

# Alvarado Score: A Promising Tool in Diagnosis of Acute Appendicitis

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## ABSTRACT

**Introduction:** Appendicitis is the inflammation of vermiform appendix, one of the most frequent diagnoses for emergency department visits, resulting in hospitalization. Accurate and prompt diagnosis of acute appendicitis may reduce the incidence of morbidity and mortality resulting from perforation and other gravid complications. **Aims:** To evaluate the effectiveness of Alvarado scoring system in preoperative diagnosis of acute appendicitis. **Methods:** The study of 100 patients attending to Nepalgunj Medical College and Hospital during the year August 2021 to July 2022, with symptoms of acute appendicitis were included. The Alvarado score for each patient was evaluated. All the subjects included were scheduled for open appendicectomy and the specimens were subjected for histopathological evaluation. Patients with score less than 7 were categorized as Group A, whereas greater than 7 were categorized as Group B. **Results:** Among 100 patients, there were 58 males and 42 females. Symptoms like pain in right iliac fossa (97%), nausea and vomiting (85%) and anorexia (41%) were common. Positive signs were tenderness in right iliac fossa (92%) and fever (53.5%) with leukocytosis (73%) and neutrophilia in 62 cases (88%). Of 100 patients 27 belonged to Group A, whereas 73 belonged to Group B. 17 patients out of 27 in Group A were diagnosed with acute appendicitis on histology, whereas, 10 showed negative results. 69 out of 73 subjects in Group B were diagnosed with acute appendicitis on histology, whereas 4 showed negative results on histology. The rate of negative appendectomy was significantly higher in group A than group B. The overall sensitivity, specificity, positive predictive value, negative predictive value were 80.20%, 71.42%, 84.52% and 37.03% respectively. **Conclusion:** The Alvarado score when more than 7 enables risk determination in patients presenting with abdominal pain, linking the probability of appendicitis.

**Keywords:** Acute appendicitis, Alvarado score, Appendicoectomy, Histopathology, Vermiform appendix

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## INTRODUCTION

Appendix a worm like structure situated in mammalian caecum.<sup>1</sup> It is characterized by rotation of the caecum accounting for the retrocaecal position.<sup>2</sup> There is high density of mucin and IgA produced by B cells of the appendix mucosa thus, appendix can be regarded as an integral part of intestinal health.<sup>3,4</sup> The term appendicitis was first introduced by Reginald H. Filz, at Harvard in 1886.<sup>5</sup> It is one of the most frequent diagnoses for emergency department visits resulting in hospitalization.<sup>6</sup> Histologically, 5 types, namely acute ulcero-phlegmonous appendicitis, acute superficial appendicitis, lymphatic hyperplasia, submucosal fibrosis and rare diseases.<sup>7</sup> Acute appendicitis diagnosis is often exigent and involves an amalgamation of clinical, laboratory, and radiological findings, although imaging plays an insignificant role as they contribute little information unless there are added complications.<sup>8</sup> Appendicolith, carcinoid tumors, parasitic infestation or lymphoid hyperplasia are common cause of obstruction.<sup>9</sup> Abdominal pain is the chief complaint with low grade fever, abdominal rigidity, loss of appetite, nausea, constipation, vomiting etc.<sup>10</sup> Various signs which may

aid in the diagnosis of the same include the positive psoas sign, a positive obturator sign and a positive Rovsing sign.<sup>11,12</sup>

Delay in diagnosis and treatment may result in significant morbidity. A large number of scoring systems have been proposed for early diagnosis of appendicitis which differentiates appendicitis from other abdominal pain. Alvarado scoring given in 1986 for diagnosis of acute appendicitis, depends on history, clinical examination and laboratory findings, is 10-point clinical scoring system, also referred as MANTRELS.<sup>13</sup> The study evaluates the effectiveness of Alvarado scoring in diagnosing appendicitis.

## METHODS

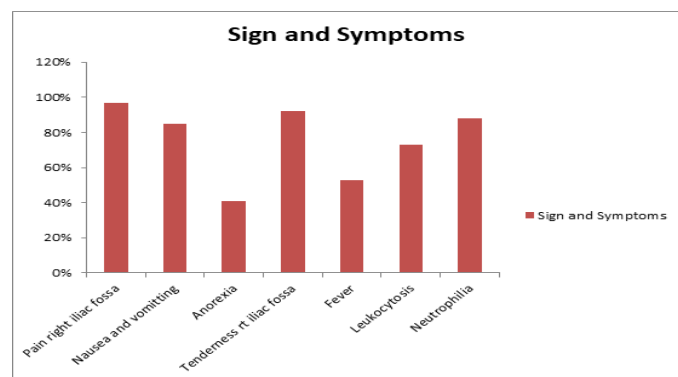
The study was carried out at Nepalgunj Medical College and Hospital from August 2021 to July 2022. A total of 100 patients of either sex, reporting the emergency department presenting with symptoms evocative of acute appendicitis, were included. Ethical permission was granted from the Institutional Review Committee and an informed consent was taken for all the

patients. Patients with symptoms suggestive of urological, gastrointestinal or gynecological entities; patients subjected for elective surgery and the ones who were not willing to participate were excluded from the study. The Alvarado score for all patients was evaluated. All the patients included were scheduled for appendectomy after examination by a surgeon via an open approach and the specimens were subjected for histopathological evaluation.

The symptoms included: migratory right iliac fossa pain (Score 1), anorexia (Score 1) and nausea/ vomiting (Score 1). The signs included: tenderness in right iliac fossa (Score 2), rebound tenderness in the right iliac fossa (Score 1) and elevated temperature (Score 1). Laboratory findings comprise of leukocytosis (Score 2), shift to the left of neutrophils (Score 1). The maximum value of Alvarado score is 10. Based on the scoring, the patients were divided into 2 groups; Group A: patients with score <7 and Group B: patients with score >7. The reliability of the Alvarado scoring system was assessed by determining the negative appendectomy rate referred as subjects reflecting no signs of inflammation on the histopathological examination of the removed specimen. Data were collected using a pretested questionnaire, recorded in master chart and analyzed using SPSS version 16 (SPSS Inc., Chicago, IL, USA).

**RESULTS**

The study comprised of 58 (58%) males and 42 (42%) females. Majority of the patients were in their 2<sup>nd</sup> and 3<sup>rd</sup> decades of life. The subjects presented with symptoms like pain in right iliac fossa (97%), nausea and vomiting (85%) and anorexia (41%). Positive signs seen during examination were tenderness in right iliac fossa (92%) and fever (53%). Laboratory investigations illustrated leukocytosis (73%) with neutrophilia in (88%). (Figure 1)



**Figure 1: Sign and symptoms of acute appendicitis**

Out of 100 patients, 27 belonged to Group A, and 73 belonged to Group B. 17 (62.96%) patients out of 27 in Group A were diagnosed with acute appendicitis on histopathological examination, whereas 10 showed negative results. 69 (94.52%) out of 73 subjects in Group B were diagnosed with acute appendicitis on histopathological examination, whereas 4 showed negative results. (Table II). The rate of negative appendectomy was significantly higher in group A than group

B. The rate of negative appendectomy was higher in females than males. (Table I)

Alvarado score	Total no. of cases(n)	Histopathological Negative	Male	Female
<7	27	10	3 (30%)	7 (70%)
>7	73	4	1 (25%)	3 (75%)

Group A= Alvarado score <7; Group B= Alvarado score >7

**Table I: Sex distribution of negative appendectomy with Alvarado score**

Alvarado score	Histopathological Positive	Histopathological Negative	Total no. of case (n)	P-value
<7	17	10	27	0.01 (S)
>7	69	4	73	0.89

Group A= Alvarado score <7; Group B= Alvarado score >7; S=Significance

**Table II: Correlation of Alvarado score with histopathological findings**

Alvarado score	No. of cases (n)	Confirmed appendicitis	Normal appendicitis
>7	73	69 (True positive)	4 (False positive)
<7	23	17 (FalseNegative)	10 (True negative)

**Table III: Dignostic accuracy of the Alvarado score**

The diagnostic accuracy of Alvarado score was high when it was more than 7, with a sensitivity, specificity being 80.20% and 71.42%. Similarly the positive predictive value was 94.52% and the negative predictive value was 37.03%. (Table III)

**DISCUSSION**

Acute appendicitis relics the most frequent abdominal condition entailing emergency surgical intercession globally. In spite of being a common clinical situation, it is cumbersome to diagnose the same by fresh graduates or doctors.<sup>14</sup> The diagnosis of the same is one of the most divisive tasks in general surgery due to inconsistent presentations of the disease and lack of a reliable diagnostic modality. Removal of a healthy appendix carries a greater risk of abdominal adhesions as compared to the diseased counterpart.<sup>15</sup>

Majority of the patients were in their 2<sup>nd</sup> and 3<sup>rd</sup> decades of life. Our findings were in agreement to Drinkovic who in his retrospective analysis comprised of 1050 patients operated on for acute appendicitis in the period 1983-1987. He found that appendicitis was most common in the age group from 11 to 20 years.<sup>16</sup> The present study comprised of 58 males and 42 females. Our results were in concordance with the study conducted by Stein et al who in his research on 3,736 patients found that males had more appendicitis attacks than females,

whereas females had more normal appendixes than males.<sup>17</sup>

The subjects presented with symptoms like pain in right iliac fossa (97.8%). Abdominal pain is the chief complaint of acute appendicitis patients. The progression of colicky abdominal pain proceeded by migration of the pain to the right iliac fossa was first illustrated by Murphy, however, may only be present in 50% of cases.<sup>18</sup> The characteristic triad of symptoms includes abdominal pain, anorexia and nausea and vomiting which may reflect in around 60% subjects. The presence of the above mentioned symptoms independently is nonspecific for diagnosis of appendicitis.<sup>19</sup>

In our study fever was seen in 53.5% cases. A study carried out by Lin et al reported that subjects with acute appendicitis group had higher frequency of fever in comparison to a non-appendicitis group (43.4% and 17%, respectively).<sup>20</sup> Laboratory investigations illustrated leukocytosis (73.6%) with neutrophilia in 62 cases (61.4%). Leukocytosis is a common finding in acute appendicitis. Similar results have been emphasized in many studies. One of such studies was conducted by Sang Hyun et al who in their study found that the average WBC level was 14,800/mm<sup>3</sup> in acute appendicitis group, which was higher than the 9,700/mm<sup>3</sup> of the non-acute appendicitis group. It was also found that neutrophilia was significantly higher in the acute appendicitis group. It has been observed that neutrophilia and leukocytosis are not significant factors in immunocompromised patients, like the ones with malignant conditions or HIV infection.<sup>21</sup> The rate of negative appendectomy in our study was higher in females than the males. These findings were in concordance to the one conducted by Jalil et al who in their study found that Alvarado scoring system was not found to be of high sensitivity in women of child bearing age.<sup>14</sup> The weaker sensitivity rates for diagnosis in females may be attributed to underlying gynecological or obstetric conditions like pelvic inflammatory diseases, ruptured ectopic pregnancy, torsion of ovarian cyst, etc. which may pose the examiner to misinterpret the condition.<sup>22</sup>

A low score is quite sensitive to rule out appendicitis warranting the examiner to subject the patient to imaging, as it is unlikely to diagnose appendicitis; however, a high score is more specific for appendicitis and may therefore indicate the surgeon to proceed with the surgical intervention without subjecting the patient for diagnostic imaging.<sup>23</sup> The Alvarado scoring system is one of the easiest and most commonly recognized aid for the diagnosis of acute appendicitis. It may also indicate about the severity of inflammation.<sup>24</sup>

In our study the overall sensitivity and specificity of Alvarado score were 80.20% and 71.42% respectively which were in concordance with the studies conducted by Ali et al and Limpawattanisiri et al which may suggest that Alvarado score may serve as an effective diagnostic aid in diagnosis of acute appendicitis.<sup>25, 26</sup>

## LIMITATIONS

The limitations is this study analyzed the effectiveness of only Alvarado score but not compared with other scoring system.

## CONCLUSION

The Alvarado score enables risk determination in patients presenting with abdominal pain, linking the probability of appendicitis, however, imaging modality are needed for accurate assessment and evaluation of the same. Thus the Alvarado score may aid as criterion to 'rule out and play a pivotal role in diagnosing acute appendicitis.

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