

Post Operative Wound Infection after Open Appendectomy in Surgery Department CMH Rawalpindi

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ABSTRACT

Objective: To determine the frequency of post-operative wound infection after open appendectomy in surgery department of Combined Military Hospital Rawalpindi, Pakistan.

Study Design: Quasi-experimental study

Place and Duration of Study: Department of surgery, Combined Military Hospital, Rawalpindi, Pakistan from Jul to Dec 2021.

Patients and Methods: Patients aged 18 years and above of any gender of Diagnosed cases of acute appendicitis and undergoing open appendectomy were consecutively enrolled. Within 30 days following surgery, wound infection was defined as either incisional (superficial or deep) or organ/space wound infection.

Results: Of 122 patients, the overall wound infection was observed in 11(9%) patients. Of these 11 patients, incisional wound infection was observed in 7(63.6%) and organ/space wound infection in 6(54.5%) patients. The mean age of patients with no wound infection was considerably greater than that of patients with wound infection, i.e., 41.53±5.14 years and 37.27±5.58 years respectively (p -value 0.022). Diabetes (p -value: 0.006), IHD (p -value: 0.001), COPD (p -value: 0.039), 30 day rehospitalization (p -value: 0.001), ASA status (p value: 0.020), preoperative SIRS (p -value: 0.001), and wound classification (p value: 0.002) were all significantly higher in wound infection patients than in non-wound infection patients. Pulmonary infection 43(35.2%) was the most common postoperative complication.

Conclusion: Postoperative wound infection was observed in nine percent patients who underwent open appendectomy. Increased age, diabetes, IHD, COPD, preoperative SIRS, contaminated/dirty wound classification, and lower preoperative WBCs were significant risk factors.

Keywords: Open appendectomy, Postoperative, Surgery, Wound infection

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INTRODUCTION

In many cases of acute appendicitis, an appendectomy is considered standard treatment. At the same time, it is currently one of the most popular emergency surgeries in the world.¹ When it comes to appendectomy, there are two basic surgical approaches: laparoscopic and open. Regardless of any surgical approach, wound infections remain the most prevalent consequence following appendectomy, despite all advancements and range of alternatives.^{2,3}

Wound infection is an unanticipated and serious problem that leads to a high rate of morbidity and mortality after surgery.^{4,5} For more than a century, open appendectomy has been regarded a safe and successful procedure for acute appendicitis. Still almost all published studies have observed

postoperative wound infection in their findings.^{6,7} Though the rate of infection and associated risk factors varies in all studies, including published studies from Pakistan.⁹ So, this is planned to determine the postoperative wound infection after open appendectomy in surgery department of Combined Military Hospital Rawalpindi, Pakistan.

METHODOLOGY

The Quasi-experimental study was conducted at department of surgery, Combined Military Hospital (CMH), Rawalpindi, Pakistan from July to December 2021. Ethical approval was obtained from the institute before commencement of the study. Moreover, signed informed consent was also obtained from the study participants prior enrolment of the patients in the study.

Inclusion Criteria: Patients diagnosed with acute appendicitis and having open appendectomy must be at least 18 years old and of either gender.

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Exclusion Criteria: Patients presented with BMI of >30 kg/m², autoimmune disease, end-stage renal failure or hepatic disease were excluded. Patients with appendiceal tumours, as well as those who had a negative appendectomy or an inadvertent appendectomy in conjunction with another surgery.

Non-probability consecutive sampling was used to enroll all the patients. For the determination of sample size, the Open Epi sample size calculator was used, using a confidence interval of 95%, a margin of error of 5%, and a reported incidence of wound infection in patients who had an open appendectomy of 8.7%¹⁰. The estimates sample size came out to be 122.

Open appendectomy surgery was performed by a surgeon having years of experience and were trained in well reputed national and international institutes. McBurney's incision was used in almost every open appendectomy. The base of the appendix was ligated with an absorbable knot and the appendix was separated using a scalpel after the mesoappendix was ligated and divided with scissors. A purse-string suture was used to invert the appendix stump into the cecum's lumen.

When necessary, one abdominal drain would be implanted during the surgical operation. In most cases, abdominal incisions were closed with absorbable sutures, with the exception of those with a clearly dirty/infected wound. The wounds were not treated with antibiotics or subcutaneous drains. Broad spectrum penicillin/second/ third generation cephalosporin was administered intravenously to all patients. The antibiotic was administered intravenously at a dose of 1-2 g at the time of anesthesia induction, and another dose was given intravenously at three hours interval. In general, antibiotics were maintained for 1-5 days following surgery. Other aspects of perioperative treatment were nearly uniform.

The Centers for Disease Control (CDC) and Prevention of the National Nosocomial Infections Surveillance employed defined surveillance criteria was used for determining wound infection. In 30 days following surgery, wound infection was noted.

A pre-structured proforma was used for the data collection. Detailed information on the patients' demographics, pre-operative white blood cells, active cigarette usage; ASA score; preoperative systemic inflammatory response syndrome (SIRS),¹¹ and comorbidities were noted. Surgical factors such as

wound classification¹², as well as operating time, were also recorded. Subsequently, postoperative complications such as length of hospital stay, wound dehiscence, bowel obstruction, pulmonary infection, urinary tract infection, intra-abdominal bleeding, colon fistula, wound infections such as incisional and organ/space wound infections, and re-hospitalization within 30 days of discharge were noted.

For data analysis, the Statistical Package for Social Sciences (SPSS) version 24 is utilized. Mean along with standard deviation was computed for quantitative variables like age, weight, height, body mass index (BMI), length of hospital stays, preoperative white blood cells (WBCs), and operative time. Frequency and percentages were calculated for qualitative variables like gender, ASA classification, preoperative SIRS, wound classification, rehospitalization within 30 days, wound infection, and postoperative complications. The mean difference of quantitative variables with outcome, i.e., wound infection was explored using independent t-test. The Chi-square/Fisher-Exact test was used to determine the relationship between qualitative factors and outcome. The p value of 0.05 was considered significant.

RESULTS

A total of 122 patients were enrolled. The mean age of the patients was 41.18±5.27 years. There were 81(66.4%) males and 41(33.6%) females. The mean weight, height, and BMI of the patients were 69.88±9.51 kg, 1.68±0.12 m, and 23.97±2.19 kg/m² respectively. The presence of comorbidities showed that hypertension was the most common comorbidity observed in 52(42.6%) patients, followed by diabetes mellitus 31(25.4%), chronic obstructive pulmonary disease (COPD) 24(19.7%), renal dysfunction 19(15.6%), whereas 12(9.8%) had ischemic heart disease (IHD). Active smoking status was observed in 49(40.2%) patients.

The overall wound infection was observed in 11(9%) of the patients. Of these 11 patients, incisional wound infection was observed in 7(63.6%) and organ/space wound infection in 6(54.5%) patients. In patients who did not have a wound infection, the mean age was substantially greater than in those who did, i.e., 41.53±5.14 years and 37.27±5.58 years respectively (*p*-value 0.022) whereas weight (*p*-value 0.129), height (*p*-value 0.158), and BMI (*p*-value 0.389) was found statistically insignificant. Similarly, gender (*p*-value 0.331) and active smoking use (*p*-value 0.523)

were also statistically insignificant. As far comorbidities are concerned, diabetes was found to be significantly greater in wound infection patients compared to those who did not have a wound infection., i.e., 7(63.6%) and 24(21.6%) (p -value 0.006). IHD was considerably greater in participants with wound infection compared to those without wound infection., i.e., 6(54.5%) and 6(5.4%) respectively (p -value <0.001). COPD was also considerably greater among wound infection patients compared to individuals who did not have a wound infection., i.e., 5(45.5%) and 19(17.1%) respectively (p -value 0.039). (Table-I)

Table-I: Comparison of Wound Infection with Demographics and Baseline Clinical Characteristics (n=122)

Variables	Wound Infection		p -value
	Yes (n=11)	No (n=111)	
	mean \pm SD	mean \pm SD	
Age, years	37.27 \pm 5.58	41.53 \pm 5.14	0.022 †
Weight, kg	65.73 \pm 9.29	70.29 \pm 9.47	0.129 †
Height, m	1.62 \pm 0.11	1.67 \pm 0.12	0.158 †
BMI, kg/m ²	24.51 \pm 2.67	23.91 \pm 2.15	0.389 †
	n(%)	n(%)	p -value
Gender			
Male	9(81.8)	72(64.9)	0.331 †
Female	2(18.2)	39(35.1)	
Comorbidity			
DM	7(63.6)	24(21.6)	0.006 †
HTN	6(54.5)	46(41.4)	0.526 †
IHD	6(54.5)	6(5.4)	<0.001 †
COPD	5(45.5)	19(17.1)	0.039 †
Renal Dysfunction	1(9.1)	18(16.2)	>0.999 †
Active Tobacco Use			
Yes	3(27.3)	46(41.4)	0.523 †
No	8(72.7)	65(58.6)	

COPD: Chronic Obstructive Pulmonary Disease, DM: Diabetes Mellitus, IHD: Ischemic Heart Disease, HTN: Hypertension
 †Independent t-test applied, †Fisher-Exact test applied, p -value \leq 0.05 considered significant

The mean length of hospital stay was 6.23 \pm 1.13 days. ASA status I was observed in majority 46(37.7%), ASA status II in 48 (39.3%), while ASA status III in 28(23%) patients. The mean pre-operative WBCs was 16542.3 \pm 1664.3 per mm³. Preoperative SIRS was observed in 31(25.4%) patients. The mean operative time was 38.40 \pm 4.27 minutes. Wound classification showed that 66(54.1%) had clean-contaminated wound, 44(36.1%) had contaminated, while 12(9.8%) had dirty wound. Rehospitalization within 30 days was observed in 40(32.8%) patients. A significant association of wound infection was observed with ASA status (p -value 0.020), preoperative SIRS (p -value <0.001), wound classification (p -value 0.002), and

rehospitalization within 30 days (p -value <0.001). (Table-II)

Table-II: Comparison of Wound Infection with Demographics and Baseline Clinical Characteristics (n=122)

Variables	Wound Infection		p -value
	Yes (n=11)	No (n=111)	
	Mean \pm SD	Mean \pm SD	
Length of hospital stay, days	6.18 \pm 1.33	6.24 \pm 1.11	0.864 †
Preoperative WBCs, per mm ³	14400.7 \pm 940.1	16754.9 \pm 1569.17	<0.001 †
Operative Time, mins	40.27 \pm 3.90	38.21 \pm 4.27	0.128 †
	n (%)	n (%)	p -value
ASA			
I	2(18.2)	43(39.4)	0.020 †
II	3(27.3)	46(42.2)	
III	6(54.5)	20(18.3)	
Preoperative SIRS			
Yes	9(81.8)	22(19.8)	<0.001 †
No	2(18.2)	89(80.2)	
Wound Classification			
Clean-Contaminated	2(18.2)	68(61.3)	0.002 †
Contaminated	5(45.5)	35(31.5)	
Dirty	4(36.4)	8(7.2)	
Rehospitalization within 30 days			
Yes	9(81.8)	31(27.9)	<0.001 †
No	2(18.2)	80(72.1)	

ASA: American Society of Anesthesiology, SIRS: Systemic Inflammatory Response Syndrome, UTI: Urinary Tract Infection
 †Independent t-test applied, †Fisher-Exact test applied, p -value \leq 0.05 considered significant

Post-operative complications showed that pulmonary infection was the most common postoperative complication 43(35.2%), followed by intraabdominal bleeding 28(23%), bowel obstruction 26(21.3%), urinary tract infection (UTI) 25(20.5%), while wound dehiscence and colon fistula in 8(6.6%) each. Except UTI, wound infection was found significantly higher among patients who had wound dehiscence (p -value <0.001), bowel obstruction (p -value 0.012), pulmonary infection (p -value <0.001), intrabdominal bleeding (p -value <0.001), and colon fistula (p -value <0.001). (Table-III)

DISCUSSION

According to the findings of the current study, nine percent of the patients had wound infection. Somewhat similar findings were reported in previous studies as well. In a recent study Koumu et al reported postoperative wound infection in approximately seven of the patients.¹³ Petrosillo *et al.*¹⁴ reported a slightly

lower, i.e., five percent however Aranda *et al.*¹⁵ reported slightly higher wound infection, i.e., thirteen percent approximately. In a little bit old published study, Marzouk *et al* reported wound infection in four percent patients.¹⁶ In contrast to the current study findings, Garcel *et al* reported wound infection in twenty two percent patients.¹⁷ Xiao *et al* in their reported year wise comparison of wound infection.¹⁸ Their findings showed a gradual decline in the prevalence of wound infection from ten percent approx. in 2010 to around four percent in 2013.¹⁸ Surprisingly a considerably higher rate was reported in a study from Pakistan by Nazir *et al* in which wound infection was reported in more than twenty-seven percent of the patients.¹⁹ However, somewhat similar to the current study findings, Ibrahim *et al* in their study reported infection in twelve percent patients who underwent open appendectomy.⁹ Both these studies from Pakistan compared the outcome between laparoscopic and open appendectomies. However, better findings were reported among patients who were treated with laparoscopic appendectomy.

Table-III: Comparison of Wound Infection with Post Operative Complications

Postoperative Complications	Wound Infection		p-value]
	Yes (n=11)	No (n=111)	
	n (%)	n (%)	
Wound Dehiscence	5 (45.5)	3 (2.7)	<0.001
Bowel Obstruction	6 (54.5)	20 (18.0)	0.012
Pulmonary Infection	10 (90.9)	33 (29.7)	<0.001
UTI	4 (36.4)	21 (18.9)	0.172
Intraabdominal Bleeding	8 (72.7)	20 (18.0)	<0.001
Colon Fistula	4 (36.4)	4 (3.6)	<0.001

UTI: Urinary Tract Infection

]Fisher-Exact test applied, p-value ≤0.05 considered significant

Incisional wound infection was found in 63.6 percent of the eleven patients with wound infection in the current study, and organ/space wound infection was found in 54.5 percent of the patients. Post-operative complications showed that pulmonary infection, intraabdominal bleeding, bowel obstruction, and UTI were the most common postoperative complications. Except UTI, wound infection was found significantly higher among patients who had wound dehiscence, bowel obstruction, pulmonary infection, intrabdominal bleeding, and colon fistula.

Similar to the current study findings, Koumu *et al.*¹³ and Langelotz *et al.*²⁰ also reported statistically insignificant association of gender with wound

infection. In the current study, however, the mean age of patients with no wound infection was considerably greater than that of patients with wound infection. This contrasts with the findings of studies by Watanabe *et al.*²¹ and Morikane *et al.*²²

Furthermore, as per current study findings, diabetes, IHD, and COPD were significantly higher among patients who had wound infection as compared to those who did not have wound infection.

Rehospitalization within 30 days was observed in 32.8% patients. A significantly higher proportion of rehospitalization within 30 days was observed among patients who had wound infection compared to those who had no wound infection. Similar findings were reported in a previous study as well.¹⁸

Despite of some limitations, this study is an effort in reporting the outcome of wound infection among patients with open appendectomy from Pakistan where the limited number of studies are published so far. Further largescale multicenter studies are recommended that can overcome the limitations of the current study.

LIMITATION OF STUDY

There were certain limitations in the current study. Firstly, this was just an observational study with no comparison group. Previously studies were conducted that have compared the outcome in between Laparoscopic and Open Appendectomies. Secondly, obese patients were excluded in the current study. Thirdly, treatment modalities offered were not observed. Lastly, quality of life of the patients were also not studied in this study.

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CONCLUSION

After an open appendectomy, nine percent of patients developed a postoperative wound infection. A higher age, presence of comorbidity such as diabetes, IHD, COPD, preoperative SIRS, contaminated/dirty wound classification, and lower preoperative WBCs were the factors significantly associated with wound infection. While pulmonary infection and intraabdominal bleeding were the most common post-operative complications.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

HMM & SRN: Data acquisition, data analysis, critical review, approval of the final version to be published.

A & SHT: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SFR: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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