

## Original Research Article

# Comparative study between clinical diagnosis using modified Alvarado score and ultrasound imaging in decreasing negative appendectomy rate

Sayali S. Samudre\*, Anil S. Munde

Department of General Surgery, VDGIMS, Latur, Maharashtra, India

**Received:** 10 February 2021

**Revised:** 17 March 2021

**Accepted:** 19 March 2021

### \*Correspondence:

Dr. Sayali S. Samudre,

E-mail: sayalisamudre@gmail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** Acute appendicitis is the acute inflammation of appendix which is the most common cause of acute surgical emergencies. Appendicitis can mimic other pathologies. Removing normal appendix is an economical burden both on patients and health resources. Misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis.

**Methods:** This was prospective comparative study carried out in 200 patients over the period of 2 years. Patients with clinical features of acute appendicitis and fitting in inclusion and exclusion criteria were selected. Detailed history was noted and clinical examination was done. Necessary investigations were done, modified Alvarado score was calculated and all were subjected to ultrasonography of abdomen and pelvis. Intra operative findings were noted about nature of appendix and histopathology findings were noted.

**Results:** The sensitivity of ultrasound is 78.19% and specificity is 50%. The sensitivity of modified Alvarado scoring system is 78.7% and specificity is 25%. Negative appendectomy rate in the study was 6%.

**Conclusions:** Modified Alvarado score has slightly higher sensitivity and ultrasound imaging has higher specificity of in the diagnosis of acute appendicitis and in decreasing negative appendectomy rates. Ultrasound imaging provides good supportive diagnosis in cases of low or equivocal modified Alvarado scores.

**Keywords:** Appendicitis, Modified Alvarado score, Ultrasound imaging, Negative appendectomy

## INTRODUCTION

Acute appendicitis is the acute inflammation of appendix which is the most common cause of acute surgical emergencies.<sup>1</sup> It has a lifetime risk of about 8.6% in males and 6.7% in females. It may progress to perforate which is associated with higher morbidity and mortality.<sup>2</sup> Hence, surgeons are more inclined to operate when diagnosis is probable rather than wait till it is certain.<sup>3</sup> Rate of appendectomy for appendicitis is at 10 per 10,000 patients per year. Appendectomy for appendicitis is the most commonly performed emergency operation in the

world. Despite the increased use of ultrasonography, computed tomography and laparoscopy, the rate of misdiagnosis of appendicitis has remained constant (15.3%) as has the rate of appendicular rupture.<sup>4</sup> Experienced clinicians accurately diagnose appendicitis based on a combination of history, physical examination and laboratory studies about 80% of the time.<sup>6</sup> Removing normal appendix is an economical burden both on patients and health resources. Misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis.<sup>5</sup> A scoring system described by Alvarado was designed to reduce negative appendectomy rate without increasing morbidity and

mortality. It is a 10-point scoring system. In his original paper, Alvarado recommended an operation for all patients with score 7 or more.<sup>7</sup> Attempts to increase the diagnostic accuracy in acute appendicitis have included various scoring systems, imaging by ultrasonography and contrast enhanced computed tomography scan. This study is aimed at comparing the accuracy of modified Alvarado score and ultrasonography in the diagnosis of acute appendicitis and decreasing negative appendectomy rate.

### Objectives of study

Objectives of the study were-A. To compare and evaluate diagnostic accuracy of modified Alvarado score with USG imaging findings in diagnosis of acute appendicitis in correlation to histopathology report. B. To study usefulness of incorporating USG imaging in patients with low or equivocal modified Alvarado score in improving diagnostic accuracy in acute appendicitis, and C. To decrease negative appendectomy rates.

### METHODS

This prospective study was conducted in the department of general surgery, Vilasrao Deshmukh government institute of medical sciences (VDGIMS), Latur, Maharashtra, India period of study was January 2019 to December 2020. It was carried out on 200 patients.

#### Sample size calculations

For modified Alvarado score

**Table 1: Modified Alvarado score.**

Variable	D 20%	D 25%
Sensitivity 95%	121	78
Specificity 35%	208	133

For ultrasonography (A+P) finding,

**Table 2: Ultrasonography (A+P) finding.**

Variable	D 20%	D 25%
Sensitivity 83%	206	132
Specificity 33%	52	67

Sample size was calculated using above data in following formula

$$\text{Sample size} = \frac{Z^2 S (1-S)}{d^2}$$

Z-Value associated with  $\alpha$

At, 95% $\alpha$ , Z=1.96

S-Sensitivity or specificity

d-Absolute precision i.e., 20% of sensitivity or specificity,

By putting the values in above formula, we got sample size as 200.

#### Inclusion criteria

Inclusion criteria included all patients presenting with right iliac fossa pain, patients undergoing emergency appendectomy, age group 12 to 60 years and patients who are medically fit for surgery.

#### Exclusion criteria

Exclusion criteria excluded patients with presentation of gynecological urological and surgical problems other than acute appendicitis. Pregnant females with signs and symptoms of acute appendicitis, patients undergoing interval appendectomy, patients managed conservatively and patients with right iliac fossa mass.

Patients who presented in surgical OPD/ casualty with abdominal pain in right lower quadrant and having signs and symptoms of acute appendicitis and those patients who are fitting into inclusion criteria and giving consent for participation into study were taken for study. Detailed history was noted about the onset of symptoms and its progression over time and clinical examination was done in detail. Patients underwent investigations like complete blood counts. Peripheral blood smear, ultrasonography of abdomen and pelvis and other routine investigations like liver function, kidney function, chest X-ray, HIV, HBsAg, blood group for anesthesia fitness were done.

The female patient had pelvic examination or gynaecological consultation if felt necessary. All the patients were evaluated according to modified Alvarado scoring system and all were subjected to ultrasonography of abdomen and pelvis. Written informed consent for operative procedure was taken from all patients, pre-anesthetic checkup was done by anesthetist and then patients were operated after doing necessary investigations if required. Patients underwent emergency appendectomy either open/laparoscopic procedure.

On exploration, findings were noted about nature of appendix (normal/ inflamed/ perforated/ gangrenous) and also other pathologies present if any. Specimen of resected appendix was sent for histopathology and reports were correlated for analysis of effectiveness of pre-operative modified Alvarado score and ultrasound findings for diagnosis of acute appendicitis as well as for decreasing negative appendectomy rates.

#### Statistical analysis

Data collected was entered and analyze using Microsoft excel software. Chi square test was used wherever necessary. This data was collected in pretested proforma, which includes the general information and clinical details of the patients.

**Ethical committee approval**

Written approval from institutional ethics committee was obtained. Written approval of surgery and anesthesia department was obtained.

**RESULTS**

Out of 200, 120 cases had acute appendicitis, 29 cases had acute perforated appendicitis 4 cases had inflamed appendix and 11 cases had mild probe tenderness.

**Table 3: Ultrasonography imaging findings of study.**

Variable		Frequency	%
<b>Ultrasonography report</b>	Acute appendicitis	120	60
	Acute perforated appendicitis	29	14.5
	Inflamed appendix	4	2
	Mild probe tenderness	11	5.5
	Normal	36	18
<b>Total</b>		200	100

All the patients were operated and intraoperative findings along with histopathology findings were compared. Intraoperative findings were- 76.5% patients had inflamed appendix and 17.5% had perforated appendicitis. 6% patients had normal appendix.

**Table 4: Intraoperative findings of study.**

Variable		Frequency	%
<b>Intraoperative finding</b>	Inflamed appendix	153	76.5
	Normal	12	6
	Perforated appendicitis	35	17.5
	<b>Total</b>	200	100

Histopathology reports suggested that 12% patients had acute on chronic appendicitis, 63.5% had acute appendicitis and 18.5% had acute suppurative

**Table 7: Correlation of modified Alvarado score and ultrasound findings in this study.**

Variables		Ultrasound positive		Ultrasound negative		Total
		Frequency	Percent (%)	Frequency	Percent (%)	
<b>Modified Alvarado score</b>	Positive	130	83.9	27	60.0	157
	Negative	23	14.8	20	44.4	43
<b>Total</b>		155	100.0	45	100.0	200

Chi square test=16.13, p=0.0001 (<0.05), highly significant

Out of one hundred and fifty-seven positive MAS cases, one hundred and thirty cases had appendicitis on

appendicitis. In the 6% cases, appendix found to be normal.

**Table 5: Histopathology findings of study.**

Variables		Frequency	%
<b>Histopathology finding</b>	Acute on chronic appendicitis	24	12.0
	Acute appendicitis	127	63.5
	Acute suppurative appendicitis	37	18.5
	Normal appendix	12	6.0
	<b>Total</b>	200	100.0

Modified Alvarado score was considered positive if it is more than 5.

**Table 6: Modified Alvarado score findings in this study.**

Variables		Frequency	Percent (%)
<b>Modified Alvarado score grade</b>	<5	43	21.5
	5 to 6	41	20.5
	7 to 10	116	58.0
	<b>Total</b>	200	100.0

For modified Alvarado score: Chi square test=3.06, p=0.08 (>0.05), not significant, sensitivity=78.7%, specificity=25.0%, positive predictive value (PPV)=94.26%, negative predictive value (NPV)=6.97%, false positive percentage (FP%) =75% and false negative percentage (FN%) =21.27%,

For ultrasound imaging: Chi square test=4.98, p=0.026 (<0.05), significant, sensitivity=78.19%, specificity=50%, positive predictive value (PPV)=96.07%, negative predictive value (NPV) =12.76%, false positive percentage (FP %) =50.0% and false negative percentage (FN%) =27.7%

Correlation of modified Alvarado score and ultrasound imaging for diagnosis of acute appendicitis-

ultrasound imaging and out of forty-three negative MAS cases, twenty-three cases had appendicitis on ultrasound imaging.

## DISCUSSION

In the present series visualization of appendix was only seen in 18% of the patients.

In a study by Puylaert et al 88.5% of the patients on ultrasound were reported visualization of the appendix in another study by Gallego et al 82% of the patients reported with visualization of appendix. In the present series, graded tenderness over the McBurney's point by transducer was 88% which is the good diagnostic feature of acute appendicitis. According to Puylaert et al graded tenderness over the McBurney's by transducer was 89% in the present series 88% of patients are reported as local dynamic illus in ultrasound. The raise of percentage may be due to other pathologies which also show illus other than appendicitis. In the present series 23.5% of the patients were reported as normal study of ultrasound and use has a role excluding the diagnosis of acute appendicitis.

### Ultrasound specificity and sensitivity in diagnosis of acute appendicitis

In the present study ultrasound findings showed 79.25% sensitivity and 50% specificity in diagnosing acute appendicitis.

**Table 8: Value of ultrasound in the diagnosis of acute appendicitis.**

Authors	Specificity (%)	Sensitivity (%)
Mathews et al <sup>11</sup>	90.90	88.13
Puylaert et al <sup>9</sup>	100	89
Gallego et al <sup>10</sup>	82	89
Jeffrey et al <sup>12</sup>	96.2	89.9
Zeidan et al <sup>13</sup>	93.7	74.2
Fa et al <sup>14</sup>	90.6	66.7
Abu-Yousuf et al <sup>15</sup>	95	85
Adams et al <sup>16</sup>	86	89
Present study	78.1	50

In the present series 94% of the patients are histopathologically confirmed.

To prove accuracy of the scoring, ultrasound sensitivity and specificity the histopathological confirmation is needed.

**Table 9: Histopathological reports by authors.**

Authors	Percentage (%)
Bhattacharjee et al <sup>8</sup>	82.7
Mohanty et al <sup>17</sup>	94.44
Mathews et al <sup>11</sup>	84.28
Geryk et al <sup>18</sup>	78.2
Present study	94

## Negative appendectomy rate

The present study shows negative Appendectomy rate of 6%.

**Table 10: Negative appendectomy rate by various authors.**

Study	Negative appendectomy rate (%)
Gyomer et al	15
Mohammad et al	12
Limpawattanasri	14.7
Nizamuddin et al	14.6
Cuschieri et al	6
Yasin et al	7.5
Present study	6

## Limitations

The limitation of this study was ultrasound imaging had drawbacks in gaseous abdomen, fatty abdomen, uncooperative patient due to probe tenderness and it is observer dependent. Equivocal or low modified Alvarado score may underestimate the diagnosis of acute appendicitis.

## CONCLUSION

Both modified Alvarado score and ultrasound are good modalities for diagnosis of acute appendicitis and for decreasing negative appendectomy rates. With slightly higher sensitivity of modified Alvarado score and higher specificity of ultrasound imaging for diagnosis of acute appendicitis and decreasing negative appendectomy rates.

Ultrasound imaging provides good supportive diagnosis in cases of low or equivocal modified Alvarado scores.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

- Williams NS. Bailey and Love's short practice of surgery, 25<sup>th</sup> ed, London: Edward Arnold Ltd. 2008;1204-18.
- Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol. 1990;132:910-25.
- Hoffmann J, Rasmussen O. Aids in the diagnosis of acute appendicitis. Br J surg. 1989;76:774-9.
- Schwartz's Principles of Surgery, Ed 9<sup>th</sup>. The McGraw-Hill Companies. 2010.
- Ohmann C, Yang Q, Franke C. The abdominal pain study group. Diagnostic scores for acute appendicitis.

- Eur J Surg. 1995;161:273-81.
6. The Appendix. In Maa J, Townsend CM, Beauchamp RD, Evers BM, Mattox KL, eds. *Sabiston Textbook of Surgery*. 18<sup>th</sup> ed. Philadelphia, Pa: Saunders Elsevier. 2008;1333-47.
  7. Douglas CD. Randomized controlled trial of ultrasonography in the diagnosis of acute appendicitis, incorporating the Alvarado score. *BMJ*. 2000;321:919-22.
  8. Bhattacharjee PK, Chowdary T, Roy D. Prospective Evaluation of modified Alvarado Score for diagnosis of acute appendicitis. *J Indian Med Asso*. 2002;100:S.
  9. Puylaert JBCM. Acute appendicitis-US evaluation using Graded compression. *Radiology*. 1986;158:355-60.
  10. Gallego G, Neto F, Fernandez C. evaluation of ultrasonography and clinical diagnostic scoring in suspected appendicitis. *Br J Surg*. 1998;85:3740.
  11. John GM, Pattanayak SP, Panda C, Mohan Rao KRR. Evaluation of Ultrasonography as a Useful Diagnostic Aid in Appendicitis. *IJS*. 2002;64,5:436-9.
  12. Jeffery RB Jr, Laing FC, Townsend RR. Acute appendicitis: sonographic criteria based on 250 cases. *Radiology*. 1988;167:327-9.
  13. Zeidan BS, Wasser T, Nicholas GG. Ultrasonography in the diagnosis of acute Appendicitis. *J R Coll Surg Edinb*. 1997;42:24-6.
  14. Fa EM, Cronan JJ. Compression ultrasonography as an aid in the differential diagnosis of appendicitis. *Surg Gynecol Obstet*. 1989;169:290-8.
  15. Abu-Yousuf MM, Phillips ME, Franken EA Jr, Al-Jurf AS, Smith WL; Sonography of acute appendicitis: a critical review: *Crit Rev Diagn Imaging*. 1989; 29 (4):381-408.
  16. Adams DH, Fine C, Brooks PC. High-resolution real-time ultrasonography: A new tool in the diagnosis of acute appendicitis. *Am J Surg* 1988;155:93-97.
  17. Mohanty S, Si K. Evaluation of modified Alvarado score in decreasing negative appendectomy rate-our experience. *IJS*. 200;62:5;342-3.
  18. Gerick B, Kubikova E, Jakubovsky J. Clinical histopathologic picture of acute appendicitis in children. *Rozhchir*. 2000;79(5);211-4.

**Cite this article as:** Samudre SS, Munde AS. Comparative study between clinical diagnosis using modified Alvarado score and ultrasound imaging in decreasing negative appendectomy rate. *Int Surg J* 2021;8:1185-9.