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Research Article

Correlation of Alvarado score for acute appendicitis with pathological acute appendicitis

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ABSTRACT

Background: The vermiform appendix is important in surgery due to its propensity for inflammation which results in the clinical syndrome known as acute appendicitis. Approximately 7% of the population will have appendicitis in their life time, with the peak incidence occurring between 10 and 30 years. There occur numerous instances in the practice of medicine which demand of the physician expert diagnostic skill, sound judgment, quick and competent treatment. In 1986, Alvarado evaluated common clinical and laboratory findings in relation to pathologically proven acute appendicitis. Alvarado score had sensitivity of 81% and a specificity of 74%. The main objective is to study efficacy of Alvarado score in diagnosis of acute appendicitis

Methods: This is a randomized study comprising of 138 patients of suspected acute appendicitis. The patients with suspected acute appendicitis are evaluated on the basis of the Alvarado scoring system on admission and divided into 3 groups (A, B and C). Patients were treated based on the clinical impression, following all standard surgical principals. The surgical specimen was sent for histopathological examination for confirmation of diagnosis. Data was collected, recorded and then processed.

Results: Out of total 138 patients included in study, 117 patients were subjected to emergency appendectomy. 111 patients out of 117 patients operated were true positive for acute appendicitis, confirmed by histopathology report. Rest 6 patients out of 117 had normal appendix on histopathology. The Sensitivity of Alvarado score was 92.79%, specificity was 77.77%, positive predictive value was 94.49% and negative predictive value was 72.14% in our study.

Conclusions: Alvarado scoring system is a good diagnostic indicator for acute appendicitis. It helps in reducing the number of negative appendicectomies.

Keywords: Appendix, Acute Appendicitis, Alvarado scoring system

INTRODUCTION

Acute appendicitis is the most common cause of an acute abdomen in young adults.[1] This condition is a common and urgent surgical illness with protean manifestations, generous overlap with other clinical syndromes, and significant morbidity, which increases with diagnostic delay. Giovanni Morgagni (1682-1771) in 1719 published a detailed account of the appendix, its site and relations in his "Achersaria Anatomica". Verneys in 1710, coined the term "Vermiform appendix", vermiform meaning worm-like.

Appendicitis is common in the 2nd and 3rd decades. It is rare in infancy and old age. Males are affected more commonly. Before puberty ratio is 1:1, after puberty 2:1 up to 25 years. The disease is common in highly civilized countries and certain communities, but rare in remote

rural districts and among primitive people. Acute appendicitis occurs in lifelong vegetarians and even in

babies at the breast. Acute appendicitis is more common between the upper and middle classes than those belonging to working class. Involvement of lymphoid tissue in the tonsils and appendix may occur simultaneously. A blood borne infection may be present in these cases.[2-4]

Abdominal pain is the prime symptom of acute appendicitis.[5] Classically, pain is initially diffusely centered in the lower epigastrium or umbilical area, is moderately severe, and is steady, sometimes with intermittent cramping superimposed. After a period varying from 1 to 12 hours, but usually within 4 to 6 hours, the pain localizes to the right lower quadrant. Slight pyrexia (37.2– 37.7°C) with a corresponding increase in the pulse rate to 80 or 90 is usual.[6] Vomiting generally occurs in the early stages of the attack, but usually a few hours after the initial pain due to protective pylorospasm. Irritation of the ureters by the retrocaecal appendix may give rise to pain mimicking right ureteric colic. As soon as the pain has shifted, there is localized tenderness either at Mc Burney‘s point or elsewhere, as determine by the site of the appendix.[6] Guarding will usually be present over the right lower abdomen. Rigidity occurs when peritonitis sets in. Muscular rigidity occurs when the inflamed organ is in contact with the muscle.

The diagnosis of acute appendicitis is essentially clinical however a decision to operate based on clinical suspicion alone can lead to removal of normal appendix in 15-30% of cases. It is clear that 80-85% patients with acute appendicitis will have a total WBC count of over 10,000/cu mm.[7,8] Neutrophilia of >75% will occur in 78% patients. Ultrasound is found to diagnose inflammatory appendix its specificity of 90-99% and sensitivity of 75-90%.

Acute appendicitis has to be differentiated from other common conditions presenting similarly like perforated peptic ulcer, torsion of omentum, typhilitis, non-specific adenitis, terminal ileitis, Meckel’s diverticulitis, ilio-caecal tuberculosis, ectopic gestation, twisted right ovarian cyst, acute pyelonephritis, pre-herpetic pain, and torsion testis.[6,9]

The Alvarado score (MANTRELS) is now one of the most well-known and studied appendicitis scores.[10] Eight criteria were chosen for inclusion in the diagnostic score, weighted to represent joint probability of disease. Right lower quadrant (RLQ) pain and a left shift were found to be the most prevalent, thus receiving 2 points each, while each of the remaining criteria were attributed 1 point. An Alvarado score of ≥7 was considered high risk for appendicitis. Though not explicitly stated in the study, this threshold value had a sensitivity of 81% and a specificity of 74%. Several elements of the score have been criticized, particularly the threshold for fever (37.3^{o} C) and the availability of peripheral cell count differentials at some health centres, prompting some investigators to modify the score.

Table: 1 Alvarado score.

Diagnostic criteria	Value
Migration of pain to RLQ 1	1
Anorexia 1	1
Nausea-Vomiting 1	1
Tenderness in RLQ 2	2
Rebound Tenderness 1	1
Elevation of Temperature (≥37.3 C)	1
Leukocytosis (> 10 000)	2
Shift to Left (> 75%)	1
Total Score	**10**

The treatment of acute appendicitis is immediate appendicectomy without delay. J.B. Murphy quoted "The earlier the operation, the lower the mortality". While there are no absolute rules, appendicectomy should be avoided in the presence of a mass or localized abscess. Cases admitted with diffuse peritonitis are treated with early operation.[5,6,11]

METHODS

138 consecutive patients presenting to the Department of Surgery at this institution with right iliac fossa pain during the time period of November 2011 to October 2013 were included in the study. The patients with suspected acute appendicitis are evaluated on the basis of the Alvarado scoring system on admission.

Inclusion criteria

- All patients presenting with right iliac fossa pain with clinical diagnosis of acute appendicitis during the study period, after informed consent, consecutively enrolled into the study.
- Patients of all age groups and both sexes were included in study.

Exclusion criteria

- Patients with a palpable mass in the right iliac fossa.
- Those who fail to provide information and had no relatives nearby were excluded from the study.

Plan of action

- Ethical approval to conduct the study was obtained from the joint institutional ethical committee before the commencement of the study.
- Detailed clinical examination of all the patients carried out and relevant investigations were ordered.
- The patients were examined and according to the variables of Alvarado score divided into three groups.

- Group A included patients with Alvarado score of seven and above (patients likely to have acute appendicitis) and Group B were patients with Alvarado score between 5-6 (doubtful). And group C included with Alvarado score less than 4 (less likely to have appendicitis).

The decision to operate was not based on Alvarado score of the patients but on the clinical impression by the clinician taking charge of the patient. Abdominal ultrasound was performed in all cases. All appendices removed at operation were sent for histopathology. The diagnosis of acute appendicitis was confirmed by histopathological examination. Data was collected. Then, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were determined.

Management of operated cases

- The cases subjected to emergency surgery are adequately prepared by parenteral fluids, electrolyte supplementation, and administration of broad spectrum antibiotics intravenously (usually combination of Ceftriaxone 1g 12th hourly + Metronidazole 500 mg 8th hourly).
- Surgery was done under spinal anesthesia. Grid iron incision was employed in majority of the cases. All appendices removed during operation were subjected to histopathological examination.
- Post operatively patients are kept nil orally, till bowel sounds returned; parenteral fluid, electrolytes, antibiotics and analgesics were continued.
- Patients were monitored for any post-operative complications and treated wherever needed. Post operatively sutures were removed on 7-9 days
- Patients were usually discharged after they resumed proper oral intake and general condition was satisfactory.

RESULTS

A prospective study of 138 consecutive patients presenting with right iliac fossa pain was undertaken to evaluate the Alvarado score as a diagnostic indicator and histopathology.

Out of total 138 patients included in study, 117 patients were subjected to emergency appendectomy. 111 patients out of 117 patients operated were true positive for acute appendicitis, confirmed by histopathology report. Rest 6 patients out of 117 had normal appendix on histopathology.

In present study the male to female ratio was 2.17:1. Maximum incidence was found in the age group of 21 to 30 years and Mean age was 27.41 years. Incidence of disease in total number of patients referred to department of surgery during study period in this institution (total 15,226 patients) is 0.76%.

Incidence of symptoms and signs as per Alvarado score: Pain was the commonest presenting symptom and had been observed in all the cases (100%) in present study. The classical shifting of pain from umbilical region to right iliac fossa was present in 90% of cases (100 patients). Other common symptoms observed were nausea and vomiting in 83.78% cases (93 patients) and anorexia 81% of patients (90 patients). On clinical examination of the patients, tenderness at right iliac fossa was present in all 111 patients (100%). Rebound tenderness was present in 94 patients (84.68% patients). Fever was present in 95 cases (85.58% patients). Increased WBC count (>10,000/cumm) was observed in 95 patients i.e. 85.58% of cases and shift to left noted in 76 patients i.e. 68.46% of cases.

Table 2: Manifestations as per Alvarado score.

Manifestattion	Cases (out of 111)	Percentage
Migrating pain	100	90%
Anorexia	90	81%
Nausea/vomiting	93	83.78%
Tenderness in rif	111	100%
Rebound tenderness	94	84.68%
Fever	95	85.58%
Leukocytosis	95	85.58%
Shift to left	76	68.46%

Range of Alvarado score

All 138 patients included in study were divided in three groups. 109 patients were included in Group – A (Alvarado score 7-10, highly suggestive of acute appendicitis). 11 patients were in group B (Alvarado score 5-6, equivocal diagnosis) and remaining 18 were included in group-C (Alvarado score 1-4, not suggestive of appendicitis).

Observed Alvarado scores in the study

Group-A: (Alvarado score more than 7; 109 patients): Of the 138 patients studied 109 patients had Alvarado score 7 and more. Out of these 109 patients one patient had findings consistent with hollow viscus perforation on ultrasonography, with gas under diaphragm on x-ray erect abdomen. He underwent exploratory laparotomy and found to have perforated gastric ulcer. 4 patients with Alvarado score 7 were diagnosed as acute appendicitis but intra-operatively their appendix was found normal which was confirmed on histopathology later. One patient with Alvarado score 8 was found to have normal appendix on ultrasonography later confirmed intraoperatively and histo-pathologically. Remaining 103 patients were diagnosed as acute appendicitis and found to have same intra operatively and on histopathology.

Group-B: (Alvarado score 5 & 6, total 11 patients) 9 patients had Alvarado score 6. 7 patients of which were

diagnosed as acute appendicitis later confirmed intra-operatively and on histopathology. One patient was diagnosed as having appendicitis but later appendix was found normal intra-operatively and on histopathology. One patient had normal study on ultrasonography and responded well to conservative treatment. Two patients had Alvarado score 5. One of which had acute appendicitis and was operated and diagnosis of acute appendicitis was confirmed on histopathology. Other patient with Alvarado score 5 had normal ultrasonography study and was managed conservatively.

Group-C: (Alvarado score 4 and less, total 18 patients) Total 18 patients had score 4 or less. None of them had acute appendicitis on ultrasonography. 8 patients had right ureteric calculus, 2 patients had ilieo-colitis, 5 patients had normal ultrasonography study. All of them responded well to conservative treatment. One patient had ovarian cyst and 1 had endometriosis with PID both cases were referred to gynecologist for further management. 1 patient had medical renal disease and was treated for the same by physician.

Table 3: Distribution of patients in three study groups.

Group	No of cases
A (as 7-10)	109
B(as 5-6)	11
C(as 1-4)	18
Total	**138**

Histopathology

Table 4: Statistical analysis - Alvarado score.

	Appendicitis (+)	Appendicitis (-)	Total
Alvarado score >= 7	103	6	109
Alvarado score < 7	8	21	29
Total	**111**	**27**	**138**

The specimen of the appendix was sent for histopathological examination in all operated cases. The histopathological examination confirmed the diagnosis of acute appendicitis in 85 cases. Necrotizing and gangrenous changes were seen in 11 and 16 cases respectively. The appendix was found to be normal in 6 cases.

Table 5: Determined values after histopathology.

Sensitivity	92.79%
Specificity	77.77%
Positive predictive value	94.49%
Negative predictive value	72.41%

DISCUSSION

In 1986, Alvarado evaluated common clinical and laboratory findings in relation to pathologically proven acute appendicitis.[10] Alvarado score had sensitivity of 81% and a specificity of 74%.

Carisa Schneider, evaluated the performance of the previously published Alvarado and Samuel appendicitis scoring systems in a prospectively identified pediatric cohort.[12] During this study sensitivity of Alvarado score is 72%, specificity is 81%, positive predictive value is 65% negative predictive value is 85%.

Chandra Prakash Panday et al studied 56 patients of acute appendicitis and evaluated performance of Alvarado score in them.[13] During this study they observed sensitivity 95.67%, specificity 70%, positive predictive value 93.62%, and negative predictive value 77.78%.

Subhajeet Dey et al in their study "Alvarado Scoring in Acute Appendicitis—A Clinicopathological Correlation" report sensitivity 94.2%, specificity 70% , positive predictive value 86.9% and negative predictive value 69.8 %.[14]

Table 6: Comparison of performance of Alvarado score in present study with other studies.

Study	No.of patients	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Alvarado A.	305	81%	74%	92%	46%
Carisa Schneider (pediatric cohort)	588	72%	81%	65%	85%
Chandra Prakash Panday	56	95.67%,	70%,	93.62%,	77.78 %.
Subhajeet Dey	155	94.2%,	70 %,	86.9%,	69.8 %.
Present study	138	92.79 %	77.77%	94.49%	72.42 %

CONCLUSION

Alvarado scoring system is a good diagnostic indicator for acute appendicitis. It has a sensitivity of 92.79% in diagnosing acute appendicitis. It helps in reducing the number of negative appendicectomies. It can work effectively in routine practice as an adjunct to surgical decision-making in questionable cases of acute appendicitis. It is simple to use and easy to apply since it relies only on history, clinical examination and basic laboratory investigations. It is cost-effective and can be used in all set ups with basic laboratory facilities.

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Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Liu CD, McFadden DW. Acute abdomen and appendix, In: Greenfield IJ, et al., eds Surgery: Scientific Principles and practice. 2nd ed. Philadelphia: Lippincott-Raven; 1997:126-1261.
2. Maa J, Kirkwood KS. Appendix. In: Courtney M. Townsend (ed) Sabiston Text Book of Surgery, 18th edition, Saunders; 2007:917- 923.
3. Das S: Text book of surgery, 3rd edition. Das academy; 2001:1002-1012.
4. Barker DJP, Osmond C, Golding J, Wadsworth MEJ. Acute appendicitis and bathrooms in three samples of British children. British Medical Journal. 1988;296:256-9.
5. Bernard M, Jaffe, Berger DH. The Appendix In: F. Charles Brunicardi (Ed): Schwartz's Principles of Surgery. New York. 9th Edition: The McGraw-Hill; 2014:1119-1137.
6. O'Connell RP, the Vermiform Appendix. In: O'Connell RP, Bullstrode CK, Williams NS.(eds): Bailey and Love's short practice of surgery, 25th edition, London: Edward Arnold Publishers; 2008: 1204-1218.
7. Swasso RD, Hanna EA, Moore DL. Leukocytic and neutrophilic counts in the acute appendicitis. Am J Surg. 1970;120:563-6.
8. English DC, Allen W, Coppala ED, Sher A. Excessive dependence on the leucocytosis clue in diagnosing appendicitis. Am J Surg. 1977;43:399-402.
9. Ellis H. Appendix. In: Seymour I Schwartz (Ed). Maingot's abdominal operations. 9th ed; Appleton and Lange; 1990:953-975.
10. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Annals of Emergency Medicine. 1986;15(5):557-64.
11. Mc Burney C. The Indications for Early Laparotomy in Appendicitis. Ann Surg. 1891;13(4):233-54.
12. Schneider C, Kharbanda A, Bachur R. Evaluating Appendicitis Scoring Systems Using a Prospective Pediatric Cohort. Annals of Emergency Medicine. 2007;49:778-84.
13. Panday CP, Ahmed QR, Chauhan CGS, Keserwani RC, Agarwal V, Awasthi M. Evaluation of Histopathological Correlation With Alvarado Score In Acute Appendicitis. National Journal Of Medical And Allied Sciences. 2012;1(2):30-6.
14. Dey S, Mohanta PK, Baruah AK, Kharga B, Bhutia KL, Sing VK. Alvarado Scoring in Acute Appendicitis - A Clinicopathological Correlation. Indian J Surg. 2010;72(4):290-3.

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