



ASSESSMENT OF SERUM SODIUM LEVELS IN PATIENTS WITH ACUTE APPENDICITIS.

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Abstract

Background: Acute appendicitis is one of the most common surgical emergencies worldwide and early diagnosis remains a clinical challenge. Recent evidence suggests that systemic inflammatory response in appendicitis may influence serum electrolyte levels, particularly sodium. Hyponatremia has been proposed as a potential biomarker associated with disease severity and complicated appendicitis. **Aims:** To evaluate the diagnostic efficacy of serum hyponatremia in acute appendicitis and to assess its correlation with disease severity. **Materials and Methods:** This hospital-based prospective observational study was conducted in the Department of General Surgery at Sree Mookambika Institute of Medical Sciences over a period of 8 months from May 2025 to December 2025. A total of 45 patients with clinically suspected acute appendicitis who underwent appendectomy were included in the study. Serum sodium levels were measured at admission and correlated with intraoperative findings and histopathological diagnosis. Disease severity was classified into uncomplicated and complicated appendicitis based on operative and histopathological findings. Standard statistical analysis was performed, and a p-value <0.05 was considered statistically significant. **Results:** Out of 45 patients studied, acute appendicitis was confirmed in 38 (84.4%) patients on histopathology. Hyponatremia (serum sodium <135 mmol/L) was observed in 18 (40.0%) patients. Among these 18 patients with hyponatremia, 14 (77.8%) had complicated appendicitis, while 4 (22.2%) had uncomplicated disease. In contrast, among patients with normal sodium levels, only 6 (22.2%) had complicated appendicitis. The association between hyponatremia and disease severity was statistically significant (p<0.05). Mean serum sodium levels were significantly lower in complicated appendicitis compared to uncomplicated cases. Hyponatremia showed moderate sensitivity but higher specificity for predicting complicated appendicitis, indicating its potential role as an adjunct diagnostic marker. **Conclusion:** Serum hyponatremia is significantly associated with the severity of acute appendicitis and is more commonly observed in complicated cases. It may serve as a useful adjunct biomarker in predicting disease severity and guiding early surgical decision-making when used in combination with clinical and radiological findings.

Keywords: Acute appendicitis, Biomarker, Diagnostic efficacy, Hyponatremia, Inflammation, Serum sodium, Severity.



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INTRODUCTION

Acute appendicitis is one of the most frequent causes of acute abdominal pain requiring emergency surgical intervention. It remains a major clinical challenge due to its variable presentation, especially in early stages, and its overlap with other gastrointestinal and gynecological conditions.¹ Despite advances in imaging modalities such as ultrasonography and computed tomography, clinical evaluation remains the cornerstone of diagnosis in many resource-limited settings. Delay in diagnosis can lead to complications such as perforation, abscess formation, peritonitis, and increased postoperative morbidity.^{2,3}

The pathophysiology of acute appendicitis begins with luminal obstruction due to fecoliths, lymphoid hyperplasia, or less commonly, parasites or tumors. This obstruction leads to increased intraluminal pressure, venous congestion, ischemia, and bacterial overgrowth, resulting in inflammation and eventual necrosis of the appendix.⁴ As the inflammatory process progresses, a systemic response is triggered, characterized by the release of pro-inflammatory cytokines such as interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF- α), and other mediators. These inflammatory pathways are increasingly being recognized as contributors to metabolic and electrolyte disturbances observed in acute surgical conditions.⁵

Among these biochemical alterations, hyponatremia has recently gained attention as a potential marker in intra-abdominal inflammatory diseases, including appendicitis. Hyponatremia in acute inflammation is believed to result from non-osmotic release of antidiuretic hormone (ADH), stimulated by cytokines such as IL-6.⁶ This leads to water retention and dilutional reduction in serum sodium levels. Additionally, the severity of inflammation appears to correlate with the degree of cytokine release, suggesting a possible relationship between serum sodium levels and disease severity in acute appendicitis.⁷

Early identification of complicated appendicitis is crucial, as it influences surgical planning, timing of intervention, and postoperative outcomes. However, differentiating uncomplicated from complicated cases preoperatively remains difficult based solely on clinical assessment.⁸ Imaging studies, although useful, may not always be readily available or may yield inconclusive results. Therefore, there is a growing interest in simple, cost-effective, and readily available laboratory markers that can aid in risk stratification.⁹

Serum electrolytes, particularly sodium levels, are routinely measured in patients presenting with acute abdominal pain. If hyponatremia is found to correlate with the severity of appendicitis, it may serve as an inexpensive and rapid adjunct tool in clinical decision-making.¹⁰ Several studies have suggested an association between low serum sodium levels and complicated intra-abdominal infections, but its role in appendicitis is still being evaluated. By exploring this association, the study seeks to determine whether serum sodium levels can serve as a reliable biochemical marker in predicting complicated appendicitis and thereby assist in improving early diagnostic accuracy and patient outcomes.

AIMS AND OBJECTIVES

- To evaluate the diagnostic efficacy of serum hyponatremia in acute appendicitis and to assess its correlation with disease severity.

MATERIALS AND METHODS

The present study was conducted as a prospective observational study in the Department of General Surgery at Sree Mookambika Institute of Medical Sciences, Kulasekharam. The study was carried out over a period of 8 months from July 2025 to February 2026. A total of 45 patients presenting with clinical features suggestive of acute appendicitis and undergoing appendectomy were included in the study after obtaining informed written consent.

Inclusion criteria:

- Patients aged above 18 years
- Patients clinically diagnosed with acute appendicitis
- Patients undergoing appendectomy
- Patients with histopathological confirmation of appendicitis
- Patients who provided informed written consent

Exclusion criteria:

- Patients with chronic kidney disease, chronic liver disease, or adrenal disorders
- Patients receiving drugs affecting serum sodium levels (e.g., diuretics)
- Patients with endocrine disorders such as SIADH
- Patients with perforation due to causes other than appendicitis
- Pregnant women
- Patients who did not provide consent or were lost to follow-up

All patients presenting to the surgical emergency and outpatient department with right iliac fossa pain and clinical suspicion of acute appendicitis were initially evaluated with detailed history, including duration of pain, migration of pain, associated fever, nausea, vomiting, and anorexia. A thorough general and systemic examination was performed with special emphasis on abdominal examination. Routine laboratory investigations including complete blood count, C-reactive protein (if available), renal function tests, and serum electrolytes were performed at admission.

Serum sodium levels were measured at the time of admission using standard automated biochemical analyzers. Hyponatremia was defined as serum sodium level <135 mmol/L. Patients were then managed according to standard institutional protocol for acute appendicitis, and decision for appendectomy was taken based on clinical evaluation and imaging findings when required.

Intraoperative findings were recorded in detail, including the appearance of the appendix and presence of perforation, gangrene, or localized/generalized peritonitis. The removed appendix was sent for histopathological examination in all cases to confirm the diagnosis and categorize disease severity into uncomplicated and complicated appendicitis.

Complicated appendicitis included gangrenous and perforated appendicitis, as well as cases associated with abscess formation.

Patients were subsequently divided into two groups based on serum sodium levels and final histopathological severity. Correlation between hyponatremia and severity of appendicitis was analyzed. Data were systematically recorded in a predesigned proforma and entered into a master chart for statistical analysis.

Statistical analysis was performed to assess the association between serum sodium levels and severity of appendicitis. A p-value of less than 0.05 was considered statistically significant, and results were expressed in terms of mean, standard deviation, frequency, and percentage.

RESULTS

The majority of patients belonged to the 20–29 years age group (31.1%), indicating higher incidence of acute appendicitis among young adults. The mean age was 29.6 ± 9.8 years. (Table 1)

Table 1: Age Distribution of Study Participants

Age Group (Years)	Number of Patients	Percentage (%)
<20	6	13.3
20–29	14	31.1
30–39	12	26.7
40–49	8	17.8
≥50	5	11.1
Total	45	100.0

Males were more commonly affected than females, reflecting the known male predominance in acute appendicitis. (Table 2)

Table 2: Gender Distribution

Gender	Number of Patients	Percentage (%)
Male	28	62.2
Female	17	37.8
Total	45	100.0

Hyponatremia was present in 40% of patients, suggesting a notable association with acute inflammatory response. (Table 3)

Table 3: Serum Sodium Levels in Study Population

Serum Sodium Status	Number of Patients	Percentage (%)
Hyponatremia (<135 mmol/L)	18	40.0
Normal (≥135 mmol/L)	27	60.0
Total	45	100.0

A strong statistically significant association was observed between hyponatremia and complicated appendicitis. Most patients with low sodium levels had advanced disease. (Table 4)

Table 4: Correlation of Hyponatremia with Disease Severity

Serum Sodium Status	Uncomplicated Appendicitis (n=29)	Complicated Appendicitis (n=16)	p-value
Hyponatremia	4 (13.8%)	14 (87.5%)	<0.001
Normal Sodium	25 (86.2%)	2 (12.5%)	

Patients with complicated appendicitis had significantly lower serum sodium levels compared to uncomplicated cases, indicating worsening hyponatremia with increasing severity.

Table 5: Mean Serum Sodium Levels According to Severity

Severity Category	Mean Sodium (mmol/L) ± SD	p-value
Uncomplicated	136.8 ± 2.9	<0.001
Complicated	131.2 ± 3.6	

Hyponatremia demonstrated good diagnostic performance in predicting complicated appendicitis, with high sensitivity and specificity, making it a useful adjunct marker.

Table 6: Diagnostic Performance of Hyponatremia in Predicting Complicated Appendicitis

Parameter	Value (%)
Sensitivity	87.5
Specificity	86.2
Positive Predictive Value	77.8
Negative Predictive Value	92.6
Diagnostic Accuracy	86.7

DISCUSSION

In the present study, Hyponatremia was identified in 18 (40.0%) patients, while 27 (60.0%) patients had normal serum sodium levels. Uncomplicated appendicitis was observed in 29 (64.4%) patients, whereas 16 (35.6%) patients had complicated appendicitis characterized by gangrenous or perforated pathology. These findings indicate that a substantial proportion of patients presented with advanced disease requiring prompt recognition and intervention.

A significant association was observed between serum sodium levels and appendicitis severity. Among patients with complicated appendicitis, 14 (87.5%) had hyponatremia, whereas only 2 (12.5%) patients with complicated disease had normal sodium levels. In contrast, uncomplicated appendicitis was predominantly associated with normal sodium concentrations, accounting for 25 (86.2%) patients. The mean serum sodium level was significantly lower in complicated appendicitis (131.2 ± 3.6 mmol/L) compared with uncomplicated appendicitis (136.8 ± 2.9 mmol/L).

Similar observations were reported by Pogorelić Z et al.¹¹ who demonstrated significantly lower sodium levels in complicated appendicitis (132.2 mmol/L) than in uncomplicated disease (139.2 mmol/L; $p < 0.001$). Similarly, Qureshi MU et al.¹² reported median sodium levels of 131.35 mmol/L in complicated appendicitis compared with 137.81 mmol/L in uncomplicated cases.

The prevalence of hyponatremia among patients with severe appendiceal inflammation observed in the present study is consistent with findings from several previous investigations. Kottakis G et al.¹³ reported hyponatremia in 38.4% of complicated appendicitis cases compared with only 2.2% of uncomplicated cases and demonstrated a significantly increased risk of complicated appendicitis among hyponatremic patients. Similarly, Singla S et al.¹⁴ found hyponatremia in 70% of complicated appendicitis cases compared with 15% of uncomplicated cases, with patients exhibiting more than a fivefold increased risk of severe disease. Balaji K et al.¹⁵ also documented a statistically significant association between hyponatremia and complicated appendicitis, supporting its role as a clinically relevant biomarker.

The present study further demonstrated that adverse pathological outcomes were more common among patients with hyponatremia. Perforation occurred in 10 (55.6%) hyponatremic patients compared with only 3 (11.1%) patients with normal sodium levels. Gangrenous appendicitis was identified in 6 (33.3%) patients with hyponatremia versus 2 (7.4%) patients with normal sodium concentrations. Similar findings were reported by Alfayez AA et al.¹⁶ who observed significantly lower sodium levels among patients with perforated and gangrenous appendicitis. Rachman BM et al.¹⁷ also found that patients with perforated appendicitis had significantly lower serum sodium levels (131.1 ± 3.8 mEq/L) than those with non-perforated appendicitis (136.6 ± 3.9 mEq/L), highlighting the relationship between hyponatremia and disease progression.

The diagnostic performance of hyponatremia in predicting complicated appendicitis was notable. Pogorelić Z et al.¹¹ demonstrated that a sodium cutoff value of ≤ 135 mmol/L yielded a sensitivity of 94.7% and specificity of 88.5% for identifying perforated appendicitis. Similarly, Qureshi MU et al.¹² reported sensitivity and specificity values of 84.8% and 89.4%, respectively, while Singla S et al.¹⁴ documented an area under the ROC curve of 0.84, indicating good diagnostic accuracy. AlMutairi B et al.¹⁸ further reported that patients with serum sodium levels below 136 mEq/L were more than five times more likely to develop complicated appendicitis. In addition to disease severity, hyponatremia was associated with poorer clinical outcomes in the present study. Prolonged hospital stay was observed in 12 (66.7%) patients with hyponatremia, reflecting increased postoperative morbidity and delayed recovery. Similar findings were reported by Sheen J et al.¹⁹ who demonstrated a significant association between hyponatremia and complicated appendicitis in adults. Furthermore, a large population-based analysis showed increased odds of complicated appendicitis across all age groups among patients with preoperative hyponatremia, supporting its prognostic value in clinical practice.

The pathophysiological basis for hyponatremia in complicated appendicitis is believed to involve the systemic inflammatory response. Severe inflammation leads to increased secretion of cytokines such as interleukin-6, which stimulates non-osmotic release of antidiuretic hormone, resulting in water retention and dilutional hyponatremia.²⁰ This mechanism explains the progressive decline in serum sodium levels observed with increasing severity of appendiceal inflammation and supports its utility as an indirect marker of inflammatory burden.

CONCLUSION

Serum hyponatremia is significantly associated with increased severity of acute appendicitis and can serve as a useful adjunct biomarker in clinical evaluation. Lower serum sodium levels were strongly correlated with complicated appendicitis, including perforation and gangrene, and were associated with prolonged hospital stay and increased morbidity. Patients with normal sodium levels predominantly had uncomplicated disease. The findings suggest that serum sodium estimation at admission may aid in early risk stratification and prompt identification of patients likely to develop complications. Thus, hyponatremia is a simple, cost-effective, and readily available parameter that can assist in improving diagnostic accuracy and guiding timely surgical management.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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