

Application of alvarado scoring system in diagnosis of acute appendicitis

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Abstract:

Acute appendicitis is a common cause of abdominal pain and can be difficult to diagnose, especially during the early stages. There is still appreciable morbidity and occasionally mortality which may be related to failure of making an early diagnosis⁽¹⁾

As a result of their concern about these surgeons create for themselves 'a surgical security zone which allows them to accept a 15-30% negative laparotomy rate with impunity⁽²⁾, Although various aids exist to facilitate more accurate diagnosis and reduce the rate of negative appendectomy, many are complex.

Whereas simple scoring systems have been available for some time, they have not been widely tested.

The aim of this study was conducted to assess one of these scoring systems which was described by Alvarado in 1985⁽¹⁾, by comparing it's to the histopathology results of operated patients.

This retrospective study of consecutive patients admitted to surgical ward at Benghazi Aljala hospital with suspicion of having acute appendicitis during the period of January 2008 to January 2010.

The Alvarado scoring system was computed from admission notes and records correlated with histopathology, all cases with insufficient data or no histopathology result were excluded from the study

Out of 153 patients 90 underwent appendectomy with the intention to treat appendicitis and diagnosis was confirmed in 80 patients. Reliability of the system was assessed by calculating negative appendectomy rate and positive predictive value which was 85%, and the normal appendectomy frequency was 12%.

Alvarado scoring system is easy, cheap, and useful tool in preoperative diagnosis of acute appendicitis and can work effectively in routine practice.

Keywords: Acute Appendicitis, Alvarado score, Appendectomy

Introduction:

Acute appendicitis is one of the most common surgical emergency with a life time prevalence of approximately 1 in 7⁽²⁾ Its incidence is 1.5-1.9/1000 in male and female population⁽³⁾. Surgery for acute appendicitis is the most frequent operation performed (10% of all emergency abdominal operations)^(4,5)

In 1886, Reginald Fitz of Boston correctly identified the appendix as the primary cause of right lower quadrant inflammation. He coined the term appendicitis and recommended early surgical treatment of the disease⁽⁵⁾

Soon afterwards, Charles McBurney described the clinical manifestations of acute appendicitis including the point of maximum tenderness in the right iliac fossa that now bears his name.⁽⁶⁾

The differential diagnosis of appendicitis can include almost all causes of abdominal pain, as described in the classic treatise, A useful rule is never to place appendicitis lower than second in the differential diagnosis of acute abdominal pain in a previously healthy person

The treatment of acute appendicitis is basically surgical, and negative appendectomy rates are high. A negative appendectomy rate of 20-40% has been reported in literature and many surgeons would accept rate of 30% as inevitable.⁽⁷⁾ Removing normal appendix is an economic burden both on patients and health resources. Misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis.⁽⁸⁾

The process of reach and confirm the diagnosis of the disease includes the following steps:

History:

The typical presentation begins with periumbilical pain, caused by the activation of visceral afferent neurons, followed by anorexia and nausea. The pain then localizes to the right lower quadrant as the inflammatory process progresses to involve the parietal peritoneum overlying the appendix. This

classic pattern of migratory pain is the most reliable symptom of acute appendicitis. A bout of vomiting may occur, Anorexia is a useful and constant clinical feature, particularly in children. fever ensues, followed by the development of leukocytosis. These clinical features may vary from one person to another and some clinical features may not appear in some patients. ⁽⁶⁾

hematuria, perhaps because of inflammation of periappendiceal tissues adjacent to the ureter or bladder, and this may be misleading. Although most patients with appendicitis develop an ileus and absent bowel movements on the day of presentation, occasional patients may have diarrhea. Others may present with small bowel obstruction related to contiguous regional inflammation. ⁽⁶⁾

Clinical examination:

patients with acute appendicitis usually look ill and are lying still in bed. Low-grade fever is common ($\approx 38^{\circ}\text{C}$). Examination of the abdomen usually reveals diminished bowel sounds and focal tenderness, with voluntary guarding. The exact location of the tenderness is directly over the appendix. Usually, this occurs at McBurney's point, located one third of the distance along a line drawn from the anterior superior iliac spine to the umbilicus; however, the normal appendix is mobile, so it may become inflamed at any point on a 360-degree circle around the base of the cecum. Thus, the site of maximal pain and tenderness can vary. Rebound tenderness may appear and indicates peritoneal irritation. ⁽⁶⁾

Any movement, including coughing (Dunphy's sign), may cause increased pain. Other findings may include pain in the right lower quadrant during palpation of the left lower quadrant (Rovsing's sign), pain on internal rotation of the hip (obturator sign, suggesting a pelvic appendix), and pain on extension of the right hip (iliopsoas sign, typical of a retrocecal appendix) ⁽⁶⁾.

If the appendix perforates, abdominal pain becomes intense and more diffuse and abdominal muscular spasm increases, producing rigidity. The heart rate rises, with an elevation of temperature above 39°C ⁽⁶⁾.

Laboratory studies: The white blood cell count is elevated, with more than 75% neutrophils in most patients. A completely normal leukocyte counts and differential is found in approximately 10% of patients with acute appendicitis. A high white blood cell count ($>20,000/\text{mL}$) suggests complicated appendicitis with gangrene or perforation. A urinalysis can also be

helpful in excluding pyelonephritis or nephrolithiasis ⁽⁶⁾.

Radiological study:

Computed tomography (CT) is commonly used in the evaluation of adult patients with suspected acute appendicitis. Improved imaging techniques, including the use of 5-mm sections, have resulted in increased accuracy of CT scanning, which has a sensitivity of approximately 90% and a specificity of 80% to 90% for the diagnosis of acute appendicitis in patients with abdominal pain. CT findings of appendicitis increase with the severity of the disease. Classic findings include a distended appendix more than 7 mm in diameter and circumferential wall thickening and enhancement, which may give the appearance of a halo or target. As inflammation progresses, one may see periappendiceal fat stranding, edema, peritoneal fluid, phlegmon, or a periappendiceal abscess. CT detects appendicoliths in approximately 50% of patients with appendicitis ⁽⁶⁾.

ultrasonography has a sensitivity of approximately 85% and a specificity of more than 90% for the diagnosis of acute appendicitis. Sonographic findings consistent with acute appendicitis include an appendix of 7 mm or more in anteroposterior diameter, a thick-walled, noncompressible luminal structure, it is commonly used in children and in pregnant patients with equivocal clinical findings suggestive of acute appendicitis ⁽⁶⁾.

Diagnostic laparoscopy:

It is used as a last method of diagnosis in Small number in whom the diagnosis remains elusive. For these patients, diagnostic laparoscopy can provide a direct examination of the appendix and a survey of the abdominal cavity for other possible causes of pain ⁽⁶⁾.

Alvarado score

is a clinical scoring system used in the diagnosis of appendicitis, the score has 6 clinical items and 2 laboratory measurements with a total 10 points. It was introduced in 1986 and although meant for pregnant females, it has been extensively validated in the non-pregnant population. ⁽⁸⁾

As shown previously the variable presentation of the acute appendicitis symptoms and signs, which makes it difficult to diagnose and time\money consuming in some cases for this reason it is impractical to have a definitive preoperative diagnosis by gold standard, in order to reduce the negative appendectomy rates various scoring systems have been developed for supporting the diagnosis of acute appendicitis. (Alvarado scoring system) is one of them and is

purely based on history, clinical examination and investigations. The scoring system for specific points in history, examination, and few laboratory tests makes it cheap, easy, and fast to apply⁽⁹⁾.

The Alvarado score mainly focus on 6 clinical symptoms which found to be the commonest between acute appendicitis patients these symptoms includes: migration of pain, anorexia (loss of appetite), nausea, rebound tenderness, elevated temperature which are all given the score of one point, tenderness at right iliac fossa got the score of two points as it's an important and main symptom in all cases of acute appendicitis.

The score also includes two findings in a basic, available and cheap laboratory investigation which is the complete blood count, the findings are, leukocytosis (high WBC count) which a basic finding in acute appendicitis and other inflammatory pathologies that's why it's given score of two points, the other laboratory finding is the shifting of WBC count to the left (maximum percentage of WBC are eosinophil) given a score of one point⁽¹¹⁾.

After collecting the total points, the patient managed according to the total result as following:

Score 1-4 discharge (most likely not appendicitis)

Score 5-6 admission or close observation as the patient most likely to have acute appendicitis and may need surgical intervention

Score 7-10 patient must have urgent surgical intervention as he has acute appendicitis for sure

the accuracy of the Alvarado and modified Alvarado scoring systems were under continuous evaluation by different types of studies and most of the results were encouraging regarding using these scoring systems as a cheap quick method to evaluate patients suspected to have acute appendicitis.

one of the studies was published at a1998 by A. A. Malik, and N. A.Wani , aimed to study the accuracy of acute appendicitis evaluation through modified alvarado score in a total of 106 patients underwent modified alvarado scoring in emergency surgical service at sk institute of medical sciences in India. The result of the study was that the high scores in men and children were found to be an easy and satisfactory aid in the early diagnosis of acute appendicitis, but a high false-positive rate for acute appendicitis was found in women. (12)

Another study published by Ikramullah khan and Ataur Rehman at 2003 and performed at Khyber teaching hospital in Pakistan , this study aimed to evaluate the accuracy of application of alvarado scoring system in diagnosis of acute appendicitis, where number of 100 consecutive patients with suspected acute appendicitis were included in the study during the period from July to December 2003. The positive predictive value was 84.3% (males 88%, females 82.1%). And resulted that this scoring system is easy, simple and cheap complementary aid for supporting the diagnosis of acute appendicitis especially for junior surgeons. (13)

Last but not least is a prospective study to assess the accuracy of the Alvarado scoring system in predicting acute appendicitis, and published at JK science journal of medical education and research. 2008 Apr. - June included 100 patients suspected to have acute appendicitis, the results were satisfactory with a positive predictive value of 83.79% (14)

Materials and Methods:

This retrospective study was conducted in the Department of Surgery of a Aljala Hospital in Benghazi for the period January 2008 to January 2010. All consecutive patients admitted to (common surgical ward) in that period with pain in the right lower abdomen were considered. Patients of all age groups and both genders admitted were included in the study. Patients with no Histopathology results or those patients with incomplete documentations in the case sheets were excluded from the study. The admission records and notes were reviewed and Alvarado scoring computed and patients were categorized into three groups, (score 7-10, 4-6

and 1-4 as it standard to label those patients with a score 7-10 as diagnostic of appendicitis, score 4-6 as doubtful but potential candidates suffering from the disease and scores 1-4 unlikely to suffer from the condition.

This was correlated and analyzed with operative notes and histopathologic examination of the specimen. And finally we tried to find out the negative appendicectomy rate, the positive predictive value, negative predictive value, sensitivity and specificity, and compared them with the results of other similar researches in order to assess the reliability of Alvarado scoring system.

Calculations and Results:

A total number of 153 patients were included in this study, which comprised of 82 male patient (53.5%) and 71 female patients (46.5%) , mean age was 25 years in range of 12-57 years with a median of 22 years. Data was collected from patient's files including the features of the score as shown on table1

Table 1: distribution of patients according to Alvarado score features:

Feature	Number of patients (%)
Migratory right iliac fossa pain	142 (93%)
Nausea	100 (65%)
Anorexia	120 (78%)
Tenderness at right iliac fossa	144 (94%)
Rebound tenderness	117 (76%)
Fever	30 (20%)
Leukocytosis	110 (72%)
WBC shift to left	80 (52%)
Total	153 (100%)

The patients were divided into three main groups, **Group 1** with Alvarado scoring range between 1-4 included 21 patients (14.1%), **Group 2** with Alvarado scoring range of 5-6 contains 70 (45.1%) patients, and **Group 3** with scoring range of 7-10 contains 62 (40.6%) patients. Table 2

GROUP	PATIENT NUMBER	HISTOLOGY +VE	HISTOLOGY -VE
1 (SCORE 1-4)	21	2	19
2 (SCORE 5-6)	70	61	9
3 (SCORE 7-10)	62	60	2
TOTAL	153	123	30

13 male patients (62.6%) and 8 female patients (37.3%) within Group1 that with score range of 1-4, 37 male patients (52.8 %) male patients and 33(47.1%) female patients within Group2 that having Alvarado scoring range from 5-6 , and 32 (51.7%) male patients and 30 (48.2%) female patients at last Group (Group3) that with Alvarado scoring range of 7-10. figure 1

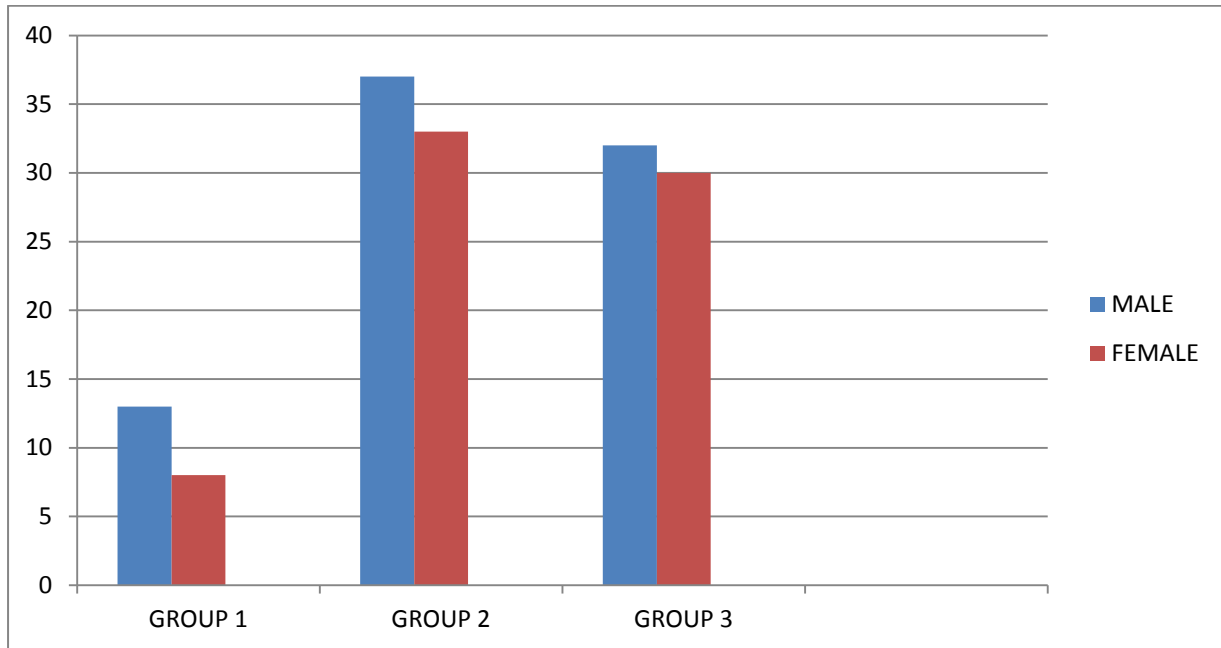


Figure 1: Sex distribution of patients in groups

Further retrospective analysis of the data revealed that all the 62 (32 male and 30 females) patients categorized to be in the score range of 7-10 underwent appendectomy within 24 hours of admission (range of 6–24 hours). Histopathological examination of the specimens confirmed acute appendicitis in 60 patients. There were 4 perforated appendix (Male 3 and Female 1) in the group and 5 (Male 3 and Female 2) had gangrenous appendicitis. 2 males had negative appendectomy, no pathology was detected in one and one had Meckel's diverticulitis.

Of the 70 patients with in the score of 5–6, 27 i.e. 38.5% (15 males and 12 females) underwent appendectomy within 36-48 hours of admission after reassessment. It was noted that those patients who underwent delayed appendectomies were either due to increased severity of symptoms and clinical deterioration that they were fitting into the next group, ≥ 7 or that the diagnosis was confirmed by radiological evaluation methods (ultrasonography / CT scan). In this group there were 9 patients (Male 6 and Female 3) in whom histology showed removed appendix was normal. Of the 6 male patients no pathology was detected in 4 patients, 2 had mesenteric lymphadenitis . No pathology was detected in 1 female and 2 each had ovarian cyst

The first group of patients with the range of 1–4 score had 21 (13 Male and 8 Female) patients and all of these patients were discharged within 48-72 hours of admission. 2 male patients from this group were readmitted within 24 hours of discharge with complaints of increased severity of symptoms and underwent appendectomy. They were found to have a score 7-10 on readmission. Histopathology confirmed acute appendicitis in both the patients. Figure 2

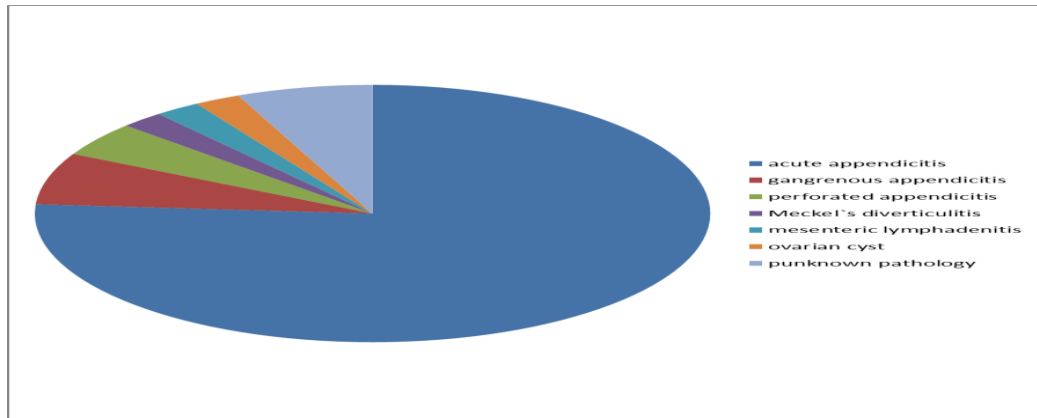


Figure 2: Percentage of operated cases according to operative findings

After statistical analysis of the collected data, it was found that there were 47 males and 43 females who underwent appendectomy; appendicitis was confirmed in 40 males and 36 females, giving a negative appendectomy rate of 18.3% in males and 6.9% in females with an overall negative appendectomy rate of 12.1%. Operative note findings and histology reports confirmed appendicitis in 80 out of 90 patients undergoing appendectomy (88.9 %). (column1)

In males the sensitivity and specificity were 89% and 62.8% whereas the positive and negative predictive values were 81.6% and 62.8%. Females had a positive predictive value of 93% and sensitivity of 89% whereas the negative predictive value and specificity were 30.9%. The overall positive predictive value of Alvarado score was 88.9%, negative predictive value of 69.8% and sensitivity and specificity of 94.2% and 70% respectively.

There were 5 patients with gangrenous appendicitis, 4 had perforated appendicitis in the series and they all were within the score range of 7-10. All these patients underwent surgery and were not missed out.

Overall there was a positive diagnostic likelihood ratio of 9.5 and a negative diagnostic likelihood ratio of 0.24.

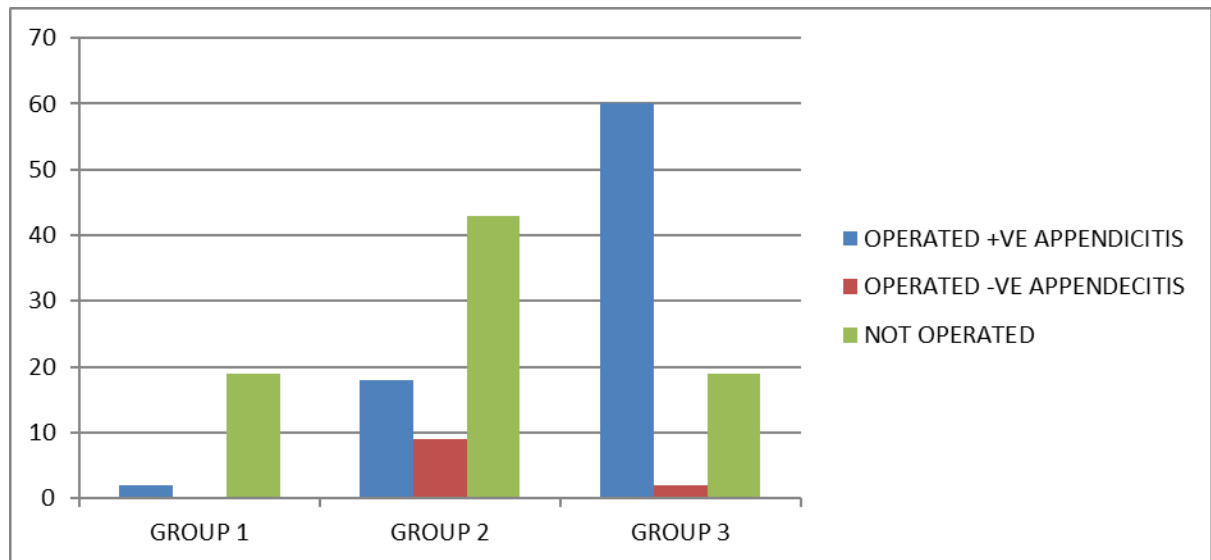


Figure 3: Number of operated cases (positive and negative histology) and not operated cases

Discussion:

Decision making in cases of acute appendicitis poses a clinical challenge especially in developing countries (including Libya) where advanced radiological investigations do not appear cost effective and so

clinical parameters remain the mainstay of diagnosis (13).

Through history and clinical examination still remains the mainstay for the diagnosis, but misdiagnosis and negative appendectomy still do occur at quite a high rate.

Despite the availability of radiological (US/CT) investigative modalities, a recent population-based

study in USA indicated that there was essentially no change in the frequency of negative appendectomy (16). Similar results were also reported, where the authors found Ultrasonography did not have any additional benefit over Alvarado score and were of the opinion that Ultrasonography is unnecessary in diagnosis of acute appendicitis (12).

It is the surgeon who has to decide the best management and at a cost effective manner. The decision to operate or not is very important as surgical intervention in acute appendicitis is not without the risk of morbidity and mortality.

Even though, a negative appendectomy has a negligible mortality and morbidity of around 10% (12). Various scoring systems are being used to aid the diagnosis of acute appendicitis and bring down the negative appendectomy rates.

In 1986 A. Alvarado published 8 predictive factors, which he found to be useful in making the diagnosis of acute appendicitis, since then there have been various studies, trying to validate the utility and usefulness of this simple scoring system.

The results of our study are comparable with the relevant literature. Our study shows a positive predictive value of 88.9% comparable with literature reports of 97% (11), 97.6% (12), 83.5% (14).

We had a negative appendectomy rate of 12% (Males-18.3% and Females-6.9%). Similar results were reported in literature; 21% (13), 15.6% (14), 7% (11). There are even opinions and evidences that if negative appendectomy rates are below 10–15%, the surgeon is operating on too few patients thus increasing the risk of complications (15).

Negative predictive value of our series was 69.8% as compared to 77% (13).

From the previous comparison with similar literatures performed at developing countries, with different statistical methods, we find similarity between the results, and all of them indicates to the good accuracy of the Alvarado scoring system in the

diagnosis of acute appendicitis, with low chance of misdiagnosis or operating on patients who doesn't have acute appendicitis.

This is a simple scoring system which can easily be performed by non-surgical emergency residents (17).

Even though the scoring system may be effective in the adults, we agree with the opinion that it is not effective and reliable in younger children. Probably because it does not contain variables that allow for differentiating appendicitis from the numerous other conditions mimicking it in the paediatric population. The clinician remains the best judge of the acute abdomen in the paediatric age group (18).

Also another preoperative study made to determine the accuracy of Alvarado score over a period of 9 months in two hospitals (Gateshead and Sunderland). The presence of a high score was found to be an easy and satisfactory aid to early diagnosis of appendicitis in children and men. However, the false-positive rate for appendicitis in women particularly those of child bearing age, it falls disappointingly short of expectations. Even with scores of 7 or more, over 30% did not have an inflamed appendix. was unacceptably high (19).

Conclusion:

Alvarado scoring system is easy, simple, cheap, useful tool in pre-operative diagnosis of acute appendicitis and can work effectively in routine practice.

Scores more than 7 definitely warrant a virtual confirmed diagnosis of acute appendicitis and early operation is indicated to avoid complications like perforation. Patients with in the score range of 5–6 require admission and need re-evaluation for possible deterioration of clinical condition and earliest possible intervention. The application of Alvarado scoring system definitely improves diagnostic accuracy and possibly reduces the complication rates

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