

# Is Appendectomy Performed Early for Patients with Acute Appendicitis: Single Centre Experience

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## Abstract

**Background:** Acute appendicitis usually requires surgery. In addition, whether to perform early or delayed appendectomy is still a controversial issue.

**Aim:** The aim of this study is to assess the practice of offering early appendectomy to patients with acute appendicitis in our centre and compare between early and delayed appendectomies with respect to complications.

**Methods:** This study carried out the retrospective analysis of prospectively maintained data of all patients admitted with acute appendicitis in our institute from 01/01/2013 to 30/11/2017. Early appendectomy was defined as appendectomy within the first 12 hours of the clinical diagnosis while late appendectomy is after 12 hours of diagnosis. Outcome Measures: combined drainage procedures, pathologic findings, time to a soft diet, postoperative complications, length of hospital stay, hospital costs and Opioid Intake.

**Results:** During the study period, a total of 311 patients underwent appendectomies. There were no differences between early and late appendectomy in terms of combined drain (12.4% vs. 7.8%;  $p=0.178$ ), time to soft diet (83.4% vs. 87.3%;  $p=0.329$ ), length of stay ( $p=0.669$ ), total costs ( $p=0.612$ ) and opioid intake (82.8% vs. 80.7%;  $p=0.643$ ).

**Conclusion:** Early appendectomy is not performed for most of the patients presenting with acute appendicitis in our centre. Our findings showed that there is not much difference in the outcomes of early and delayed appendectomies.

**Keywords:** Acute appendicitis; Appendectomy; Complication; Perforation

## Introduction

Acute appendicitis (AA) is the most common emergency disease that requires surgery [1]. There are some studies that have highlighted the medical treatment of AA and reported that delayed surgery did not result in morbidity and complications in both paediatric and adult age group [2-6]. However, several studies have showed that any delay in surgery would lead to postoperative morbidity and complications [7-9]. Performing appendectomy early or delayed still a controversial issue. Our aim of study to assess the practice of offering early appendectomy to patients with acute appendicitis in our centre and compare between early and delayed appendectomies with respect to complications.

## Materials and Methods

### Patients

This is a retrospective, observational study designed at a single institution. The medical records of patients with AA who underwent surgery between 01/01/2013 to 30/11/2017 were retrospectively reviewed. The following patients were excluded from this study: (1) pregnant women, (2) those with any severe medical disease requiring intensive care, and (3) those that underwent incidental, interval, and negative appendectomies. The selected patients were then divided into two groups for comparison: (1) Early: those with a time of 12 hours or less from arrival to incision, and (2) Late: those with a time of longer than 12 hours from arrival to incision.

### Data collection

After ethical approval, the data were collected from the electronic medical records. The following parameters were included: demographics, time from diagnosis to operation, initial body temperature, initial white blood cell (WBC) counts, method of appendectomy, Duration

of Procedure, operation at night, combined drainage procedures, complicated appendicitis, time to a soft diet, length of hospital stay, hospital costs, and opioid intakes.

### Outcome measures

The outcome measures were Duration of Procedure, operation at night, combined drainage procedures, complicated appendicitis, and time to a soft diet, length of hospital stay, hospital costs, and opioid intakes.

### Statistical analysis

The data were analysed using SPSS version 22. Mean  $\pm$  standard deviation (SD) was used to analyse the data. The  $p$  value of less than 0.05 was considered statistically significant.

## Results

This retrospective study aimed to compare the outcome of early versus delayed appendectomies. A total of 311 participants were enrolled in the study. The data findings were organised into different sections based on the objectives of the research study. These sections

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were transferred the data on 311 participants into results presented into two sections.

First, the descriptive analysis section which reported proportions for categorical variables and mean  $\pm$  standard deviation for continuous variables which presented in **Table I** with Second, the inferential analysis section presented in **Table II** in terms of univariate analysis for the association between socio-demographic characteristics versus mode of appendectomy. This result interpreted in details the characteristics of the study population and the association between sociodemographic characteristics versus mode of appendectomy to which address the study objectives.

### Section 1: Descriptive statistics

**Table I** represents the descriptive analysis of the socio-demographic characteristics of the 311 participants enrolled in this study. The results were presented as mean  $\pm$  standard deviation for all continuous variables and as number and percentages for all categorical variables. Age in years which had been calculated as mean  $\pm$  standard deviation had a number of  $23.9 \pm 11.3$ . Among these numbers, majority of them were males as 208 (66.9%) while 103 (33.1%) were females. 175 (56.3%) of them had open appendectomy whilst 136 (43.7%) had laparoscopic. Initial body temperature which was presented as mean  $\pm$  standard deviation had  $36.6 \pm 03.7$ . Initial blood cell counts which was counted as mean  $\pm$  standard deviation shows  $12.8 \pm 08.7$ . Majority of the participants have no co morbidities as 268 (86.2%) compared to without co morbidities as 43 (13.8%). The mean hours from arrival to time of incision was  $14.7 \pm 12.5$  standard deviation. Mode of appendectomy has been divided into categories as early ( $\leq 12$  hours) with 145 (46.6%) and delayed ( $>12$  hours) with 166 (53.4%). The mean Duration of Procedure was  $1.4 \pm 0.6$  standard deviation. Most of operation were done during the day as 155 (72.7%) while 85 (27.3%) were conducted at night. Patients who had complicated appendicitis were 47 (15.1%). Among these numbers, 23 (71.1%) were pus and perforated, 17 (37.8%) were gangrenous and 05 (01.6%) were mass. Most of the patients had one-day soft diet as 266 (85.5%) whereas 45 (14.5%) had more than one-day soft diet. The mean hospital stay of patients (days) was  $02.2 \pm 01.6$  standard deviation and the total cost expressed as Saudi Arabian Riyals (SAR) was  $4360.1 \pm 3176.4$  standard deviation. Only 11 (03.5%) patients had post op complications while 03 (01.0%) had readmission after 30 days and 254 (81.7%) patients had opioid intake.

### Section 2: Inferential statistics

**Table II** presents the comparison between early versus delayed modes of appendectomy in relation to socio-demographic characteristics of participants. Analysis revealed that methods of appendectomy (p-value  $<0.001$ ), co morbidities (p-value 0.046), hours from arrival to time of incision (p-value  $<0.001$ ), operation at night (p-value 0.002) and complicated appendicitis (p-value 0.053) were all statistically significant. Other socio-demographic and clinical characteristics included in the table have no significant relationship with the outcome variables.

**Table III** shows the comparison of patients' clinical characteristics at age  $\leq 14$  years and the mode of appendectomy. The results revealed that none of the clinical characteristics had a significant relationship with the mode of appendectomy.

**Table IV** shows multivariate regression analyses predicting the mode of appendectomy from the participants' socio-demographic characteristics. Logistic regression analysis estimated the factors that influenced mode of appendectomy for the two groups of participants: early and delayed. Socio-demographic factors were controlled in the model such as age in years, gender, methods of operation, initial body temperature, initial white blood cells counts, co morbidities, hours from arrival to time of incision, duration of procedure, operation at

night, complicated appendicitis, combined drain, time to soft diet, length of stay, total costs, and opioid intake. The result shows that only the hours from arrival to time of incision were statistically significant. The rest of the socio-demographic and clinical characteristics included in the model provided no statistical difference between the outcome interests.

## Discussion

AA is the most common emergency disease that requires surgery [1] and is more prevalent in males than in females. It is commonly observed in the age group of 20 to 40 years [10]. Patients are usually diagnosed based on clinical symptoms such as periumbilical pain shifted to right iliac fossa; signs like tenderness and rebound

**Table I:** Descriptive Analysis for Socio Demographics Characteristics<sup>(n=311)</sup>.

Factor	Results
<b>Age in years</b>	23.9 $\pm$ 11.3
<b>Gender</b>	
· Male	208 (66.9%)
· Female	103 (33.1%)
<b>Methods of appendectomy</b>	
· Open	175 (56.3%)
· Laparoscopic	136 (43.7%)
<b>Initial body temperature</b>	36.6 $\pm$ 03.7
<b>Initial white blood cells counts</b>	12.8 $\pm$ 08.7
<b>Comorbidities</b>	
· Yes	43 (13.8%)
· No	268 (86.2%)
<b>Hours from arrival to time of incision</b>	14.7 $\pm$ 12.5
<b>Mode of appendectomy</b>	
· Early ( $\leq 12$ hours)	145 (46.6%)
· Delayed ( $>12$ hours)	166 (53.4%)
<b>Duration of procedure</b>	1.4 $\pm$ 0.6
<b>Operation at night</b>	
· Yes	85 (27.3%)
· No	115 (72.7%)
<b>Complicated appendicitis</b>	
· Yes	47 (15.1%)
· No	264 (84.9%)
<b>If complicated, please specify</b>	
· Pus and perforated	23 (51.1%)
· Gangrenous	17 (37.8%)
· Mass	05 (11.1%)
<b>Combined drain</b>	
· Yes	31 (10.0%)
· No	280 (90.0%)
<b>Time to soft diet</b>	
· One day	266 (85.5%)
· More than one day	45 (14.5%)
<b>Length of stay</b>	02.2 $\pm$ 01.6
<b>Factor</b>	<b>Results</b>
<b>Total cost</b>	4360.1 $\pm$ 3176.4
<b>Complications post-op</b>	
· Yes	11 (03.5%)
· No	300 (96.5%)
<b>Readmission after 30 days</b>	
· Yes	03 (01.0%)
· No	308 (99.0%)
<b>Opioid intake</b>	
· Yes	254 (81.7%)
· No	57 (18.3%)

Results are expressed as mean  $\pm$  standard deviation, number and percentage.

**Table II:** Univariate Analysis for the Association between Socio-Demographic Characteristics vs Mode of Appendectomy<sup>(n=311)</sup>.

Factor	Mode of appendectomy		P-value <sup>∞</sup>
	Early(n=145)	Delayed(n=166)	
Age in years	23.0 ± 11.0	24.7 ± 11.5	0.186
Gender			
· Male	103 (71.0%)	105 (63.3%)	0.146
· Female	42 (29.0%)	61 (36.7%)	
Methods of appendectomy			
· Open	102 (70.3%)	73 (44.0%)	<0.001§
· Laparoscopic	43 (29.7%)	93 (56.0%)	
Initial body temperature	36.7 ± 03.1	36.5 ± 04.1	0.559
Initial white blood cells counts	13.8 ± 11.5	11.9 ± 05.2	0.063
Comorbidities			
· Yes	14 (09.7%)	29 (17.5%)	0.046 §
· No	131 (90.3%)	137 (82.5%)	
Hours from arrival to time of incision	08.5 ± 03.7	20.1 ± 14.7	<0.001§
Duration of procedure	01.4 ± 0.6	01.4 ± 0.5	0.656
Operation at night			
· Yes	52 (35.9%)	33 (19.9%)	0.002 §
· No	93 (64.1%)	133 (80.1%)	
Complicated appendicitis			
· Yes	28 (19.3%)	19 (11.4%)	0.053§
· No	117 (80.7%)	147 (88.6%)	
Combined drain			
· Yes	18 (12.4%)	13 (07.8%)	0.178
· No	127 (87.6%)	153 (92.2%)	
Time to soft diet			
· One day	121 (83.4%)	145 (87.3%)	0.329
· More than one day	24 (16.6%)	21 (12.7%)	
Length of stay	02.1 ± 01.5	02.2 ± 01.6	0.669
Total costs	4262.1 ± 3048.3	4445.8 ± 3290.9	0.612
Opioid intake			
· Yes	120 (82.8%)	134 (80.7%)	0.643
· No	25 (17.2%)	32 (19.3%)	

Results are expressed as number (%) and mean ± standard deviation. <sup>∞</sup> P-value has been calculated using chi-square test and independent t-test. <sup>§</sup>Significant value considering the level of significance when p-value is ≤ 0.05.

**Table III:** Comparison of Patients' Clinical Characteristics on age ≤ 14 years old vs. Mode of Appendectomy <sup>(n=73)</sup>.

Factor	Mode of appendectomy		P-value <sup>∞</sup>
	Early (n=36)	Delayed (n=37)	
Duration of procedure	10.1 ± 17.1	06.2 ± 12.5	0.264
Complicated appendicitis			
· Yes	09 (25.0%)	07 (18.9%)	0.53
· No	27 (75.0%)	30 (81.1%)	
If complicated, please specify			
· Pus & Perforated	03 (37.5%)	04 (57.1%)	0.542
· Gangrenous	04 (50.0%)	03 (42.9%)	
· Mass	01 (12.5%)	0	
Combined drain			
· Yes	03 (08.3%)	04 (10.8%)	0.719
· No	33 (91.7%)	33 (89.2%)	
Time to soft diet			
· One day	27 (75.0%)	32 (86.5%)	0.213
· More than one day	09 (25.0%)	05 (13.5%)	
Length of stay	02.7 ± 01.9	02.3 ± 01.6	0.981
Total costs	4555.6 ± 3752.7	4702.7 ± 3169.9	0.857

Results are expressed as number (%) and mean ± standard deviation. <sup>∞</sup> P-value has been calculated using chi-square test and independent t-test.

tenderness in right iliac fossa; laboratory tests such as elevated WBC count, neutrophils shifted to the left, etc.; and radiological studies [11]. Factors such as age, sex and ethnicity can complicate appendicitis [12].

Whether appendectomy should be performed early or should be delayed is still a controversial issue. Several studies have showed that AA can be treated medically, and delayed surgery did not result in any morbidity and complication.

**Table IV:** Multivariate analysis predicting mode of appendectomy as early vs. delayed from the socio demographic and clinical characteristics of participants (n=311).

Characteristics	Odds ratio	95% CI	P-value
<b>Age in years</b>	0.993	0.946-1.042	0.993
<b>Gender</b>			
· Male vs. Female	1.313	0.473-3.640	0.601
<b>Methods of appendectomy</b>			
· Open vs. Laparoscopic	1.137	0.428-3.018	0.797
<b>Initial Body temperature</b>	1.045	0.851-1.283	0.673
<b>Initial white blood cells counts</b>	0.995	0.935-1.058	0.867
<b>Comorbidities</b>			
· Yes vs. No	1.473	0.370-5.864	0.582
<b>Hours from arrival to time of incision</b>	2.423	1.930-3.041	<0.001 §
<b>Duration of Procedure</b>	1.828	0.765-4.367	0.174
<b>Operation at night</b>			
· Yes vs. No	0.81	0.277-2.363	0.699
<b>Complicated appendicitis</b>			
· Yes vs. No	1.461	0.297-7.186	0.641
<b>Combined drain</b>			
· Yes vs. No	1.341	0.239-7.514	0.739
<b>Time to soft diet</b>			
· One day vs. More than one day	2.246	0.444-11.363	0.328
<b>Length of stay</b>	0.453	0.004-46.958	0.738
<b>Total costs</b>	1	0.998-1.003	0.862
<b>Opioid intake</b>			
· Yes vs. No	1.678	0.463-6.084	0.431

OR-Odds Ratio; CI-Confidence Interval.

§Significant value.

A study done on 309 patients by Abou-Nukta showed that late appendectomy from 12-24 hours after presentation did not increase the rate of perforated appendix, operative times or length of stay [2]. Another prospective study done by Partelli et al. showed that delayed appendectomy in uncomplicated appendicitis due to surgical priorities did not affect the result [3]. A study done by Papziagas et al. showed that there was no increase in complications if appendectomy was performed within 24 hours [4].

Surana et al. published a study which showed no difference in the complication rates between early versus delayed appendectomy in the paediatric age group [5]. Yardeni et al.'s study showed that appendectomy done within 6-24 hours in children did not increase the rate of perforation in comparison with appendectomy done within 6 hours [6].

However, some studies showed that any delay in surgery will lead to postoperative morbidity and complications like perforation or abscess. Ditulo et al.'s study on 1,000 patients diagnosed with AA concluded that delayed appendectomy from the onset of symptom to appendectomy greater than 71 hours was unsafe and increased the rate of complications by 13 folds [7]. In a study, Von Titte et al. found that delayed appendectomy by 72 hours or more increased the incidence of perforation [8]. Moreover, there are several factors that affect the time of surgery such as operating room availability, limited availability of anaesthetists and decision of the surgeons [9].

In our study, the male to female ratio of 2.1:1 was high compared with the ratio of 1.1:1 reported in a previous local study. However, there were no significant differences in demographics and preoperative clinical characteristics between early appendectomy and delayed appendectomy groups [10-12].

In addition, there were no significant differences in time to soft diet and length of postoperative hospital stay between the two groups. There were also no significant differences in other parameters such as hospital costs and complications between the two groups. These results were similar with previous other studies [6,13,14].

## Limitations

This study was a retrospective observational study in a single centre. Thus, it was difficult to assess the number of patients who sought medical advice outside our centre in the post-operative period. In addition, our study did not include the effect of radiological findings in the management plan. The study did not include the early on use of antibiotics for suspected patient and the post op morbidity. The study did not focus on the symptomatology of emergency patients and the likelihood of complication from the patients' medical history such as pain duration, previous attacks, etc.

## Conclusion

Early appendectomy is not performed for most of the patients presenting with AA in our centre. There is not much difference in the outcome of both early and delayed appendectomy, indicating that appendectomy can be delayed with safe outcomes.

## Availability of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

## Author contribution

All authors contributed to the content of this manuscript.

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## Ethical Consent

IRB was obtained from ethical Comity in Our Centre.

## Conflict of Interest

Authors deny any conflict of interest.

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