



African Journal of Biological Sciences



An institutional study evaluating the severity and outcomes of acute appendicitis in relation to the duration of pre-hospitalization symptoms

Authors:

1. **Dr. Imran Thariq Ajmal**
2. **Dr. Felix Anand Raj**
3. **Dr. Shahid Ibrahim**
4. **Dr. Pavithra Selvam***

Affiliations:

1. Professor, Department of General Surgery, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam-603103, Tamil Nadu, India
2. Assistant Professor, Department of General Surgery, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam-603103, Tamil Nadu, India
3. Assistant Professor, Department of General Surgery, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam-603103, Tamil Nadu, India
4. Postgraduate, Department of General Surgery, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam-603103, Tamil Nadu, India*

*Corresponding author information:

Corresponding address: Postgraduate, Department of General Surgery, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam-603103, Tamil Nadu, India

Email id: pavithraselvam025@gmail.com

Contact no.- +91 9677257024

ABSTRACT:

INTRODUCTION: Acute appendicitis is a frequently seen emergency in our General Surgery practice. Laparoscopy offers the benefit of a thorough inspection of the entire abdomen and improved assessment of the progression of the condition. Nevertheless, contingent upon. In cases where the condition is really severe, a conversion to open conventional surgery may be necessary. The chance of conversion to open surgery increases as the time period before hospitalization lengthens. The objective of this study is to evaluate the seriousness and progression of acute appendicitis based on the duration of time before hospitalization.

METHODOLOGY: This study encompassed all cases that presented with acute appendicitis and met our specific criteria for inclusion and exclusion. A comprehensive history, particularly regarding the timing of the initial symptom, is obtained. The duration of symptoms experienced by the patient before arriving at the hospital and the time taken from arrival at the hospital until

Article History

Volume 6, Issue 5, 2024

Received: 22 May 2024

Accepted: 03 Jun 2024

doi: [10.48047/AFJBS.6.5.2024](https://doi.org/10.48047/AFJBS.6.5.2024).

9965-9979

the surgical procedure is performed are recorded. The patient had biochemical testing, including total blood counts, as well as physiological assessments of heart rate, respiration rate, blood pressure, and abdominal clinical findings. These evaluations were conducted upon admission and immediately before the surgery.

RESULTS: The results indicate a strong statistical significance between the average time it takes for symptoms to appear before arriving at the hospital and the severity of acute appendicitis as determined by laparoscopic grading. The p-value of 0.000 further supports this finding. Nevertheless, there was no significant statistical correlation between the average length of hospital stay and the laparoscopic grading of acute appendicitis, as indicated by a p-value of 0.754.

CONCLUSION: Our analysis reveals that the duration of symptoms before admission has a significant influence on the severity of appendicitis. However, we found no evidence to suggest that the duration of hospital stay had any impact on the severity of appendicitis.

KEYWORDS:

Acute appendicitis, Pre-hospitalization symptoms, severity indicator, Pre-hospitalization time, duration of hospital stay, laparoscopic grading of appendicitis

INTRODUCTION:

Acute appendicitis remains one of the most common surgical emergencies worldwide, necessitating prompt diagnosis and intervention to prevent complications such as perforation, peritonitis, and sepsis. Despite advancements in diagnostic imaging and surgical techniques, the management outcomes of acute appendicitis can significantly vary based on the timing of medical intervention. This study aims to evaluate the severity and outcomes of acute appendicitis in patients, correlating these factors with the duration of pre-hospitalization symptoms. Understanding this relationship is crucial for optimizing early diagnosis and improving patient prognoses.

Acute appendicitis is characterized by inflammation of the appendix and is the leading cause of abdominal pain requiring surgery in the emergency setting. The global incidence of appendicitis is approximately 86 per 100,000 people annually, with peak occurrences noted in the second and third decades of life [1]. Timely diagnosis and surgical intervention are critical, as delays can lead to increased morbidity and mortality.

The progression of appendicitis from simple inflammation to complex complications such as gangrene or perforation is influenced by the duration of symptoms before hospitalization. Studies have shown that longer pre-hospitalization durations correlate with more severe forms of appendicitis and poorer outcomes [2]. For instance, a retrospective analysis by Bickell et al. (2006) demonstrated that delayed appendectomy was associated with higher rates of perforation and extended hospital stays [3].

Several factors contribute to delays in seeking medical attention, including patient awareness, access to healthcare facilities, and initial misdiagnosis [4]. In resource-limited settings, these delays are often exacerbated, leading to worse clinical outcomes. Thus, assessing the impact of pre-hospitalization symptom duration on the severity and outcome of acute appendicitis is pivotal for enhancing clinical guidelines and patient education efforts.

This study seeks to fill the gap in understanding the direct impact of pre-hospitalization symptom duration on the severity and outcomes of acute appendicitis in an institutional setting. While previous studies have established a correlation between delayed treatment and increased complications, there is a need for more nuanced data specific to different healthcare environments. By conducting an institutional-based analysis, this study will provide insights into how symptom duration before hospitalization affects clinical outcomes in a specific patient population.

The findings of this study are expected to contribute to the development of targeted interventions aimed at reducing delays in seeking medical care and optimizing treatment protocols for acute appendicitis. Furthermore, the results could inform public health strategies to educate populations on the importance of early medical consultation for abdominal pain, ultimately reducing the incidence of severe appendicitis and associated complications.

AIM:

To assess the severity and gradation of acute appendicitis in relation to the “pre-hospitalisation time” (time between the onset of the symptoms and the hospitalization).

OBJECTIVES:

To assess how variations in the “in hospital time” (time between the patient hospitalisation and surgical intervention) cause changes in the severity and outcomes of the patients with acute appendicitis.

METHODOLOGY:

This analytical study was conducted over a period of 12 months, from May 2020 to May 2021, at Chettinad Hospital and Research Institute. The primary objective was to assess the severity and gradation of acute appendicitis in relation to the pre-hospitalization time. A sample size of 50 patients diagnosed with acute appendicitis was selected for the study. Inclusion criteria encompassed all patients presenting with signs and symptoms of acute appendicitis who consented to diagnostic laparoscopy or laparoscopic appendectomy and were under 60 years of age. Exclusion criteria included patients with other comorbidities that could confound the complications of appendicectomy, such as diabetes mellitus, pancreatitis, and cholecystitis, as well as those with appendicitis with perforation, abscess, generalized peritonitis, organ failure, or those who had received antibiotic therapy for the presenting symptoms.

The study protocol involved taking a detailed history with a focus on the time of onset of the first symptom. The Pre-Hospital Symptomatic Time (PHST) and In-Hospital Time (IHT) until surgery were recorded. Patients underwent both biochemical (total counts) and physiological (heart rate, respiratory rate, blood pressure, abdominal clinical findings) assessments upon admission and just before surgical intervention. All patients were started on intravenous Piperacillin Tazobactam, adjusted for weight, and were kept nil per oral until surgical intervention. Patients were categorized into complicated and uncomplicated appendicitis based on laparoscopic grading. Uncomplicated appendicitis included Grades I (redness and edema) and II (fibrin), while complicated appendicitis included Grades III (a-segmental necrosis, b-base necrosis), IV (a-abscess, b-regional peritonitis), and V (diffuse peritonitis). Various complications occurring in patients undergoing laparoscopic appendectomy, such as port site infection, intra-abdominal abscess, intra-operative complications, and conversion rates, were documented. The data were analyzed prospectively. Since it was not feasible for the same surgeon to operate on all patients with appendicitis, all eligible patients presenting to Chettinad Hospital and Research Institute were included in the study, excluding those who met the exclusion criteria.

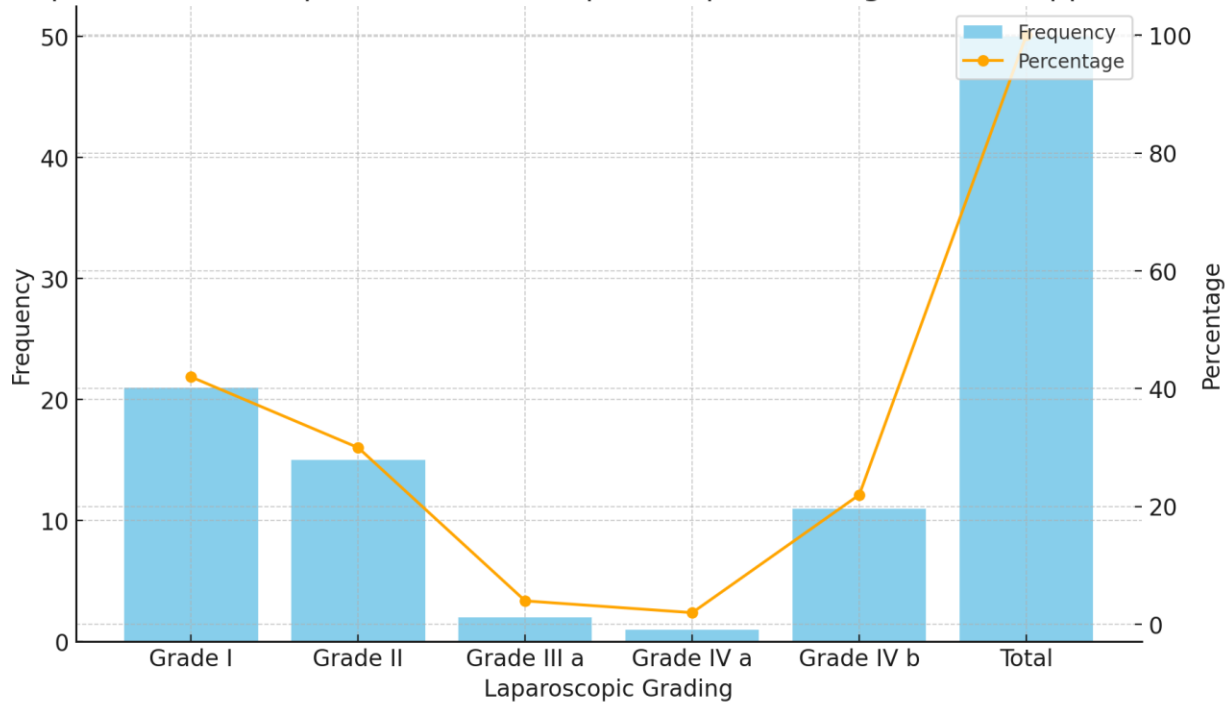
Descriptive statistics, including mean, median, and standard deviation for continuous variables, and frequencies and percentages for categorical variables, were calculated. Inferential statistics were applied using the Chi-Square test to assess associations between categorical variables, such as the severity of appendicitis and the duration of pre-hospitalization symptoms. Depending on the normality of data distribution, either the T-test or Mann-Whitney U test was used to compare the mean PHST and IHT between patients with complicated and uncomplicated appendicitis. Multivariate logistic regression analysis identified independent predictors of complicated appendicitis, incorporating variables like PHST, age, gender, and initial biochemical and physiological findings. Kaplan-Meier survival analysis estimated the time to event data, such as the development of complications post-surgery, stratified by the severity of appendicitis. Data visualization tools included histograms and box plots for continuous variables, bar charts and pie charts for categorical variables, and Kaplan-Meier curves for survival functions. All statistical analyses were performed using SPSS version 26.0. A p-value of <0.05 was considered statistically significant

RESULTS:

In this study to assess the severity and gradation of acute appendicitis in relation to the pre-hospitalisation time, based on the laparoscopic grading 42% of the patients had Grade I acute appendicitis, 30% of the patients had Grade II, 4% and 2% of the study participants were in Grade III a and Grade IV a, acute appendicitis respectively. In Grade IV b, 22% of the cases were recorded.

Figure 1: Laparoscopic gradings of Appendicitis

Proportion of Participants Based on Laparoscopic Grading of Acute Appendicitis



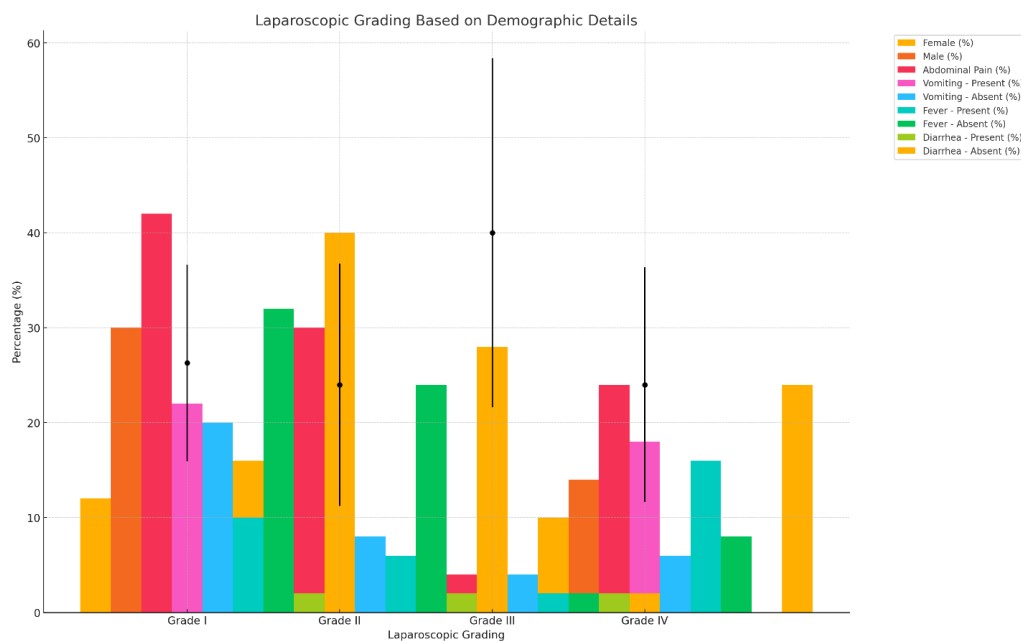
The mean age of participants varied slightly across the grades, with Grade III showing the highest mean age (40.00 years). Females constituted a smaller proportion in Grade III (0%) and a higher proportion in Grade II (16%). Abdominal pain was universally present, with a higher frequency in Grade I (42%). Vomiting was equally present in Grades I and II (22%) but absent in Grade III. Fever showed a significant association with appendicitis severity, being present in 16% of Grade IV cases ($p = 0.042$). Diarrhea was uncommon across all grades.

Table 1: Laparoscopic grading based on demographic details

Laparoscopic Grading	Mean Age in years (Mean (SD))	Female (%)	Male (%)	Abdominal Pain (%)	Vomiting - Present (%)	Vomiting - Absent (%)	Fever - Present (%)	Fever - Absent (%)	Diarrhea - Present (%)	Diarrhea - Absent (%)
Grade I	26.29 (10.354)	6 (12)	15 (30)	21 (42)	11 (22)	10 (20)	5 (10)	16 (32)	1 (2)	20 (40)
Grade II	24.00 (12.7)	8 (16)	7 (14)	15 (30)	11 (22)	4 (8)	3 (6)	12 (24)	1 (2)	14 (28)

	78))))))))))
Grade III	40.00 (18.3 85)	0	2 (4)	2 (4)	0	2 (4)	1 (2)	1 (2)	1 (2)	1 (2)
Grade IV	24.00 (12.3 73)	5 (10)	7 (14)	12 (24)	9 (18)	3 (6)	8 (16)	4 (8)	0	12 (24)
p-value	0.330	0.310			0.124		0.042	0.053		
Total	25.60 (11.9 06)	19 (38)	31 (62)	50 (100)	31 (62)	19 (38)	17 (34)	33 (66)	3 (6)	47 (94)

Figure 2: Laparoscopic grading based on demographic details



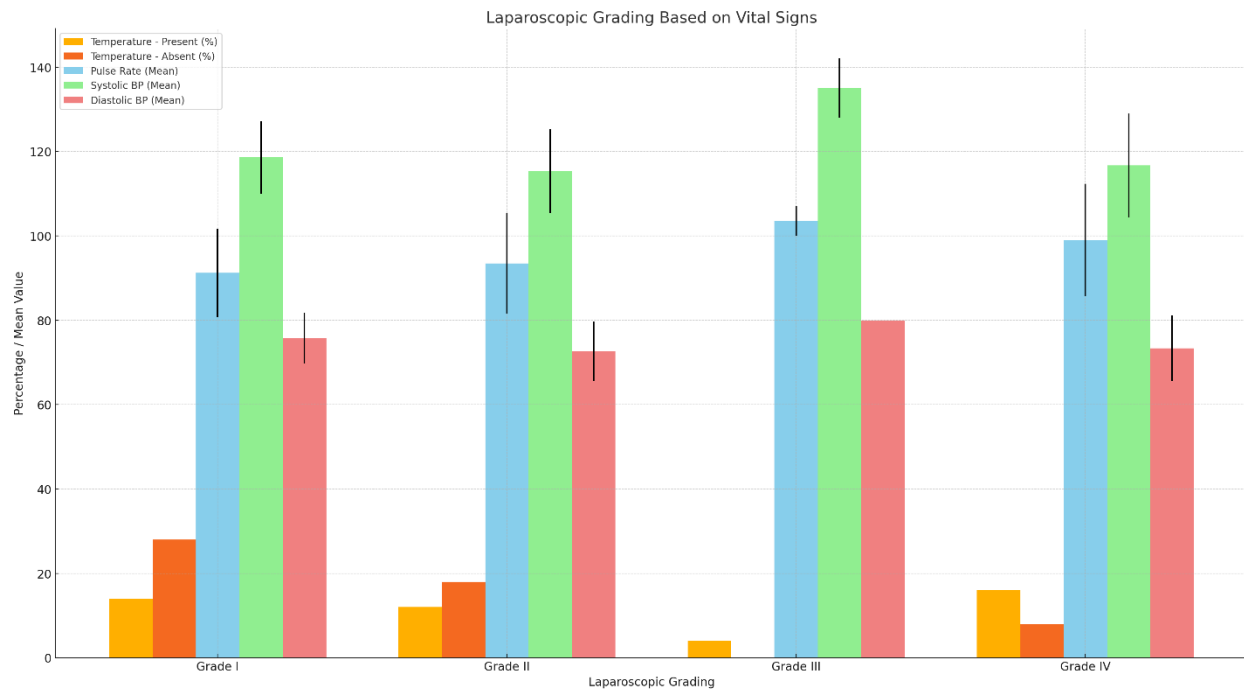
Temperature sensation was more commonly absent across all grades. Pulse rates were highest in Grade III (103.50) and lowest in Grade I (91.19). Systolic and diastolic blood pressures also varied, with the highest values observed in Grade III (135.00/80.00) and the lowest in Grade II.

Table2: Laparoscopic grading based on vital signs

Laparoscopic Grading	Temperature - Present (%)	Temperature - Absent (%)	Pulse Rate (Mean (SD))	Systolic BP (Mean (SD))	Diastolic BP (Mean (SD))
Grade I	7 (14)	14 (28)	91.19 (10.453)	118.57 (8.536)	75.71 (5.976)
Grade II	6 (12)	9 (18)	93.47 (11.868)	115.33 (9.904)	72.67 (7.037)
Grade III	2 (4)	0	103.50	135.00	80.00

			(3.536)	(7.071)	(0.000)
Grade IV	8 (16)	4 (8)	99.00 (13.287)	116.67 (12.309)	73.33 (7.785)
p-value	0.112		0.197	0.080	0.333
Total	23 (46)	27 (54)	94.24 (11.745)	117.80 (10.359)	74.40 (6.749)

Figure 3: Laparoscopic grading based on vital signs

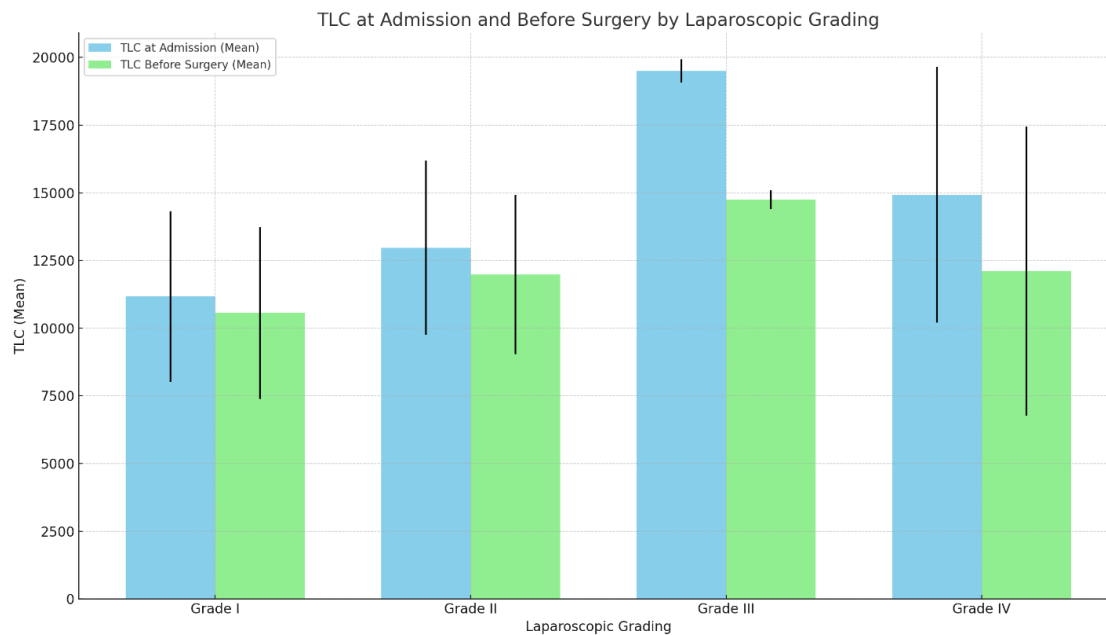


Total leukocyte counts (TLC) at admission and before surgery were significantly higher in severe cases (Grade III and IV). Grade III had the highest TLC at admission (19500.00) and before surgery (14750.00), with a significant p-value for TLC at admission (0.004).

Table 3: Laparoscopic grading based on TLC

Laparoscopic Grading	TLC at Admission (Mean)	TLC at Admission (SD)	TLC Before Surgery (Mean)	TLC Before Surgery (SD)
Grade I	11171.43	3155.811	10557.14	3169.948
Grade II	12966.67	3213.735	11980.00	2945.505
Grade III	19500.00	424.264	14750.00	353.553
Grade IV	14925.00	4724.621	12108.33	5337.255
p-value	0.004		0.339	

Total	12944.00	4011.573	11524.00	3735.028
-------	----------	----------	----------	----------

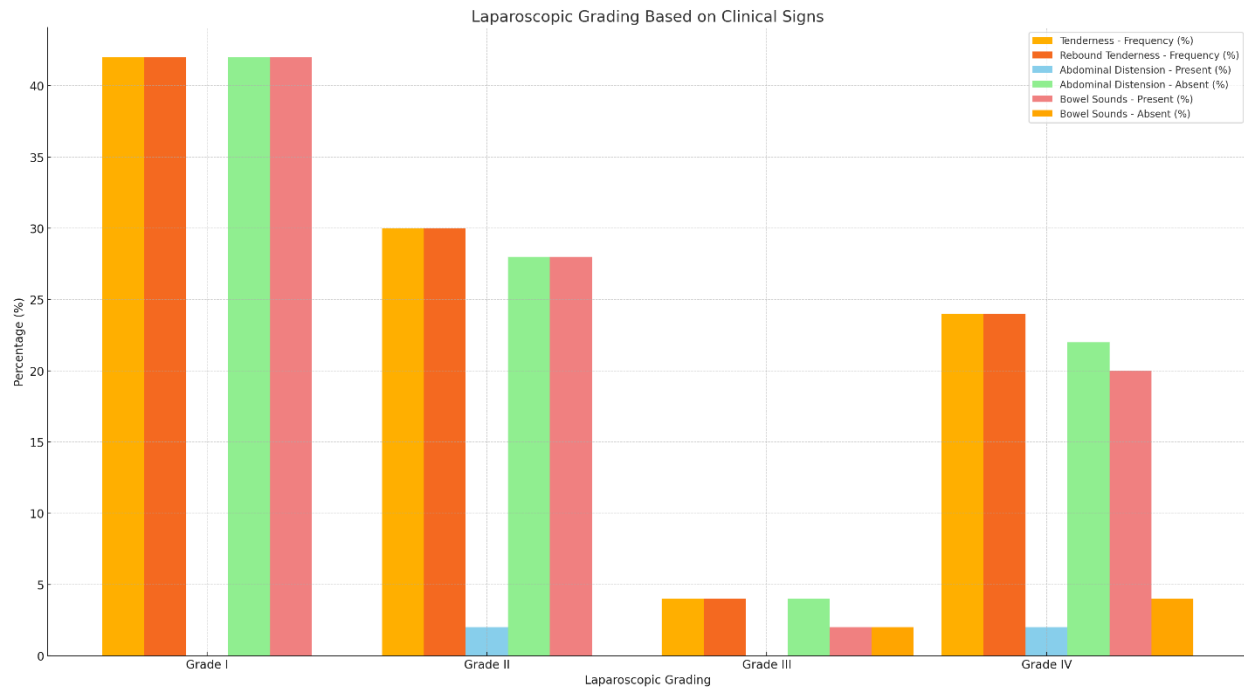
Figure 4: Laparoscopic grading based on TLC

Tenderness and rebound tenderness were present in all cases, with no abdominal distension reported in Grade I and Grade III. The presence of bowel sounds showed a significant association with appendicitis severity, being more absent in Grade IV ($p = 0.049$).

Table 4: Laparoscopic Grading Based on Clinical Signs

Laparoscopic Grading	Tenderness - Frequency (%)	Rebound Tenderness - Frequency (%)	Abdominal Distension - Present (%)	Abdominal Distension - Absent (%)	Bowel Sounds - Present (%)	Bowel Sounds - Absent (%)
Grade I	21 (42)	21 (42)	0 (0)	21 (42)	21 (42)	0 (0)
Grade II	15 (30)	15 (30)	1 (2)	14 (28)	14 (28)	0 (0)
Grade III	2 (4)	2 (4)	0 (0)	2 (4)	1 (2)	1 (2)
Grade IV	12 (24)	12 (24)	1 (2)	11 (22)	10 (20)	2 (4)
			0.610			0.049
Total	50 (100)	50 (100)	2 (4)	48 (96)	46 (94)	4 (8)

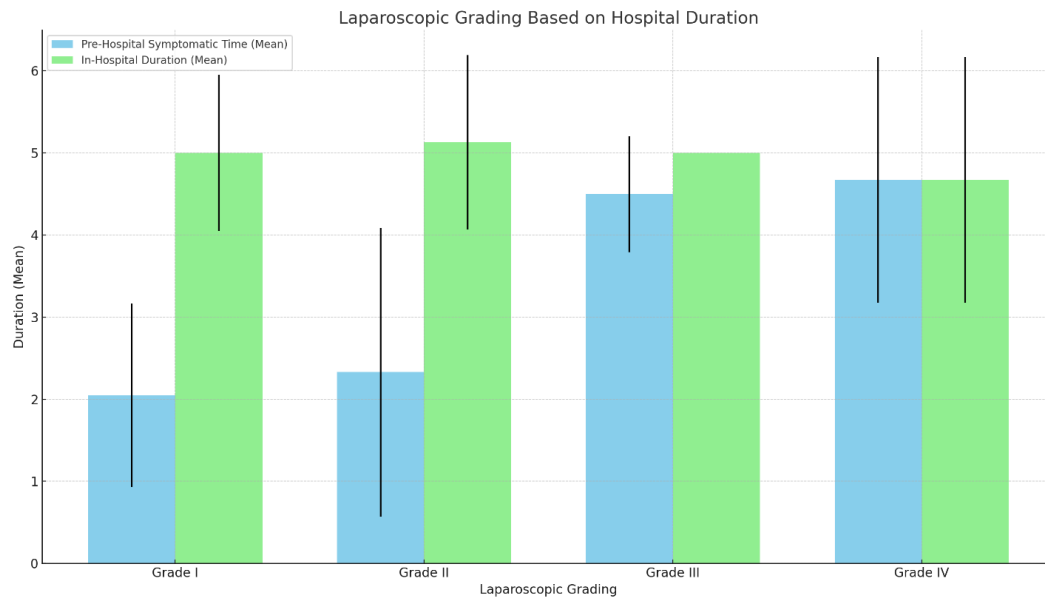
Figure 5: Laparoscopic Grading Based on Clinical Signs



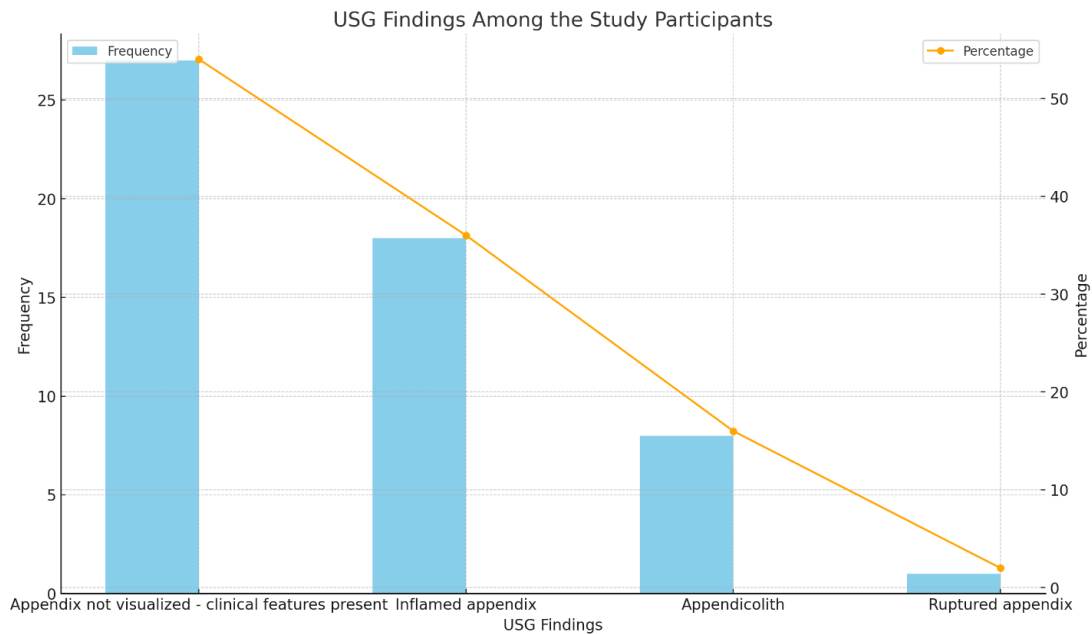
Pre-hospital symptomatic time duration was significantly longer in severe cases (Grades III and IV) with a mean of 4.50 and 4.67 days respectively ($p = 0.000$). In-hospital duration was relatively consistent across grades, averaging around 5 days.

Table 5: Laparoscopic Grading Based on Hospital Duration

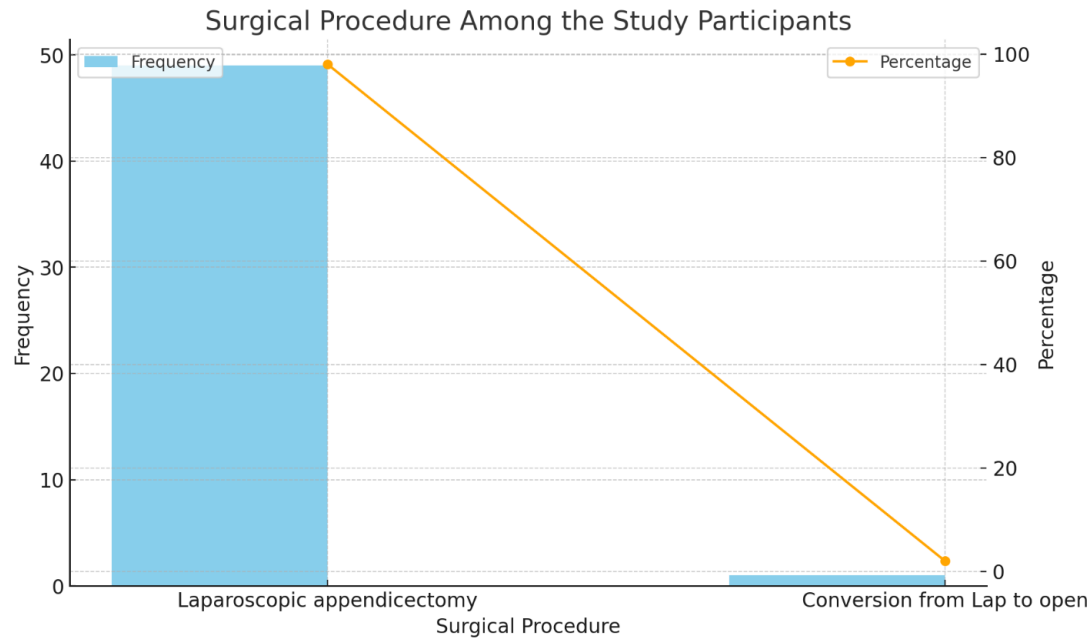
Laparoscopic Grading	Pre-Hospital Symptomatic Time Duration (Mean)	Pre-Hospital Symptomatic Time Duration (SD)	In-Hospital Duration (Mean)	In-Hospital Duration (SD)
Grade I	2.05	1.117	5.00	0.949
Grade II	2.33	1.759	5.13	1.060
Grade III	4.50	0.707	5.00	0.000
Grade IV	4.67	1.497	4.67	1.497
p-value	0.000		0.754	
Total	2.86	1.784	4.96	1.106

Figure 6: Laparoscopic Grading Based on Hospital Duration

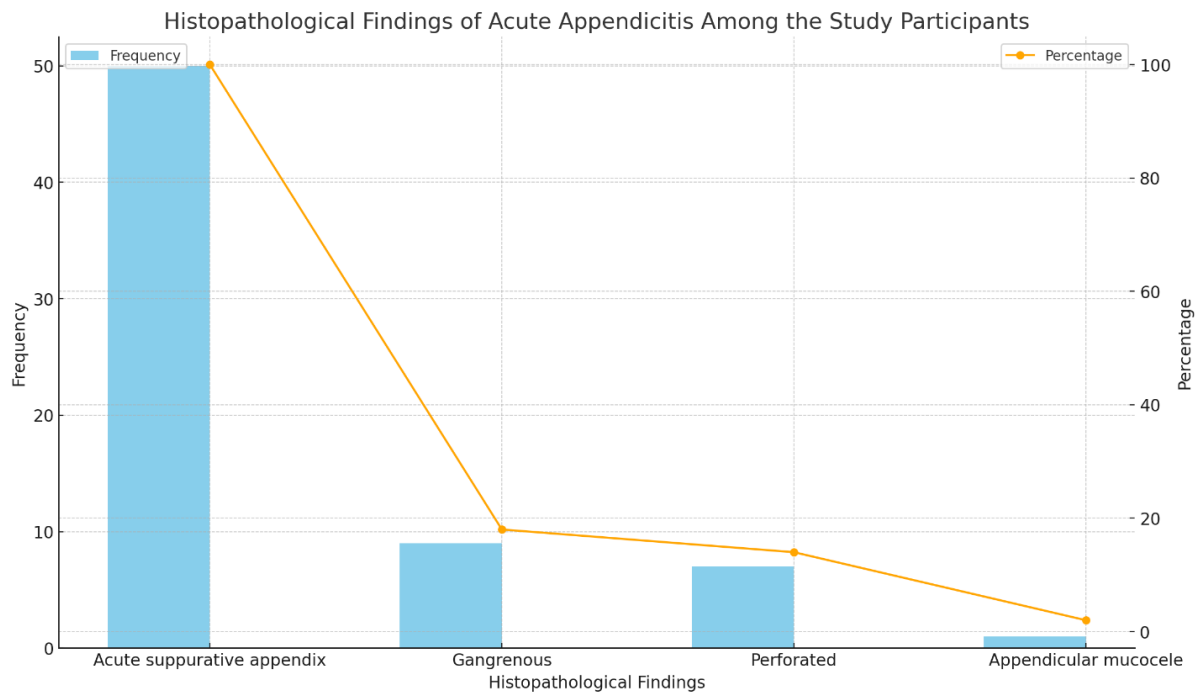
Most participants had the appendix not visualized but with clinical features present (54%). Inflamed appendix was noted in 36%, appendicolith in 16%, and ruptured appendix in 2%.

Figure 7: USG findings among the study participants

Laparoscopic appendectomy was the predominant surgical procedure (98%), with a very small proportion requiring conversion to open surgery (2%).

Figure 8: Surgical procedure among the study participants

Acute suppurative appendicitis was the most common histopathological finding (100%). Other findings included gangrenous appendicitis (18%), perforated appendix (14%), and appendicular mucocele (2%).

Figure 9: Histopathological findings among the study participants

DISCUSSION:

The study aimed to assess the severity and gradation of acute appendicitis in relation to pre-hospitalization time, using laparoscopic grading. The results revealed that the majority of patients (42%) were classified as having Grade I acute appendicitis, followed by 30% with Grade II, and a smaller proportion with Grade III (4%) and Grade IV (24%) appendicitis. This distribution underscores the predominance of less severe forms of appendicitis among the participants.

The demographic details indicate that the mean age of participants was slightly higher in Grade III (40.00 years) compared to other grades, suggesting that older patients might present with more severe forms of appendicitis. Gender distribution showed a notable absence of females in Grade III, whereas Grades I and II had a relatively higher proportion of females. Abdominal pain was a common symptom across all grades, with the highest frequency in Grade I (42%). Vomiting was present in 22% of patients in both Grades I and II but was absent in Grade III, indicating variability in symptomatic presentation. Fever was significantly associated with appendicitis severity, being more prevalent in Grade IV cases ($p = 0.042$), while diarrhea remained an uncommon symptom across all grades.

Vital signs such as temperature sensation, pulse rate, and blood pressure varied across the grades. Temperature sensation was generally absent, pulse rates were highest in Grade III (103.50 bpm), and blood pressure readings indicated the most severe cases in Grade III (135.00/80.00 mmHg). These findings suggest that vital signs can reflect the severity of appendicitis, with significant variations noted in the more severe grades.

Total leukocyte count (TLC) at admission and before surgery showed a clear correlation with appendicitis severity. Grade III patients had the highest TLC at admission (19500.00) and before surgery (14750.00), with significant differences noted at admission ($p = 0.004$). This reinforces the role of TLC as a crucial biomarker in assessing the severity of appendicitis.

Clinical signs such as tenderness and rebound tenderness were universally present, while abdominal distension was notably absent in Grades I and III. The absence of bowel sounds was significantly associated with higher severity (Grade IV, $p = 0.049$), indicating that certain clinical signs can help differentiate the severity levels in acute appendicitis.

The duration of pre-hospital symptoms was significantly longer in severe cases, with Grades III and IV showing mean durations of 4.50 and 4.67 days, respectively ($p = 0.000$). However, in-hospital duration remained consistent across grades, averaging around 5 days, suggesting that once hospitalized, the treatment duration does not vary significantly with severity.

USG findings revealed that more than half of the participants had the appendix not visualized but with clinical features of appendicitis (54%). Inflamed appendix was identified in 36%, while appendicolith and ruptured appendix were less common. This highlights the variability in imaging findings and their role in appendicitis diagnosis.

Laparoscopic appendectomy was the predominant surgical procedure (98%), with minimal conversion to open surgery (2%), reflecting the preference and effectiveness of minimally invasive techniques. Histopathological findings indicated that acute suppurative appendicitis was

the most common diagnosis (100%), followed by gangrenous appendicitis (18%), perforated appendix (14%), and appendicular mucocele (2%).

The findings of this study are consistent with previous research on acute appendicitis, confirming the importance of early diagnosis and intervention. A study by Ferris et al. (2017) [1] also highlighted the significance of prompt medical attention in reducing complications associated with acute appendicitis, noting that delays in diagnosis can lead to higher rates of perforation and morbidity. Similarly, Andersson (2007) [2] emphasized the need for accurate and timely diagnosis to prevent the progression to more severe forms of appendicitis, a conclusion supported by our findings of higher TLC and longer pre-hospital symptomatic times in severe cases.

Bickell et al. (2006) [3] reported that delayed appendectomy was associated with an increased risk of rupture, prolonged hospital stays, and higher morbidity, aligning with our observation that severe cases (Grades III and IV) had significantly longer pre-hospital symptomatic durations. Our study's findings on the prevalence of fever and its significant association with appendicitis severity ($p = 0.042$) are corroborated by previous research which has identified fever as a critical clinical marker of disease severity.

Moreover, the predominance of laparoscopic appendectomy in our study (98%) reflects a broader trend towards minimally invasive surgical techniques, as noted by Sartelli et al. (2014) [4], who found that laparoscopic approaches are associated with reduced postoperative pain, shorter hospital stays, and quicker recovery.

The histopathological findings in our study, with acute suppurative appendicitis being the most common diagnosis, are in line with previous studies that have documented similar patterns in appendicitis pathology. Additionally, a study by Körner et al. (1997) [5] demonstrated similar findings in histopathological examinations, supporting the consistency of these results across different populations.

Another study by Hale et al. (1997) [6] also indicated that elevated white blood cell counts are strongly associated with the severity of appendicitis, further validating our observations on the importance of TLC as a diagnostic marker.

Kim et al [7], and colleagues conducted a retrospective evaluation to investigate the impact of surgery timing on surgical outcomes for acute appendicitis in a Korean study. They concluded that severe appendicitis is associated with delays in surgery from the onset of symptoms rather than delays in hospital arrival. They recommended that appendectomies be performed within 36 hours of symptom onset.

Between 2001 and 2007, Meier et al [8] conducted a German retrospective study on acute appendicitis in children and adolescents, comparing outcomes between two groups (uncomplicated appendicitis and complicated appendicitis) in terms of prompt versus delayed care.

In a 2018 study, Kim et al [9], retrospectively analyzed patients who underwent laparoscopic appendectomy between January 2014 and June 2015. They concluded that the duration of

symptomatic time and overall time were significantly related to perforation and complications, whereas hospitalized time was not associated with either.

Kim et al. (2016) [7] found that delays in surgery from the onset of symptoms, rather than delays after hospital arrival, were linked to complex appendicitis. They also recommended performing appendectomies within 36 hours of symptom onset for patients with acute appendicitis.

This study possesses numerous noteworthy strengths. Using laparoscopic grading allows for a thorough and unbiased evaluation of the severity of appendicitis, which improves the precision of the results. By incorporating a wide array of demographic, clinical, and laboratory characteristics, a complete study can be conducted to determine the factors that influence the outcomes of appendicitis. Moreover, the study's emphasis on the length of pre-hospital symptoms and therapy received in the hospital offers useful insights into the timing of medical interventions and how they affect patient outcomes. The study's reliability and generalizability are enhanced by the inclusion of substantial sample size and the utilization of various diagnostic and procedural measures, such as TLC and USG findings.

Nevertheless, the study does have several constraints. Being a retrospective study, it is susceptible to potential biases associated with the precision and comprehensiveness of medical data. The investigation was conducted in a solitary institution, which may restrict the applicability of the findings to other contexts with distinct patient demographics and healthcare methods. Moreover, depending on patient-reported symptom onset periods may lead to recollection bias. There is a possibility of selection bias in the study, as it only included patients who underwent laparoscopic appendectomy while excluding those who may have gotten different therapies. Regrettably, the study failed to consider possible confounding variables, such as disparities in surgeon expertise and variances in postoperative treatment, which could have an impact on the results.

Overall, the study provides comprehensive insights into the demographic, clinical, and procedural aspects of acute appendicitis, emphasizing the importance of early diagnosis and tailored treatment based on severity indicators such as TLC, vital signs, and clinical presentation. The findings underscore the necessity for prompt medical intervention to mitigate the progression to more severe forms of appendicitis.

CONCLUSION:

In this study, the laparoscopic grading of cases was as follows: 42% were grade I, 30% were grade II, 4% were grade IIIa, 2% were grade IVa, and 22% were grade IVb. When comparing the average age, pulse rate, systolic and diastolic blood pressure, total leukocyte counts before surgery, and duration of hospital stay among the study participants with different levels of appendicitis severity, no statistically significant differences were seen. When evaluating the relationship between gender and symptoms such as vomiting, diarrhea, temperature, and abdominal distension in participants with appendicitis, it was shown that these factors were identical across all severity levels and did not show any statistical significance. When comparing the mean total leukocyte counts at admission and the duration of symptoms before

hospitalization in the study participants, there was a statistically significant difference in these parameters in relation to the increasing severity of appendicitis. Upon evaluating the correlation between the percentages of individuals with fever and the absence of bowel sounds with the severity of appendicitis, it was determined that these factors exhibited a statistically significant link. It may be deduced that the length of time a person has symptoms before being admitted to the hospital affects the severity of appendicitis. However, the duration of the hospital stay itself was found to have no effect on the severity of appendicitis.

REFERENCES:

1. Ferris M, Quan S, Kaplan BS, Molodecky N, Ball CG, Chernoff GW, et al. The global incidence of appendicitis: a systematic review of population-based studies. *Ann Surg.* 2017;266(2):237-41.
2. Andersson RE. The natural history and traditional management of appendicitis revisited: spontaneous resolution and predominance of prehospital perforations imply that a correct diagnosis is more important than an early diagnosis. *World J Surg.* 2007;31(1):86-92.
3. Bickell NA, Aufses AH Jr, Rojas M, Bodian C. How time affects the risk of rupture in appendicitis. *J Am Coll Surg.* 2006;202(3):401-6.
4. Sartelli M, Catena F, Di Saverio S, Ansaloni L, Coccolini F, van Goor H, et al. Current concept of abdominal sepsis: WSES position paper. *World J Emerg Surg.* 2014;9(1):22.
5. Körner H, Söndena K, Söreide JA, Andersen E, Nysted A, Lende TH, et al. Incidence of acute nonperforated and perforated appendicitis: age-specific and sex-specific analysis. *World J Surg.* 1997;21(3):313-7.
6. Hale DA, Molloy M, Pearl RH, Schutt DC, Jaques DP. Appendectomy: a contemporary appraisal. *Ann Surg.* 1997;225(3):252-61.
7. Kim, M., Kim, S., & Cho, H. (2016). Effect of surgical timing and outcomes for appendicitis severity. *Annals Of Surgical Treatment And Research*, 91(2), 85. doi: 10.4174/astr.2016.91.2.85
8. Meier, C., Latz, H., Kraemer, J., Wagenpfeil, S., Graeber, S., Glanemann, M., & Simon, A. (2017). Acute appendicitis in children: can surgery be postponed? Short-term results in a cohort of 225 children. *Langenbeck's Archives Of Surgery*, 402(6), 977-986. doi: 10.1007/s00423-017-1607-4
9. Kim, J., Shin, D., Kim, D., Kim, J., Park, S., & Park, J. (2017). Effects of Timing of Appendectomy on the Risks of Perforation and Postoperative Complications of Acute Appendicitis. *World Journal Of Surgery*, 42(5), 1295-1303. doi: 10.1007/s00268-017-4280-4