSTRACT:

Objective: Globally, acute appendicitis is regarded as one of the leading surgical emergencies and appendectomy considered the definitive treatment. Although appendectomy is a routine procedure, surgical site infection (SSI) remains one of the frequently encountered adverse outcomes that contributes to patient morbidity and increased healthcare burden.

Objective: To determine the frequency of "surgical site infection" (SSI) among patients presenting with acute appendicitis who underwent open appendectomy.

Methodology: This prospective descriptive observational study was conducted at Department of Surgery, "Dr. Ruth K.M. Pfau Civil Hospital Karachi", between April and July 2026. A total of 105 patients aged 15-60 years diagnosed with acute appendicitis and undergoing open appendectomy were included through consecutive sampling. SSI was defined as Southampton Grade II or above within 30 days postoperatively. Patients were followed on postoperative days 2, 7, 14 and 30. Statistical analysis conducted using SPSS version 26, with a p-value ≤0.05 considered statistically significant.

Results: Among 105 patients included, SSI was observed in 13 patients (12.4%). Male patients (n=78-74.3%) outnumber female patients (n=27-25.7%), with a mean age of 24.5±9.4 years. SSI observed more frequently in patients with higher ASA grades, history of smoking, diabetes mellitus and hypertension, contaminated wounds and complicated appendicitis.

Conclusion: SSI following open appendectomy remains relatively common in our setting, with a frequency consistent with rates reported in similar low- and middle-income countries.

Keywords: Appendectomy, Surgical Site Infection, Southampton wound grading system, Open appendectomy, Wound infection.

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Introduction:

Acute appendicitis is a frequently encountered surgical emergency in daily clinical practice. It affects considerable number of patients each year as shown by high incidence, with an annual occurrence of approximately 233 cases per 100,000 population and a lifetime risk of 6.7-8.6%, which highlights its overall burden on surgical services.[1,2] Appendectomy remains the definitive treatment of acute appendicitis and one of the most widely performed emergency abdominal surgery worldwide.[3] Despite being a routine procedure and current advances in perioperative care, postoperative complications still occur, and surgical site infection (SSI) continues to be the most commonly observed post-operative complication. Globally, the frequency of SSI following appendectomy is approximately 7%, with higher rates seen in low- and middle-income countries (LMICs), extending up to 11.1%.[4] In government operated high-volume settings, development of SSI results in prolonged hospital stay, additional antibiotics, repeated wound care visits, adds financial stress on the health care system and increased morbidity.[5] Therefore, SSI prevention is an integral part of perioperative care. Various intra-operative preventive strategies such as peritoneal lavage and wound irrigation, sometimes with antimicrobial and antiseptic solutions, have traditionally been employed in an effort to minimize the bacterial contamination of the wound, though their effectiveness remains variable.[6,7] Despite these practices, infections are still prevalent in a few subsets of patients including those with delayed presentation, complicated appendicitis, open appendectomies or, where infection-control practices are difficult to maintain consistently.[8]

Peri-operative assessment can help in identifying the patients who are at risk of developing SSI and can guide in preemptive measures to control the infection rate. One such practice is preoperative antibiotic prophylaxis which is considered a key strategy in reducing SSI risk.[9] Reported infection rates vary across different settings, for instance, Hussain et al. documented a 4.6% rate of SSI among patients undergoing open appendectomy who had received preoperative antibiotics,[10] whereby a recent meta-analysis from the Indian subcontinent reported a pooled SSI prevalence of approximately 5.25%.[11]

Local evidence on the frequency of surgical site infections (SSI) following open appendectomy remains scarce. In particular, prospective, institution-specific data from public sector tertiary care hospitals in Pakistan—using standard-

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ized definitions and follow-up protocols are lacking. This gap makes it difficult to objectively assess whether current perioperative practices are sufficient. By prospectively following patients and documenting both antibiotic administration timing and postoperative wound outcomes, the present study aims to generate institution-specific data that reflect routine clinical practice and highlight areas where perioperative management can be strengthened.

Objective:

To determine the frequency of "surgical site infection" (SSI) among patients presenting with acute appendicitis who underwent open appendectomy.

Methodology:

This prospective descriptive observational study was conducted in the Department of Surgery at Dr. Ruth K. M. Pfau Civil Hospital, Karachi, between April and July 2026. Ethical approval was obtained from the Institutional Review Board of Dow University of Health Sciences (IRB-4589/DUHS/Approval/2026/182), and written informed consent was secured from all participants, with family consent provided for those younger than 18 years. The sample size of 105 patients was calculated using the single-proportion formula, based on a reported 4.6% frequency of surgical site infection (SSI)[10] following open appendectomy, with a 95% confidence interval and 4.1% margin of error; participants were recruited through consecutive non-probability sampling. Eligible patients included males and females aged 15–60 years diagnosed with acute appendicitis by clinical history, physical examination, or imaging studies who underwent open appendectomy. Exclusion criteria comprised patients with generalized peritonitis requiring laparotomy or conversion to laparotomy, those with immunocompromised status (HIV, malignancy, chemotherapy, or prolonged steroid use), pre-existing local skin infection at the incision site, or those receiving antibiotics for more than 48 hours prior to surgery. All patients diagnosed with acute appendicitis in the emergency department who provided informed consent were enrolled in the study. Preoperative demographic and clinical variables—including age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) grade, co-morbidities such as diabetes mellitus and hypertension, and smoking history—were systematically recorded using a structured proforma.

Surgical Procedure:

All patients received preoperative antibiotic prophylaxis (cefuroxime and metronidazole) administered 30 minutes prior to the skin incision. Surgery was carried out under general anesthesia in supine position. Standard protocol of skin prep was done using povidone-iodine surgical scrub for 10 minutes and then application of 10% povidone-iodine solution. Open appendectomy was performed by postgraduate trainee (Year 3 or above) using gridiron incision. Intra-operative findings were noted and findings of perforated or gangrenous appendix or localized purulent contamination were labelled as complicated appendicitis. Appendectomy done using standardized technique. Wound class noted according to CDC classification of surgical wound. Operative time was recorded from skin incision to closure.

Post-operative assessment:

Post-operatively, all patients were examined for evidence of surgical site infection, both in the hospital and in outpatient clinic follow-ups, using Southampton Wound Grading System (Fig. 1). SSI defined as Southampton grade II or above and examined clinically on postoperative days 2, 7, 14 and 30 by a senior registrar or above. Clinical outcomes such as Southampton grade and time to develop SSI were noted. Based on examination SSI classified into superficial SSI, deep SSI, and organ-space SSI as per CDC classification.

Data Analysis:

Data analysis was performed using SPSS version 26. Quantitative variables such as age, body mass index (BMI), and operative time were expressed as mean ± standard deviation (SD), while qualitative variables including gender, smoking status, co-morbidities (diabetes mellitus and hypertension), ASA grade, wound class, type of appendicitis, and surgical site infection (SSI) were summarized as frequencies and percentages. The normality of quantitative variables (age, BMI, and operative duration) was assessed using the Shapiro-Wilk test. Differences in mean age, BMI, and operative time between patients with and without SSI were evaluated using the independent samples t-test, whereas associations between SSI and categorical variables (gender, smoking status, diabetes mellitus, hypertension, ASA grade, wound class, and type of appendicitis) were analyzed using the Chi-square test or Fisher's exact test, as appropriate. A two-tailed p-value ≤ 0.05 was considered statistically significant.

Results:

Overall, for current study 105 patients underwent open appendectomy during study period were studied. The mean age was **24.5±9.4 years**. There were 78 (74.3%) males and 27 (25.7%) females showing male predominance. The mean BMI was **21.7±2.7 kg/m²**. As co-morbidities; diabetes mellitus was present in 4 (3.8%) patients, hypertension in 6 (5.7%), and smoking history in 18 (17.1%) patients. Most patients belonged to ASA grade I (75.2%), followed by ASA grade II (19%) then ASA grade III (5.7%). The mean operative time was **41.3±5.9 minutes**. Ninety (85.7%) patients had simple appendicitis while complicated appendicitis seen in 15 (14.3%) patients. Most patients wound was classified as clean-contaminated (83.8%) and small proportion of patients (16.2%) had contaminated wound.

Surgical site infection developed in 13 (12.4%) patients (Fig 2.) The association of development of SSI with perioperative factors is shown in table no 1. Patients aged **>30 years** showed a significantly higher frequency of SSI when compared with patients aged ≤30 years (**36.4% vs. 6.0%**). Similarly, patients having BMI **>22.5 kg/m²** demonstrated a significantly greater SSI frequency than those having BMI ≤22.5 kg/m² (**31.6% vs. 1.5%**). The mean duration of surgery was found to be comparatively longer in patients who subsequently experienced SSI in comparison to those patients who did not (**48.5±5.6 vs. 40.2±4.8 minutes**).

A significantly higher frequency of SSI was observed among smokers, patients with co-morbidity such as diabetic and hypertensive, higher ASA grades, complicated appendicitis and patients with contaminated wounds.

Fig. 1 Southampton Wound Grading System.

Southampton scoring system	
Grade	Appearance
0	Normal healing
I	Normal healing with mild bruising or erythema:
A	Some bruising
B	Considerable bruising
C	Mild erythema
II	Erythema plus other signs of inflammation
A	At one point
B	Around sutures
C	Along wound
D	Around wound
III	Clear or haemoserous discharge:
A	At one point only (<2cm)
B	Along wound (>2cm)
C	Large volume
D	Prolonged (>3 days)
Major complication	
IV	Pus:
A	At one point only (<2cm)
B	Along wound (>2cm)
V	Deep or severe wound infection with or without tissue breakdown; haematoma requiring aspiration

The wound grading system used was simplified for the use of analysis. By using the worst wound score recorded and information about any treatment instituted either in hospital or the community, wounds were regarded in four categories:
(A) normal healing;
(B) minor complication;
(C) wound infection-wounds graded IV or V or wounds treated with antibiotics after discharge from hospital, irrespective of the wound grading given to them by the nurse; and
(D) major haematoma-wound or scrotal haematomas requiring aspiration or evacuation.

(Adapted from Bailey IS et al, *BMJ* 1992 [21])

Fig. 2 Frequency of SSI following open appendectomy in our setting.

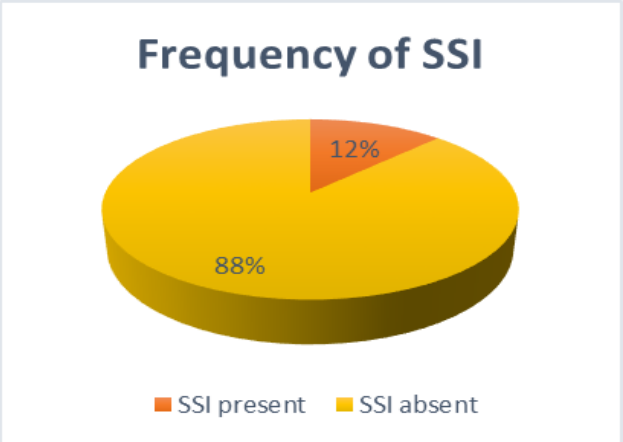


Table I. Demographics, clinical and peri-operative variables of the patients and their association with SSI (n=105)

Variables	n (%)	SSI +ve (n)	SSI -ve (n)	p-value
Age (years)				
≤ 30 years	83 (79.0%)	5 (6.02%)	78 (93.9%)	<0.001*
>30 years	22 (20.9%)	8 (36.36%)	14 (63.63%)	
BMI (kg/m^2)				
≤22.5	67 (63.8%)	1 (1.49%)	66 (98.5%)	<0.001*
>22.5	38 (36.1%)	12 (31.5%)	26 (68.42%)	
Gender				
Male	78 (74.3%)	10 (12.8%)	68 (87.2%)	0.76
Female	27 (25.7%)	3 (11.1%)	24 (88.9%)	
Smoking				
Yes	18 (17.1%)	8 (44.4%)	10 (55.6%)	<0.001*
No	87 (82.9%)	5 (5.7%)	82 (94.3%)	
Diabetes mellitus				
Yes	4 (3.8%)	4 (100%)	0 (0%)	<0.001*
No	101 (96.2%)	9 (8.9%)	92 (91.1%)	
Hypertension				
Yes	6 (5.7%)	5 (83.3%)	1 (16.7%)	<0.001*
No	99 (94.3%)	8 (8.1%)	91 (91.9%)	
ASA grades				
ASA I	79 (75.2%)	1 (1.26%)	78 (98.7%)	<0.001*
ASA II	20 (19%)	6 (30%)	14 (70%)	
ASA III	6 (5.71%)	6 (100%)	0 (0%)	
Wound class				
Clean-contaminated	88 (83.8%)	8 (9.1%)	80 (90.9%)	0.01*
Contaminated	17 (16.2%)	5 (29.4%)	12 (70.6%)	
Type of appendicitis				
Simple	90 (85.7%)	8 (8.9%)	82 (91.1%)	0.01*
Complicated	15 (14.3%)	5 (33.3%)	10 (66.7%)	

**p-value <0.05 denotes statistical significance.*

Discussion:

The results showed that surgical site infection (SSI) following open appendectomy are more frequent (12.4%), when compared with study of Hussain et al[10] who reported 4.6%

and significantly above the pooled global estimate of approximately 7% reported by Danwang et al.[4] However, these findings are coherent with studies performed in low- and middle-income countries (LMICs), where SSI rates commonly range between 8% and 15% following open appendectomy.[4,5] This higher burden in LMIC settings is mostly due to multifactor including delayed presentation, increased incidence of complicated appendicitis, overcrowded emergency services, and limitations in perioperative infection-control resources. Open appendectomy remains the predominant surgical approach in many public sector hospitals because of cost considerations and limited laparoscopic availability. Studies have shown that patients undergoing open appendectomy are more prone to develop wound-related morbidity compared to laparoscopic surgery due to greater tissue handling and direct wound contamination.[12] The SSI frequency observed in our study therefore reflects the practical realities of emergency surgical care in a high-volume tertiary care center. During current study we found statistically significant correlation was between smoking and incidence of SSI. Smokers demonstrated substantially higher infection rates compared to non -smokers. Smoking is known to impair neutrophil function, tissue oxygenation, collagen synthesis, and microvascular circulation, all of which adversely affect wound healing.[13] Almost identical findings have been reported in many studies evaluating postoperative wound complications.[14]

Also, we found strong association between Diabetes mellitus and hypertension and development of SSI. Hyperglycemia impairs leukocyte chemotaxis and phagocytic activity, increasing susceptibility to infection and delaying wound healing.[15,20] The markedly elevated SSI frequency among diabetic patients in our cohort emphasizes the importance of perioperative glycemic optimization. Hypertension was also associated with increased SSI frequency in our study, a finding that has been reported in previous studies evaluating postoperative outcomes among surgical patients.[16,17]

Patients with contaminated wounds and complicated appendicitis demonstrated significantly increased SSI frequency. These findings are expected, as complicated appendicitis is associated with perforation, tissue necrosis, bacterial spillage, and increased inflammatory burden.[18, 19] Walêdziak et al.[20] similarly identified complicated appendicitis and intra-abdominal contamination as important predictors of postoperative morbidity following appendectomy.

It was also noted that patients having higher ASA grade are more likely to develop SSI. Notably, all patients with ASA grade III developed SSI. The ASA classification reflects the patient's baseline physiological reserve and comorbidity burden and has been widely used as a predictor of postoperative morbidity and mortality.[21-23] Similar associations between higher ASA grades and postoperative infectious complications have been reported in emergency general surgery literature.[16] Operative duration was significantly longer among patients who developed SSI. Prolonged surgical duration increases tissue exposure, bacterial contamination, tissue desiccation, and operative manipulation, thereby increasing infection risk.[24] Previous studies evaluating abdominal surgeries have consistently demonstrated longer operative time as an independent predictor of SSI.[17] The outcomes of this study reinforce the importance of identifying high-risk patients preoperatively and implementing targeted infection-prevention strategies. Optimization of modifiable risk factors such as smoking cessation, glycemic control, perioperative antibiotic stewardship, and strict compliance to aseptic technique may help reduce postoperative wound complications.

Despite standardized operative technique and antibiotic prophylaxis, SSI remains a clinically relevant complication following open appendectomy in our setting. Future multi-studies with larger sample sizes are recommended to further validate these findings and guide institutional infection-control policies.

Conclusion:

At our institution, surgical site infection (SSI) following open appendectomy was identified as a common postoperative complication, with an incidence rate of 12.4%. Significant associations were observed between SSI development and patient-related or perioperative factors, including smoking, diabetes mellitus, hypertension, higher ASA grades, contaminated wound class, complicated appendicitis, and prolonged operative duration. These findings underscore the importance of early recognition of high-risk patients and strict adherence to infection-control measures to reduce postoperative wound infections. Further prospective studies are warranted to explore contributory risk factors in greater depth and to develop targeted strategies aimed at minimizing SSI rates in this setting.

Limitation:

The generalizability of these findings is limited, as the study was conducted in a single tertiary care center in Pakistan. The relatively modest sample size further restricts the representativeness of the results, and larger multicenter studies would be more informative in establishing reliable estimates of SSI frequency. Although key demographic and perioperative confounding factors were assessed and statistically analyzed, the possibility of residual confounding cannot be entirely excluded.

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Authors' contribution	
Saba Jamal	Study conception and design, data collection, and manuscript writing and drafting.
Syed Ali Haider	Study supervision, critical review of the manuscript, and intellectual input, final approval of the manuscript and correspondence with the journal.
Muhammad Zubair	Study supervision, methodological guidance and critical review of the manuscript.
Maria Zia	Literature review, data analysis and manuscript drafting.
Samina Gohar	Literature review and assistance in data collection and interpretation