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Original Research Article

Frequency of Incisional Surgical Site Infection in Patients Undergoing Open Surgical Technique Appendectomy in Complicated Appendicitis

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Abstract: *Surgical site infection (SSI) is a common postoperative complication following appendectomy, particularly in cases of complicated appendicitis. SSIs contribute to increased morbidity, prolonged hospital stay, and higher healthcare costs. Identifying the frequency and associated risk factors is essential for improving surgical outcomes.* ***Objective:*** *To determine the frequency of incisional surgical site infection in patients undergoing open appendectomy for complicated appendicitis.* ***Methods:*** *This cross-sectional study was conducted on 137 patients aged 18–60 years of either gender diagnosed with complicated appendicitis and undergoing open appendectomy conducted in the department of surgery, Hayatabad Medical Complex, Peshawar, from 8 October 2024 to 08 March 2025. Patients with chronic medical or psychiatric illnesses, hemodynamic instability, coagulation disorders, cirrhosis, active systemic infection, or pregnancy were excluded. All patients underwent open surgical appendectomy, and incisional surgical site infection was assessed within 30 days postoperatively. SSI was defined as the presence of swelling, pain (visual analog scale >3), fever >38.5°C, and purulent discharge from the incision. Data were analyzed using SPSS version 23. Associations between variables were assessed using the chi-square test, with a significance level set at $p < 0.05$.* ***Results:*** *A total of 137 patients were included, with a mean age of 39.36 ± 12.21 years and a mean body mass index of 26.96 ± 2.67 kg/m². There were 80 (58.4%) males and 57 (41.6%) females. Incisional surgical site infection occurred in 30 patients, representing 21.9% of cases. A statistically significant association was found between SSI and rural residence ($p = 0.047$). No significant associations were observed with other demographic variables.* ***Conclusion:*** *The frequency of incisional surgical site infection following open appendectomy for complicated appendicitis was relatively high (21.9%). Rural residence was significantly associated with increased risk. Targeted preventive strategies and improved postoperative care, particularly in resource-limited settings, may help reduce the burden of SSI.*

Keywords: Incisional Surgical Site Infection, Open Appendectomy, Complicated Appendicitis, Rural Residence, Pakistan

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Introduction

Surgical site infection (SSI) is a frequent complication following abdominal surgery, which contributes considerably to prolonged hospital stay and increased healthcare expenditure. Regardless of development in the surgical techniques, SSIs continue to pose the main challenge in emergency procedures, including the appendicectomy. Acute appendicitis is a common surgical emergency globally with the appendicectomy considered as definitive treatment in the complicated cases characterised by the perforation and gangrene or abscess formation (1). The risk of SSI is raised in patients with complicated appendicitis in comparison with uncomplicated cases. A study demonstrated that complicated appendicitis raises the probability of postoperative infection by fourfold due to the bacterial contamination and inflammatory burden.[2] This amplified the susceptibility by making the management of such patients challenging in resource-scarce settings where infection control is suboptimal (2, 3).

Open surgical technique appendicectomy is practised in developing countries due to the limited access to laparoscopic facilities and cost constraints. Open appendicectomy has been linked to higher rates of SSI in comparison to laparoscopic approaches. Infection rates of nearly 11 per 100 procedures for open surgery in comparison to 4.6 per 100 for laparoscopic appendicectomy have been reported (3-6). Regardless of this, open appendicectomy is indispensable in complicated appendicitis in cases of extensive contamination. Patient-related factors contributing to SSI include advanced age, diabetes mellitus and delayed presentation, which play a critical role. Intraoperative variables, including the lengthy operative time, insufficient peritoneal lavage and poor surgical technique, have been recognized as important contributors (6-8).

Perforation or the presence of an abscess additionally worsens the risk due to increased microbial load and local tissue damage. Perioperative practices, including the inappropriate timing of antibiotic prophylaxis, have also been implicated in increasing infection rates. SSI burden is pronounced in low-income countries where the healthcare infrastructure, sterilisation protocols and postoperative care are usually less robust. Emerging evidence in Pakistan suggested that SSI remains a noteworthy postoperative complication after appendicectomy, with rates influenced by the demographics and comorbidities (8-10).

Given the high burden of SSI in complicated appendicitis and reliance on the open surgical techniques, it is vital to assess the frequency of SSI in this patient population. Understanding the factors will enable the development of targeted interventions to minimize postoperative complications and improve outcomes. The study aims to investigate the frequency of SSI in patients undergoing open appendicectomy for complicated appendicitis, thus providing valuable insights into the current clinical practices as well as potential areas for improvement.

Methodology

This descriptive study was conducted in the Department of Surgery at Hayatabad Medical Complex, Peshawar, from 8 October 2024 to 08 March 2025, after obtaining an ethical certificate from the Hospital Research and Review Board. A sample size of 137 patients was selected for this study, which was calculated using the WHO sample size calculator, keeping the following assumptions: the previous frequency of incisional surgical site infection in patients undergoing open surgical technique appendectomy in complicated appendicitis was 35%, **(11)** absolute precision 8%, and confidence level 95%. A consecutive non-probability sampling technique was used. Inclusion criteria were to include patients aged 18 to 60 years, of either gender, diagnosed with complicated appendicitis and undergoing open appendectomy.

Complicated appendicitis was defined in patients presenting with all of the following symptoms, i.e., pain (VAS >4) localized to the right lower quadrant, along with fever (>38 oC), nausea, and vomiting. Ultrasound examination was used for the diagnosis, showing all of the following features: thickening of the wall > 6 mm, peri-appendiceal fluid, and presence of free air in the abdominal cavity adjacent to the appendix. Patients with chronic medical or psychiatric diseases, hemodynamic instability, coagulation disorders, cirrhosis, acute infection and pregnancy were excluded.

Patients who met the selection criteria for this study were included after they were informed of the study's purpose and benefits and assured that participation posed no risk. Informed written consent was taken from all enrolled patients. Baseline demographics such as age, gender, educational status, occupational status, socioeconomic status and residential area were recorded. Patients identified with complicated appendicitis underwent the open appendectomy under general anesthesia by making a 5 to 10 cm oblique incision in the lower right quadrant of the abdomen, typically over McBurney's point. The layers of the abdominal wall, including the skin, subcutaneous tissue, and muscles, were carefully dissected and retracted to expose the peritoneal cavity. After spotting, the appendix was gently lifted and isolated from the surrounding tissues. The appendix was adhered to the surrounding structures, and careful dissection was performed. The appendiceal artery was clamped and ligated (tied off) to prevent bleeding. The base of the appendix was tied off with sutures, and the appendix was then removed by cutting it away from the cecum. The peritoneal cavity was irrigated with sterile saline to remove any remaining infection or contamination. The abdominal muscles, fascia, and skin were sutured in layers to close the incision. Incisional surgical site infection was examined, which was defined as an infection that occurs at or near the surgical incision within 30 days of surgery in patients presenting with all of the following complaints, i.e., swelling, pain (VAS>3), and fever (>38.5 ºC). Physical examination showed pus or other purulent discharge from the incision site. This entire assessment was conducted under the guidance of a consultant with at least 5 years of post-fellowship experience. SPSS 23 software was used to analyze the data. Mean ± SD was calculated for numerical data, i.e., age and BMI. Frequencies and percentages were calculated for categorical data i.e gender, incisional surgical site infection, education status, occupation status, socio-economic status and residence area. Effect modifiers i.e age, gender, BMI, education status, occupation status, socio-economic status and residence area, were controlled through stratification. A post-stratification Chi-square test was applied at the 5% significance level.

Results

The present study was conducted on 137 patients. The mean age of the patients was 39.36 ± 12.21 years. The mean body mass index was 26.96±2.67 kg/m². There were 80 (58.4%) males, and the remaining 57 (41.6%) patients were females. Regarding education, 61 patients (44.5%) were educated, while 76 (55.5%) were uneducated. Fifty-one patients (37.2%) were employed, and 86 (62.8%) were unemployed. The remaining demographic distribution is presented in Table 1. The frequency of incisional surgical site infection in patients undergoing open appendectomy for complicated appendicitis in the present study was observed in 30 (21.9%) patients. The remaining 107 patients (78.1%) did not develop this complication (Table 2). Among those who developed incisional surgical site infection, 9 patients (30.0%) lived in urban areas, whereas 21 patients (70.0%) came from rural backgrounds. This difference was statistically significant (p = 0.047). Other demographic variables did not show a significant association with incisional surgical site infection (Table 3)

Table 1: Demographics

Demographics		n	%
Gender	Male	80	58.4%
	Female	57	41.6%
Education status	Educated	61	44.5%
	Uneducated	76	55.5%
Occupation	Employed	51	37.2%
	Unemployed	86	62.8%
Residence	Urban	63	46.0%
	Rural	74	54.0%
Socioeconomic status	Lower class	55	40.1%
	Middle class	57	41.6%
	Upper class	25	18.2%

Table 2: Frequency of Incisional Surgical Infections

Incisional surgical infection	n	%
Yes	30	21.9%
No	107	78.1%

Table 3: Stratification of Incisional surgical infection with demographics

Demographics		Incisional surgical infection				p value
		Yes		No		
		n	%	n	%	
Age distribution (Years)	18 to 30	4	13.3%	37	34.6%	0.080
	31 to 45	13	43.3%	34	31.8%	
	> 45	13	43.3%	36	33.6%	
BMI distribution (kg/m2)	18.5 to 24.9	10	33.3%	27	25.2%	0.515
	25 to 29.9	15	50.0%	66	61.7%	
	> 29.9	5	16.7%	14	13.1%	
Gender	Male	16	53.3%	64	59.8%	0.525
	Female	14	46.7%	43	40.2%	
Education status	Educated	15	50.0%	46	43.0%	0.858
	Uneducated	15	50.0%	61	57.0%	
Occupation	Employed	9	30.0%	42	39.3%	0.354
	Unemployed	21	70.0%	65	60.7%	
Residence	Urban	9	30.0%	54	50.5%	0.047
	Rural	21	70.0%	53	49.5%	
Socioeconomic status	Lower class	10	33.3%	45	42.1%	0.375
	Middle class	12	40.0%	45	42.1%	
	Upper class	8	26.7%	17	15.9%	

Discussion

The frequency of surgical site infection following appendectomy for complicated appendicitis varies across different healthcare settings and this variability is largely attributable to differences in surgical technique, perioperative protocols and patient populations. Salman et al. reported an overall surgical site infection prevalence of 8% in their cohort, which included both laparoscopic and open approaches, with the majority of patients recovering within one week postoperatively (12). Their study noted that a perforated appendix was observed in 4% of cases and a gangrenous appendix in 13%, and the authors advocated for laparoscopic appendectomy as the preferred first choice, not only for cosmetic benefits but also for the enhanced diagnostic capability to identify concomitant pathologies such as ovarian cysts or Meckel's diverticulum (12). In contrast, Aslam et al. reported a substantially higher surgical site infection rate of 34.3% in patients undergoing open appendectomy specifically for complicated appendicitis, with superficial incisional infections constituting the majority at 68.1% of all infections (13). Their analysis identified several significant predictors, including male gender, rural residence, low socioeconomic status, body mass index >25 kg/m², and operative time >90 minutes. The mean hospital stay in their study was markedly longer among infected patients, at 8.2 days compared to 4.6 days in those without infection.

Firdos et al. reported a surgical site infection rate of 21% in their study of 200 patients, with superficial incisional infections occurring in 14%, deep incisional infections in 5%, and organ space infections in only 2% of patients. Their study found that uncomplicated appendicitis was present in 67.5% of cases, while complicated appendicitis was observed in 32.5 %, and among those with complicated disease, gangrenous appendicitis had a superficial infection rate of 25.8% and a deep infection rate of 9.7%, while perforated appendicitis demonstrated even higher rates of 26.4% for superficial and 17.6% for deep infections. Interestingly, their statistical analysis did not establish a significant relationship between the appendix's morphological appearance and the subsequent development of surgical site infection (14). The study by Iqbal et al. similarly reported a surgical site infection frequency of 38% among 50 patients with complicated appendicitis, comprising 22% superficial incisional and 16% deep incisional infections, and their analysis found no statistically significant associations with gender, smoking status and diabetes mellitus (15).

In the present study, the frequency of incisional surgical site infection was observed in 30 patients (21.9%). This figure falls in the range reported for open appendectomy in complicated appendicitis, which spans from approximately 21% to 38% as documented by the aforementioned studies (13-15). The mean age of the study population was 39.36 years, which is similar to the mean age of 38.54 years reported by Iqbal et al (15). The gender distribution showed a male predominance, which aligns well with the local studies (13-15). A mean body mass index of 26.96±2.67 kg/m² in the present study indicates that the majority of patients were overweight, a finding consistent with observations by Aslam et al., who identified elevated body mass index as a significant risk factor for surgical site infection (13).

The present study found that the majority of the patients who developed incisional SSI were from rural areas, and this association was statistically significant. This finding aligns with the study by Aslam and colleagues, who reported that rural residence was associated with surgical site infection (13). The consistency of this finding across two independent studies conducted in different time periods and different institutions showed that geographic barriers to healthcare access, delays in presentation and potentially suboptimal perioperative conditions in rural settings contribute meaningfully to the risk of postoperative infections.

The overall pattern of results suggests that, while the infection rate in this study is comparable to previously published reports, the specific risk factors that achieve statistical significance may vary across populations, highlighting the importance of context-specific risk assessment and targeted preventive strategies.

Conclusion

In conclusion, the frequency of incisional surgical site infection in patients following open surgical technique appendectomy in complicated appendicitis in the present study was 30 (21.9%). A significant association was observed between incisional surgical site infection and rural residence. To reduce the burden of incisional surgical site infections in this high-risk population, it is recommended that targeted preventive strategies be prioritized for patients from rural residences.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-Letter Number 2119**)**.)

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

SSS, YJ

Contributed to study design, data collection and initial manuscript drafting

Assisted in data acquisition, literature review and manuscript editing

MA, F

Contributed to patient recruitment, data entry and results compilation

Assisted in referencing, proofreading and final revisions of the manuscript

Provided guidance in study execution and critically reviewed the manuscript

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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