

## Open appendectomy in acute appendicitis in a Palestinian government hospital: a retrospective analysis of histopathological findings, hospital stay, outcomes and postoperative complications

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### ABSTRACT

Globally, acute appendicitis is the most commonly performed surgical emergency of the abdomen. The present study was conducted to report on the duration of stay at hospitals after open appendectomy, histopathological abnormalities, and postoperative complications among patients who undergo open appendectomy in Palestinian surgical practice. The study was conducted using a retrospective observational design in which patient records ( $n = 100$ ) were identified, sampled, and included in the analysis. The study was conducted at one of the main hospitals in Hebron District in the West Bank of Palestine. Of the patients included, 52% were less than 18 years old, 59% were male in gender, 64% were discharged in 2 or less days, 80% had histopathological abnormalities detected, 97% had their appendices removed, and the vast majority (94%) did not have any postoperative complications. Of the 80 patients in which their specimens had histopathological abnormalities, phlegmonous appendicitis was prevalent in 49 patients (61.3% of the cases). Postoperative complications were documented in 6% of patients. Postoperative hospital stay was significantly longer for patients who had abnormal histopathology ( $p$  value  $< 0.05$ ), abdominal drainage ( $p$  value  $< 0.01$ ), and those with postoperative complications ( $p$  value  $< 0.01$ ). Patients who were less than 18 years old had significantly higher number of specimens with no histopathological abnormalities (Fisher's exact test = 8.74,  $p$  value  $< 0.05$ ). Male patients had significantly higher number of phlegmonous appendicitis cases compared to female patients (Fisher's exact test = 13.0,  $p$  value  $< 0.05$ ). Patients who had phlegmonous appendicitis tended to stay longer than patients who had other histopathological abnormalities (Fisher's exact test = 18.7,  $p$  value  $< 0.01$ ). In conclusion, open appendectomies are still commonly performed in the Palestinian surgical practice with comparatively low incidence of postoperative complications. Future studies should be directed at reducing postoperative complications, improving patient outcomes, and reducing hospital stay.

**Keywords:** Acute appendicitis, Open appendectomy, Hospital stay, Patient outcomes, Postoperative complications.

### INTRODUCTION

Acute appendicitis is an inflammatory condition of the vermiform appendix that is one of the frequent causes of abdominal pain [1]. This inflammation can progress and result in the formation of abscess, ileus, peritonitis, and if left untreated can result in death of the patient. Globally, acute appendicitis is the most commonly performed surgical emergency of the abdomen [2]. According to recent statistics, the lifetime risk of acute appendicitis was estimated at around 8% of the global basis [2-5]. Acute appendicitis affects patients from different age groups, genders, races, ethnic groups, and socioeconomic classes [4, 6].

The lifetime risk for acute appendicitis differs between both genders. It has been estimated that the lifetime risk for males was 8.6% and for females 6.7% [7]. Among pregnant women, acute appendicitis is the most frequent non-obstetric surgical procedure performed with an incidence rate of 63 per 100,000 pregnancies [8]. Studies have shown that of children with acute abdominal pain referred to pediatric surgical units, approximately 1 in 4 turn out to have acute appendicitis. According to some estimates, more than 300,000 patients undergo appendectomies every year in the United States [8, 9].

It is widely believed that appendicitis is a result of luminal obstruction that has various etiologies [10, 11]. Such obstruction can result in overproduction of mucus and overgrowth of bacteria, which would eventually lead to wall tension and if persisted would lead to necrosis and perforation [1]. There are many signs and symptoms that can help in clinical evaluation and rule in acute appendicitis. These signs and symptoms include pain in the right lower quadrant, rigidity in the abdominal region, and pain that radiates from the periumbilical region to the right lower quadrant [11].

Clinically, appendicitis is often categorized as either complicated or uncomplicated appendicitis [1]. When the appendicitis is simple that occurs with no signs of perforation, abscess, or necrosis, this appendicitis can be categorized under uncomplicated appendicitis. However, when the appendicitis takes a form of intense inflammation that is characterized with rapid necrosis and/or perforation that leads to formation of abscess, this appendicitis can be categorized under appendicitis.

In clinical practice, the majority of appendicitis cases can be categorized under uncomplicated appendicitis. However, the prevalence of complicated appendicitis ranges from 4%-25% [12, 13]. In surgical practice, emergency appendectomy has been the standard of care for the management of acute appendicitis because surgeons fear progression of the appendicitis to a more risky condition like progression of unperforated appendicitis to perforated appendicitis [6, 14]. In some complicated appendicitis, emergency appendectomy might cause severe manipulation of tissues which could be associated with higher risk for mortality and morbidity [15, 16]. In such cases, physicians might opt for conservative treatment which consists of drainage of periappendiceal abscess, administration of antibiotics, and later interval appendectomy [17]. Consensus on the need for interval appendectomy has not been achieved and still equivocal because of its inherent risks of recurrence, potential underlying malignancies, and perioperative risks [18].

In today's surgical practice, open as well as laparoscopic surgeries are often performed as standard of care for the management of acute uncomplicated appendicitis. Although

laparoscopic appendectomy was shown to be superior to open surgery in the management of complicated appendicitis [19], both surgical procedures are widely accepted in everyday surgical practice worldwide [20, 21]. Laparoscopic appendectomy has many advantages over open surgery relevant to improved safety, minimal risk for infection of the surgical site [22, 23]. However, laparoscopic appendectomy should be avoided in some cases, especially, for pediatric patients with complicated appendicitis because it might increase the risk for intraabdominal abscess postoperatively [24].

In Palestine, open appendectomy in the management of acute appendicitis is still commonly performed. In a histopathological study conducted in Gaza Strip, Hamdona et al reported that *Enterobius vermicularis* was present in 30 (15%) of 200 appendices of patients who underwent appendectomy [25]. Little was reported on the management of acute appendicitis in Palestine. Little was also reported on the duration of stay at hospitals after open appendectomy, histopathological abnormalities, and postoperative complications among patients who undergo open appendectomy in Palestinian surgical practice.

The present study was conducted to fill this gap in the literature and report on the duration of stay at hospitals after open appendectomy, histopathological abnormalities, and postoperative complications among patients who undergo open appendectomy in Palestinian surgical practice. Another aim was to investigate associations between various socio-demographic and clinical characteristics of the patients with the duration of stay and outcomes of the patients.

## METHODS

### *Study design*

The study was conducted using a retrospective observational design in which patient records were identified, sampled, and included in the analysis [26, 27]. Inpatient medical records for patients who received emergency surgery for acute appendicitis in the period of 2019 were searched and reviewed. The review process focused on the operative, histopathology findings, patient outcomes, and postoperative complications. The study was

conducted at the main governmental hospitals in Hebron District in the West Bank of Palestine.

### *Sample and selection of patient records*

The electronic patient record system used at the study site was searched for patient records who were admitted with acute appendicitis [26, 27]. The search was not restricted for certain age group, gender, or period of the surgical operation. Patient records were identified, retrieved, and selected if they were complete and contained all relevant information. Records that were incomplete and those missing all relevant information were excluded. For this study, a convenience sample of 100 complete patient records ( $n = 100$ ) were selected and included in the analysis.

### *Data collection form*

The information needed for this study were collected directly from the patient record into the data collection form that was created specifically for this study. The information needed were determined from previous studies that were conducted elsewhere [3, 4]. The data collection form was created into Excel Spreadsheet (Microsoft Excel 2013, Microsoft Inc.). Information relevant to age of the patient, gender, duration of stay at the hospital, histopathology of the specimen, surgical procedure, and postoperative complications were collected into the data extraction form.

### *Data collection*

Relevant patient information was collected by the main investigator into the data collection form. To ensure accuracy and completeness, collection of data was double checked and patient records were accessed again whenever needed.

### *Statistical analysis*

The data collected were entered into IBM SPSS for Windows v.21.0 (IBM, Armonk, New York, United States). Data were assessed for normality of distribution using Shapiro-

Wilk test. Non-normally distributed data were grouped into categories. Mann-Whitney  $U$  test was used to assess differences between categories. Correlations were investigated using Spearman's correlation coefficient (Spearman's rho). Associations between categories were also investigated using Fisher's exact test. Central tendency was measured using median and interquartile range (IQR). Statistical significance was considered when the  $p$  value was  $< 0.05$ .

### *Ethical considerations*

The study was conducted in accordance with the ethical principles for medical research that involves medical subjects that was declared by the World Medical Association in Helsinki, Finland (Declaration of Helsinki in 1964 and updated in the general assembly of the World Medical Association that was held in Fortaleza, Brazil in 2013). The study was approved by the administration of the hospital. No information leading to the identification of the patients was collected. Data collected was coded and completely anonymized during the analysis and reporting.

## **RESULTS**

### *The study patients*

In this retrospective study, a total of 100 patients were included in the analysis. Of those, 52% were less than 18 years old, 59% were male in gender, 64% were discharged in 2 or less days, 80% had histopathological abnormalities detected, 97% had their appendices removed, and the vast majority (94%) did not have any postoperative complications. The median age of the patients was 18 with an IQR 14.3 years and the median duration of stay at the hospital was 2 with an IQR of 1 day. Duration of the surgical procedure spanned the range of 30-45 minutes and patients were often discharged on antibiotics including ceftriaxone and metronidazole. Details of the sociodemographic and clinical characteristics of the study patients are shown in Table 1.

**Table (1):** Sociodemographic and clinical details of the study patients included in this study.

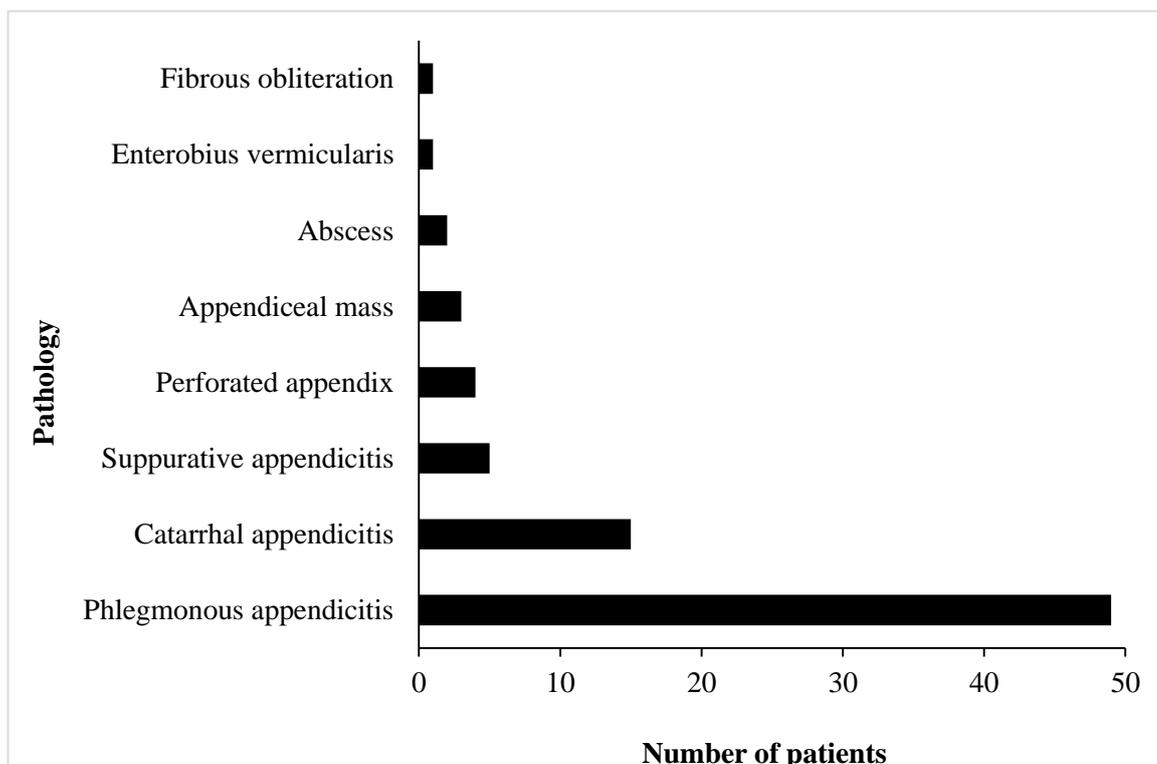
Characteristic	n	%
<b>Age (years)</b>		
< 18	52	52.0
≥ 18	48	48.0

Characteristic	n	%
<b>Gender</b>		
Male	59	59.0
Female	41	41.0
<b>Duration of stay at the hospital (days)</b>		
≤ 2	64	64.0
> 2	36	36.0
<b>Histopathology</b>		
Presence of histopathological abnormality	80	80.0
No histopathological abnormality	20	20.0
<b>Surgical procedure</b>		
Open appendectomy	97	97.0
Abdominal drainage	3	3.0
<b>Postoperative complications</b>		
Presence of complications	6	6.0
Absence of complications	94	94.0

#### *Histopathology of the specimens*

Of the 80 patients in which their specimens had histopathological abnormalities, phlegmonous appendicitis was prevalent in 49 patients (61.3% of the cases). Catarrhal appendicitis was prevalent in 15 patients (18.8%

of the cases. *Enterobius vermicularis* and fibrous obliteration were the least prevalent histopathologies (1.3% of the cases for each condition). Details of the histopathological abnormalities detected in the specimens are shown in Figure 1.

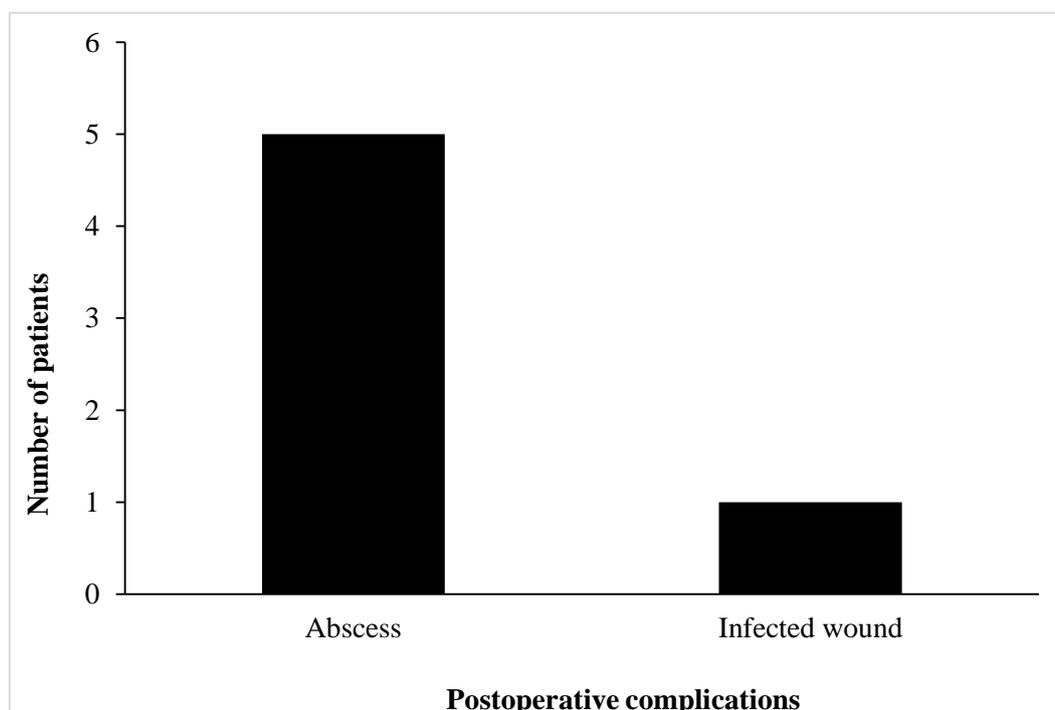


**Figure (1):** Prevalence of histopathological abnormalities in the specimens of the patients included in this study.

### Postoperative complications

Although postoperative complications were absent in the vast majority of the pa-

tients operated (94%), postoperative complications were documented in 6 patients. Of those, abscess was prevalent in 5 patients (Figure 2).



**Figure (2):** Postoperative complications documents in the patients included in the analysis.

### Associations between duration of stay at the hospital and other sociodemographic and clinical characteristics of the patients included in this study

In this study, patients whose specimens had abnormal histopathology had significantly longer hospital stays compared to patients whose specimens had no histopathological abnormalities (p value = 0.036). Patients who had their appendices removed had signif-

icantly shorter hospital stays compared to patients who had abdominal drainage (p value = 0.001). Patients who suffered postoperative complications has significantly longer hospital stays compared with patients who did not suffer postoperative complications (p value = 0.002). However, age and gender were not significantly associated (p value > 0.05). Details of the associations between duration of stay at the hospital and other sociodemographic and clinical characteristics of the patients included in this study are shown in Table 2.

**Table (2):** Associations between duration of stay at the hospital and other sociodemographic and clinical characteristics of the patients included in this study.

Characteristic	n	%	Median	IQR	Mean rank	P value	Correlation	P value
<b>Age (years)</b>								
< 18	52	52.0	2.0	1.0	47.8	0.251	0.12	0.253
≥ 18	48	48.0	2.0	1.0	53.5			
<b>Gender</b>								
Male	59	59.0	2.0	1.0	50.8	0.879	0.02	0.880
Female	41	41.0	2.0	1.0	50.0			

Characteristic	n	%	Me- dian	IQR	Mean rank	P value	Correla- tion	P value
<b>Histopathology of the specimen</b>								
Absence of histo- pathological ab- normality	20	20.0	2.0	1.0	40.2	0.037	0.21	0.036
Presence histo- pathological ab- normality	80	80.0	2.0	0.0	53.1			
<b>Surgical procedure</b>								
Open appendec- tomy	97	97.0	2.0	1.0	49.0	0.001	0.34	0.001
Abdominal drain- age	3	3.0	8.0	2.5	97.7			
<b>Postoperative complications</b>								
Presence of com- plications	94	94.0	4.5	2.5	48.6	0.003	-0.30	0.002
Absence of com- plications	6	6.0	2.0	1.0	80.1			

IQR: interquartile range.

#### *Associations between age and other socio-demographic and clinical characteristics of the patients included in this study*

In this study, there was no association between age of the patient and gender, duration of stay at the hospital, presence or absence of

abnormal histopathology, surgical procedure performed, and occurrence of postoperative complications ( $p$  value  $> 0.05$ ). Details of the associations between age and other sociodemographic and clinical characteristics of the patients included in this study are shown in Table 3.

**Table (3):** Associations between age and other sociodemographic and clinical characteristics of the patients included in this study.

Characteristic	n	%	Me- dian	IQR	Mean rank	P value	Correla- tion	P value
<b>Gender</b>								
Male	59	59.0	17.0	13.0	46.2	0.076	0.18	0.076
Female	41	41.0	21.0	20.5	56.7			
<b>Duration of stay at the hospital (days)</b>								
$\leq 2$	64	64.0	17.5	14.8	47.4	0.160	0.14	0.161
$> 2$	36	36.0	19.0	15.8	55.9			
<b>Histopathology of the specimen</b>								
Absence of histopathological abnormality	20	20.0	15.0	14.0	42.0	0.143	0.15	0.143
Presence of pathological ab- normality	80	80.0	19.0	13.8	52.6			
<b>Surgical procedure</b>								
Open appendectomy	97	97.0	18.0	15.0	49.9	0.203	0.13	0.204
Abdominal drainage	3	3.0	26.0	7.5	71.5			
<b>Postoperative complications</b>								
Presence of complications	94	94.0	18.0	14.3	51.0	0.472	0.07	0.475
Absence of complications	6	6.0	14.5	21.0	42.3			

IQR: interquartile range.

### Other associations

Presence and absence of abnormal histopathology in the specimens of the patients were significantly associated with age of the patient ( $p$  value  $< 0.05$ ). Patients who were less than 18 years old had significantly higher number of specimens with no histopathological abnormalities (Fisher's exact test = 8.74,  $p$  value  $< 0.05$ ). Gender was significantly associated with presence and absence of abnormal histopathology in the specimens of the patients ( $p$  value  $< 0.05$ ). Male patients had significantly higher number of phlegmonous appendicitis cases compared to female patients (Fisher's exact test = 13.0,  $p$  value  $< 0.05$ ). Patients who had phlegmonous appendicitis tended to stay longer than patients who had other histopathological abnormalities (Fisher's exact test = 18.7,  $p$  value  $< 0.01$ ).

### DISCUSSION

In this retrospective observational analysis duration of stay at hospitals, histopathological abnormalities, and postoperative complications among patients who underwent open appendectomy in a surgical unit in a main hospital in Hebron District of the West Bank of Palestine are reported for the first time. Associations between sociodemographic and clinical characteristics were also reported.

Despite the relatively small sample size, the study included pediatric as well as adult patients (almost half of the patients were pediatric and half was adults) and both genders (approximately 60% were males). The sample analyzed in this study was consistent in terms of higher prevalence and incidence of acute appendicitis among male patients compared to female patients. Studies have reported higher lifetime risk for developing acute appendicitis among males compared to females [7]. Similarly, acute appendicitis was reported as a common health issue in pediatric populations [28, 29].

In the present study, the majority of the patients (64%) were discharged after 2 or less days of hospital stay. Findings of this study were consistent with those previously reported elsewhere in which median hospital stay after open appendectomy was 2.88 days [30]. Studies comparing hospital stays for patients who

underwent open vs. laparoscopic appendectomies reported a significantly shorter duration of stay in the hospital for patients who underwent laparoscopic procedures [30-32]. It is noteworthy mentioning that open surgeries are shorter in duration compared to laparoscopic procedures [33]. In this study, the duration of the procedures ranged from 30-45 minutes. Laparoscopic appendectomies last on average 60 minutes.

Histopathology of appendiceal specimens showed that abnormalities were found in the majority of the specimens studied. However, no abnormalities were detected in 20% of the specimens included. Findings of this study were consistent with those reported elsewhere [34]. In a large histopathological study of 24,697 appendectomies, Charfi et al reported that negative appendectomies were prevalent in 15% of the cases. In this study, histopathology of the specimens studied showed higher prevalence of phlegmon (Figure 1). Studies elsewhere showed that 2%-6% of the patients with acute appendicitis had appendiceal masses that were described as inflammatory phlegmon or abscesses [35]. Another study compared findings of enhanced computerized tomography (CT) and histopathological diagnosis of acute appendicitis and evaluation of the severity of the condition [36]. The study included 75 cases, of those, 34 had phlegmonous, 31 had gangrenous, and 10 had catarrhal appendicitis. The study concluded that CT can be useful in the diagnosis and evaluation of severity of appendicitis. Advanced appendicitis (suppurative and perforated) was reported in 5 and 4 cases in this analysis.

In this study, *Enterobius vermicularis* was reported in 1 case. Findings of this study were consistent with those reported globally in which the incidence of *Enterobius vermicularis* among patients with symptomatic appendicitis spanned the range of 0.2%-41.8% [37, 38]. Results shown in this retrospective analysis contradict with those previously reported in Gaza Strip by Hamdona et al in which they reported that *Enterobius vermicularis* was positive in 15% appendices of patients who underwent appendectomy [25]. Another study by Ahmad et al reported 2.8% of 2,956 specimens obtained from patients

with acute appendicitis in Pakistan were positive for *Enterobius vermicularis* [38]. Taken together these findings together, apparently *Enterobius vermicularis* was a rare parasitic infection that might have caused appendicitis among patients in the West Bank of Palestine.

In this study, 3% of the patients underwent abdominal drainage. Abdominal drainage has been advocated as a procedure to minimize intra-peritoneal abscess following open appendectomy for complicated appendicitis [39]. Abdominal drainage has been criticized because of low evidence for benefits, increased risk of surgical site infection, and increased length of hospital stay [26, 40]. In a recent systematic review, Li et al analyzed 6 randomized controlled trials with 521 patients in which abdominal drainage was compared with no drainage in patients who underwent open appendectomy for complicated appendicitis [39]. The evidence to assess the impact of abdominal drainage compared with no drainage on intra-peritoneal abscess or wound infection was insufficient. The review concluded that there was no evidence for clinical benefits of using abdominal drainage for patients who underwent open appendectomy for complicated appendicitis.

Postoperative complications were reported in 6% of the patients. Previous studies have reported higher risk of postoperative complications in open appendectomies compared to laparoscopic appendectomies [41-43]. In this study, wound infection was reported in 1% of the patients. Findings of this study were lower than those previously reported by Khan et al in which wound infections were reported in 5 out of 54 patients who underwent open appendectomies [41]. In another study, Vahdad et al reported that the prevalence of wound infection was 11.5% of 122 children who underwent open appendectomy [43]. In this study, abscess was reported in 5% of the patients. In a previous study by McKinlay et al, there was no significance difference in the prevalence of intraabdominal abscess among children who underwent open appendectomies compared to those who underwent laparoscopic appendectomies [44].

In this study, age was not associated with length of stay at the hospital. Ghnam compared outcomes of appendicitis in elderly (>

60 years old) and younger patients (< 30 years old) [45]. There was a difference in the length of postoperative and total hospital stay between the two groups. In this study, patients were categorized into two categories: pediatric (< 18 years old) and adults ( $\geq$  18 years old). Due to the limited number of patients who were above 60 years old, findings of this study could not be compared to those reported by Ghnam. Similarly, length of stay was not associated with gender. Previous studies have reported conflicting findings with regard to outcomes of appendectomy and gender. Salö et al compared outcomes of appendectomies in pediatric population from a gender perspective [46]. The study showed that there were differences in terms of negative appendectomies and postoperative complications in female patients compared to male patients. A study by Stein et al showed that incidence of acute appendicitis was more frequent in male patients compared to female patients during the summer months [47]. Histopathological findings were significantly ( $p$  value < 0.05) associated with increased length of postoperative hospital stay in this study. Findings of this study were consistent with those reported in larger retrospective studies elsewhere [27, 48]. Probably, patients with complicated conditions as revealed by the histopathology could be more susceptible to more complications and would eventually stay more at the hospital. Again, patients who underwent abdominal drainage stayed significantly ( $p$  value < 0.01) longer at the hospital. Findings of this study were consistent with those reported previously [49, 50]. Abdominal drainage has been associated with complications of appendectomy and complicated appendicitis [24]. Similarly, patients who suffered postoperative complications stayed significantly ( $p$  value < 0.01) longer than those who did not suffer postoperative complications. Occurrence of postoperative complications is known to increase hospital stay postoperatively as well as total hospital stays of the patient [45].

#### **Limitations of the study**

This study is not without limitations; therefore, these limitations should be taken into account when interpreting the findings reported in this study. First, this study was conducted in a retrospective observational design.

Other prospective, comparative, or interventional designs could have reported superior evidence of the outcomes of the patients who undergo appendectomies. Second, this study included patients who underwent open surgeries and did not include patients who underwent laparoscopic procedures. However, comparing outcomes of patients who undergo open surgeries and those who undergo laparoscopic procedures could be interesting. Third, the sample size included in this study was relatively small for a retrospective study. Many previous studies have reported findings from a larger number of patients. The small sample size and the relatively limited number of variables collected in this study hindered comparing outcomes with previous studies. Finally, direct observation was not used in this study and all data were obtained from the patient records. Although a standard data collection form was used in this study, the risk of bias in data entry could not be assessed or minimized.

## CONCLUSIONS

In conclusion, open appendectomies are still performed in the Palestinian surgical practice. Prevalence of postoperative complications was relatively low after open surgeries. Absence of abnormal histopathological findings was comparable with those reported elsewhere in the world. Length of stay in the hospital was significantly longer for patients who had histopathological abnormalities, subjected to abdominal drainage, and had postoperative complications. Future studies should be directed at comparing patient outcomes among patients who undergo open and laparoscopic procedures.

## CONFLICT OF INTERESTS

The authors declare that no conflicts of interest in this manuscript.

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