Original Research Article

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

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Received: 10 February 2021
Revised: 17 March 2021
Accepted: 19 March 2021

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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 appendicectomy 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 appendicectomy 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. 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. Hence, surgeons are more inclined to operate when diagnosis is probable rather than wait till it is certain. Rate of appendectomy for appendicitis is at 10 per 10,000 patients per year. Appendicectomy 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. Experienced clinicians accurately diagnose appendicitis based on a combination of history, physical examination and laboratory studies about 80% of the time. 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. A scoring system described by Alvarado was designed to reduce negative appendicectomy rate without increasing morbidity and mortality.
mortality. It is a 10-point scoring system. In his original paper, Alvarado recommended an operation for all patients with score 7 or more. Attempts to increase the diagnostic accuracy in acute appendicitis have included various scoring systems, imaging by ultrasonography and contrast enhanced computed cosmography scan. This study is aimed at comparing the accuracy of modified Alvarado score and ultrasonography in the diagnosis of acute appendicitis and decreasing negative appendicectomy 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 appendicectomy 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

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

For 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

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

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 appendicectomy, 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 appendicectomy, 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 appendicectomy 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 appendicectomy 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 | %  |
|----------------------|-----------|----|
| Acute appendicitis   | 120       | 60 |
| Acute perforated appendicitis | 29       | 14.5|
| Inflamed appendix    | 4         | 2  |
| Mild probe tenderness| 11        | 5.5|
| Normal               | 36        | 18 |
| Total                | 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 | %  |
|---------------------|-----------|----|
| Inflamed appendix   | 153       | 76.5|
| Normal              | 12        | 6  |
| Perforated appendix | 35        | 17.5|
| Total               | 200       | 100|

Histopathology reports suggested that 12% patients had acute on chronic appendicitis, 63.5% had acute appendicitis and 18.5% had acute suppurative appendicitis. In the 6% cases, appendix found to be normal.

Table 5: Histopathology findings of study.

| Variables                          | Frequency | %  |
|------------------------------------|-----------|----|
| Acute on chronic appendicitis      | 24        | 12.0|
| Acute appendicitis                 | 127       | 63.5|
| Acute suppurative appendicitis     | 37        | 18.5|
| Normal appendix                    | 12        | 6.0 |
| Total                              | 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 (%) |
|------------|-----------|-------------|
| Modified Alvarado score grade <5 | 43 | 21.5 |
| 5 to 6     | 41        | 20.5 |
| 7 to 10    | 116       | 58.0 |
| Total      | 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-

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

| Variables              | Ultrasound positive | Ultrasound negative | Total |
|------------------------|---------------------|---------------------|-------|
|                        | Frequency | Percent (%) | Frequency | Percent (%) |       |
| Modified Alvarado score|          |             |           |             |       |
| Positive               | 130       | 83.9       | 27        | 60.0        | 157   |
| Negative              | 23        | 14.8       | 20        | 44.4        | 43    |
| Total                  | 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 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 al11        | 90.90           | 88.13           |
| Puylaert et al9        | 100             | 89              |
| Gallego et al10        | 82              | 89              |
| Jeffrey et al12        | 96.2            | 89.9            |
| Zeidan et al13         | 93.7            | 74.2            |
| Fa et al14             | 90.6            | 66.7            |
| Abu-Yousuf et al15     | 95              | 85              |
| Adams et al16          | 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 al8   | 82.7           |
| Mohanty et al17        | 94.44          |
| Mathews et al11        | 84.28          |
| Geryk et al18          | 78.2           |
| Present study          | 94             |

Negative appendicectomy rate

The present study shows negative Appendicectomy rate of 6%.

Table 10: Negative appendicectomy rate by various authors.

| Study                  | Negative appendicectomy rate (%) |
|------------------------|----------------------------------|
| Gyomer et al           | 15                               |
| Mohammad et al         | 12                               |
| Limpawattanasi         | 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 appendicectomy 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

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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.