

# Timing of Surgery and the Risk of Complications in Acute Appendicitis

Islam MN<sup>1</sup>, Sarkar P<sup>2</sup>, Islam MS<sup>3</sup>, Kudrat-e-khuda I M<sup>4</sup>, Hussain MT<sup>5</sup>, Datta KK<sup>6</sup>, Benarjee S<sup>7</sup>

## Abstract

**Background:** Delays surgery in patients with acute appendicitis there may be increase the risk of various complications. These risks must be balanced with the theoretical risk of night time operations.

**Objective:** To evaluate the effect of time of surgery for acute appendicitis on surgical outcomes to optimize the timing of appendectomies.

**Materials and methods:** This was a cross-sectional comparative study carried out in the Department of Surgery of Diabetic Association Medical college Hospital Faridpur from January 2016 to December 2021. The study population consisted of 400 patients who were diagnosed as acute appendicitis. They were separated in 2 groups according to timing of surgery, under 24 hours (group A) and 24 to 96 hours (group B) from the time of symptoms appear and had their rate of complications like perforation of appendix, post operative paralytic ileus, pelvic abscess, infection of surgical wound assessed.

**Result:** One hundred forty patients underwent surgery less than 24 hours after symptoms appear (group A) and Two hundred sixty patients were operated between 24 to 96 hours of symptoms appearance. Groups A and B had significant difference regarding the complications.

**Conclusions:** In our study, timing of surgery for acute appendicitis had great impact on the occurrence of complications.

**Keywords:** Acute Appendicitis, Appendix Perforation, Intra abdominal Abscess, Antibiotic Therapy, Wound Infection.

## Introduction

Acute appendicitis, the term we use today and the pathological abnormality we understand in the 21<sup>st</sup> century, is attributed to Fitz.<sup>1</sup> Acute appendicitis is the most common conditions of the abdomen in both sexes of any ages requiring acute surgical intervention.<sup>2</sup> The time-

honored notion that the “goal should be accelerate diagnosis and to operate before perforation occurs” has been challenged from child group in the past 5-10 years.<sup>3</sup> Similarly, a study by Henry et al, 2007, has shown that non-surgical management of perforated acute appendicitis was associated with low rate of complications and shorter hospitalization, when compared to matched controls.<sup>4</sup>

1. Dr. Md. Nazrul Islam  
Assistant Professor, Department of Surgery  
Diabetic Association Medical College, Faridpur.
2. Dr. Partho Sarkar  
Assistant Professor, Department of Orthopedic Surgery  
Diabetic Association Medical College, Faridpur.
3. Dr. Md. Saiful Islam  
Junior consultant, Department of Surgery  
Rajshahi Medical College Hospital, Rajshahi.
4. Dr. Iftekhar Md. Kudrat-e-khuda  
Assistant Professor, Department of Surgery  
Rajshahi Medical College, Rajshahi.
5. Dr. Md. Tofazzal Hussain  
Assistant Registrar, Department of Surgery  
Bangabandhu Sheikh Mujib Medical College Hospital, Faridpur.
6. Dr. Kalyan Kanti Datta  
Assistant Registrar, Department of Surgery  
Diabetic Association Medical College Hospital, Faridpur.
7. Dr. Shipra Benarjee  
Assistant Registrar (Obs & Gynae), Bangabandhu Sheikh Mujib  
Medical College Hospital, Faridpur

## Correspondence to:

Dr. Md. Nazrul Islam  
Assistant Professor, Department of Surgery  
Diabetic Association Medical College, Faridpur.  
e. mail: Nazruldr7@gmail.com

Yardeni et al., recommend that in non perforated acute appendicitis, antibiotic treatment should be initiated when surgery is delayed 2-4 hours after admission. That way, surgery must be postponed within 24 hours of admission with no significant increase in complications, duration of surgery and hospitalization.<sup>5</sup>

Teixeira et al., have shown that in patients with non-perforated acute appendicitis, delaying surgery significantly increased the rate of surgical site wound infection but not the risk of perforation.<sup>6</sup> Some authors suggest that tachycardia at admission in patients with acute appendicitis may be significant as a predictive factor of higher risk of perforation.<sup>6</sup>

In acute appendicitis patients who are treated conventionally, time seems to be the most important element in acute appendicitis progression towards complete obstruction and perforation.<sup>7</sup> Patients at a high risk of perforation may undergo surgery sooner or receive pre-operative antimicrobial therapy. But it appears most likely that perforation occurs before hospital admission and is not time dependent.<sup>7</sup>

Other authors have said no significant increase in the rate of perforation and infection of the surgical wound when

appendectomy was delayed. However, a higher risk of wound infection was associated with prolong duration of symptoms.<sup>3</sup>In a multicenter study of large numbers of patients, infection of the surgical wound occurred in 5 to 10% of the patients with complicated acute appendicitis and in 1-3% of the patients with uncomplicated acute appendicitis. Time of surgery significantly increase the occurrence of such complications.

The objective of our study was to evaluate the rate of complications (perforation, use of peritoneal drainage, post operative paralytic ileus and surgical wound infection ) related to timing of surgery in acute appendicitis patients admitted to the surgery wards from the time of symptoms onset of the Diabetic Association Medical College Hospital, Faridpur, Bangladesh.

## Materials & Methods

This cross-sectional comparative study was carried out in department of Surgery, Diabetic Association Medical College Hospital, Faridpur from January 2016 to December 2021. The study population consisted of 400 patients who were diagnosed as a case of acute appendicitis. Patients present with acute appendicitis above 13 years age of both sexes are included in this study. The hospital is a regional teaching hospital with surgical facilities available 24 hours a day and admits 150 patients with a diagnosis of acute appendicitis per year. Data were generated through record review of the respective study duration.

## Results

**Table 1:** Patient's characteristic and comparison between different time in appendectomy groups

Attributes	OT<24 h (n=140)	OT>24 h to <96 h (n=260)
Age (years)	43.7	47.3
Female	80	160
WBC count	13,487	14,425
Neutrophil count (%)	78.4	81.5
Lymphocyte count (%)	13.6	13.1
CRP	37.4	50.3
Body temperature (°C)	37.1	37.9
With abdominal ultrasonography	140	260
Operation method		
Laparoscopic appendectomy	60	60
Open appendectomy	80	200
Complication		
Mortality	0	0
Nil	120	205
Perforated appendicitis	10	30
Wound infection	12	42
Post operative paralytic ileus	3	15
Intra abdominal abscess	3	11
Length of hospital stay(day)	3.7	5.8

This study included all patients who underwent appendectomy after a diagnosis of acute appendicitis and were confirmed by postoperative pathological examination during the study period. The patients excluded were whom underwent negative appendectomy, incidental appendectomy, or interval appendectomy. Patients characteristics including age, sex, white blood cell count, C-reactive protein, body temperature at admission, abdominal ultrasonography findings, surgical approach, per-operative findings, operation time, final pathology report, length of hospital stay, and complications were obtained from hospital records. Outcome measures included the presence of perforation and the development of complications. Complications were defined as the documented development of wound infection, intra-abdominal abscess, or septic shock until 4 weeks after discharge. Patients were then divided into two groups. The first group (Group-A) consisted of appendectomy patients with symptoms of <24 hours. Second group (Group-B) included appendectomy patients with symptoms of >24 hours but <96 hours.

Data analysis were performed using SPSS 17.0 for windows. One way analysis of variance was used for comparison of independent continuous variables; Scheffe's test was used for *post hoc* examination. For categorical data, a cross table with the Chi-square test was used. To clarify the effect of appendectomy and other potential effectors on appendix perforation and postoperative complication, multiple logistic regression analysis was used. A *p* value of <0.05 was accepted as significant.

Data are presented as CRP=C-reactive protein; OT<24 h=Appendectomy done within 24 hours after appearance of symptoms. OT>24 h and<96 h=Appendectomy done after 24 hours but before 96 hours. WBC=white blood cell count.

**Table 2:** Overall patient's characteristic and comparison between non perforated and perforated groups.

Attributes	Total (n=400)	Non perforated (n=360)	Perforated (n=40)
Age (y)	44.04	41.0	50.5
Age >55 y	60	40	20
Female	160	140	20
WBC count	13,487	13,200	14,500
Leukocytosis of >16,000	120	90	30
Neutrophil count (%)	78.4	77.2	84.2
Lymphocyte count (%)	13.6	13.7	10.3
CRP	37.4	36.3	53.3
Body temperature (°C)	37.1	37.2	38.5
Complication			
Mortality		0	0
Nil		305	20
Wound infection		30	24
Post operative paralytic ileus		3	15
Intra abdominal abscess		3	11
Length of hospital stay(days)		3.7	6.2
Septic shock		-	-

Data are presented as CRP=C-reactive protein; OT<24 h=Appendectomy done within 24 hours after appearance of symptoms. OT>24 h and<96 h=Appendectomy done after 24 hours but before 96 hours. WBC=white blood cell count.

**Table-3:** Characteristic of patient's without and with complications.

	Without (n=325)	With (n=75)
Age (y)	43.7	48.0
Female >55 y	40	20
Female	110	50
WBC count	13,487	14,425
Neutrophil count (%)	80.4	83.5
Lymphocyte count(%)	13.6	13.7
CRP	37.4	50.3
Body temperature (°C)	37.1	37.9
With abdominal ultrasonography	325	75
Operation method		
Laparoscopic appendectomy	97	23
Open appendectomy	228	52
Perforated appendicitis	143.7	26
Length of hospital stay(day)		5.8

Data are presented as CRP=C-reactive protein; OT<24

h=Appendectomy done within 24 hours after appearance of symptoms. OT>24 h and<96 h=Appendectomy done after 24 hours but before 96 hours. WBC=white blood cell count.

In this study, a total of 400 patients with acute appendicitis underwent appendectomy at the Diabetic Association Medical College Hospital Faridpur, between January 2016 and December 2021. Perforation occurred in 10% (40/400) and postoperative complications developed in 18.75% (75/400) of these patients. There were 260 patients appendectomy had done between 24 to 96 hours; patients with appendectomy >24 hours had a significantly longer hospital stay ( $p < 0.01$ ) compared with the other group. The mean age was 46.04 years. Female patients accounted for 60% (240/400) and leukocytosis (>16000) presented in 30% (120/400) of all patients. All patients received abdominal ultrasonography before operation. None of the ultrasonography reports definitively described appendicular lump. Despite pathologic examination demonstrating the presence of perforation in 60 (15%) of the surgical specimens, none of the patient had a preoperative diagnosis of perforated appendicitis. Overall 120(30%) of the appendectomies were performed as laparoscopic procedures.

The patients with perforated appendicitis were more likely to be aged >55 years and more likely to have higher neutrophilic leukocytosis, lower lymphocyte count, and higher C-reactive protein than patients without perforation. Open appendectomy was more frequently chosen in perforated appendicitis (70% vs. 30%), but no significant difference was observed. Comparison of outcomes between the two groups demonstrated that patients with perforated appendicitis were more likely to develop complications, such as intra-abdominal abscess and sepsis, and more likely to have a significantly longer hospitalization.

Patients who developed complications were more likely to be older, and to have higher neutrophil count, higher body temperature, higher open appendectomy rate, higher perforation rate, and longer hospitalization than patients without complications. After logistic regression analysis, age > 55 years, perforated appendicitis, and open appendectomy were found to be independently associated with an increase in development of complications.

## Discussion

Our study have suggested that delayed appendectomy for acute appendicitis is unsafe because of the risk of developing advanced pathology and postoperative complications increasing with time following the appearance of symptoms.<sup>10</sup> The large study by Teixeira et al demonstrated that delayed appendectomy did not increase the risk of perforation but was associated with a significantly increased risk of surgical site infection in patients with non perforated appendicitis. Other current studies suggested that delayed appendectomy does not result increased morbidity and that appendicitis could be managed as a semi-elective condition<sup>11-14</sup>. The findings of this study demonstrated that delay of appendectomy increases appendix perforation and postoperative complication rate, also associated with longer hospitalization stay. Increased postoperative complications, with or without perforation of appendicitis, have been attributed to a negative impact on outcome associated with delayed appendectomy. Busch et al<sup>15</sup> found that an appendectomy delayed for >24 hours was associated with a significant increase in the rate of perforation.

Meanwhile, the study revealed, that appendectomy delayed >24 hours increases the length of hospital stay. This result was in agreement with that reported by Omundsen and Dennett,<sup>16</sup> who demonstrated that appendectomy delayed >4 hours increased the postoperative length of stay. Ingraham et al's<sup>14</sup> population –based study using the American College of Surgeon National Surgical Quality Improvement Program database likewise showed a compatible result.

## Limitations

The study was done limited time of span, samples were collected single centre also sterility of operation theatre and wards may reflect result of surgical outcome.

## Conclusion

The present study suggest that delayed appendectomy for acute appendicitis is unsafe because of the risk of developing more complications. Our results incline toward the position that appendectomy can be performed as soon as after diagnosis of acute appendicitis.

**Conflict of Interest:** No.

## Data Availability:

Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author upon reasonable request.

## References

1. Fitz RH. Perforating inflammation of the vermiform appendix, with special reference to its early diagnosis and treatment. *Trans Assoc Am Physician* 1886;1: 107-44.
2. Owings MF, Kozak LJ. Ambulatory and inpatient procedures in the United States, 1996. *Vital Health Stat* 1998;13:1-119.
3. Owings MF, Kozak LJ. Ambulatory and inpatient procedures in the United States, 1996. *Vital Health Stat* 1998;13:1-119.
4. Henry, M.C., Gollin, Islam, S., Sylvester, K., Walker, A., SDilverman, B.L. and Moss, R.L (2007) Matched Analysis of Nonoperative Management vs Immediate Appendectomy for Perforated Appendicitis. *Journal of Pediatric Surgery*, 42, 19-24. <https://doi.org/10.1016/j.jpedsurg.2006.09.005>
5. Yardeni D, Hirschl RB, Drongowski RA, Teitelbaum DH, Geiger JD, Coran AG. Delayed versus immediate surgery in acute appendicitis: do we need to operate during the night? *J Pediatric Surg* 2004;39:464-9.
6. Teixeira, P.G., Sivrikoz, E., Inaba, K., Talving, P., Lam, L. and Demetriades, D. (2002) Appendectomy Timing. *Annals of Surgery*, 256, 538-543.
7. Serres, E.K., Cameron, D.B., Glass, C.C., Graham, D.A., Zurakowski, D., Karki, M., Anandalwar, S. and Rangel, S.J. (2017). Time to Appendectomy and Risk of Complicated Appendicitis and Adverse Outcomes in Children. *JAMA Pediatrics*, 171, 740-747. <https://doi.org/10.1001/jamapediatrics.2017.0885>
8. Boomer, L.A., Cooper, J.N., Deans, K.J., Minneci, A.C., Leonhart, K., Diefenbach, K.A., Kenney, B.D. and Besner, G.E. (2014) Does Delay in Appendectomy Affect Surgical Site Infection in Children with Appendicitis? *Journal of Pediatric Surgery*, 49, 1026-1029. <https://doi.org/10.1016/j.jpedsurg.2014.01.044>

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7. Boomer, L.A., Cooper, J.N., Anadalwar, S., Fallon, S.C., Ostlie, D., Leys, C.M., Minneci, P.C., *et al.* (2016) Delaying Appendectomy Does Not Lead to Higher Rates of Surgical Site Infections. *Annals of Surgery*, 264, 164-168. <https://doi.org/10.1079/SLA.0000000000001396>
  10. Ditillo MF, Dziura JD, Rabinovici R. Is it safe to delay appendectomy in adult with acute appendicitis? *Ann Surg* 2006;244:656-60.
  11. Yardeni D, Hirschl RB, Drongowski RA, Teitelbaum DH, Geiger JD, Coran AG. Delayed versus immediate surgery in acute appendicitis: do we need to operate during the night? *JPediatr Surg* 2004;39:464-9.
  12. Stahlfeld K, Hower J, Homitsky S, Madden J. Is acute appendicitis a surgical emergency? *Am Surg* 2007;73:626-9.
  13. Kearney D, Cahill RA, O'Brien E, Kirwan WO, Redmond HP. Influence of delays on perforation risk in adults with acute appendicitis. *Dis Colon Rectum* 2008;51:1823-7.
  14. Ingraham AG, Cohen ME, Bilimoria KY, Ko CY, Hall BL, Russel TR, *et al.* Effect of delay to operation on outcomes in adults with appendicitis. *Arch Surg* 2010;145:886-92.
  15. Busch M, Gutzwiller FS, Aellinh S, Kuettel R, Metzger U, Zingg U. In hospital delay increases the risk of perforation in adults with appendicitis. *World J Surg* 2011;35:1626-33.
  16. Omundsen M, Dennett E. Delay to appendectomy and associated morbidity: a retrospective review. *ANZ J Surg* 2006;76:153-5.
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