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THE DIAGNOSTIC PROBLEMS OF ACUTE APPENDICITIS IN MILITARY MEDICAL PRACTICE

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Abstract

Acute appendicitis is one of the most common surgical emergencies. However acute appendicitis often mimics other acute abdominal conditions and might be difficult to diagnose. The accuracy of diagnosis has scarcely improved over decades, the negative appendicectomy rate is therefore high, typically 15-30% with most surgeons unwilling to risk missing the diagnosis.

Present study aimed to assess the effectiveness of Modified Alvarado Score along with ultrasound examination for diagnosis of acute appendicitis in military medical practice.

A total number of 60 patients (52 males and 8 females) presenting with signs of acute appendicitis were included in the study. The age range of the patients was 18-43 years. Patients participating in the study were divided into three groups in accordance with the value of the total Modified Alvarado Score. In 3 cases among 36 patients who underwent surgery the diagnosis was not confirmed during the subsequent histological examination of the removed appendix. Total negative appendectomy rate was 8.3%. Modified Alvarado Score showed high diagnostic significance sensitivity of 90.9% and specificity of 88.9%. The high diagnostic accuracy of Modified Alvarado Score is attributed to the fact that our study involved mainly military personnel, males at the age of 8-40. Among patients with aggregate Modified Alvarado Score of 1-4 no cases of acute appendicitis have been observed and in group of patients with aggregate Modified Alvarado Score of 8-10, there were rare cases of negative appendectomy.

Management of the patients with the 5-7 range of Modified Alvarado Score still remains the most important issue. Additional instrumental examinations such as ultrasound, observation and proper clinical judgment are required in such cases to avoid diagnostic mistakes. Sensitivity of ultrasound examination was as low as 51.5%, specificity 80%, but ultrasound examination had high significance in identifying concomitant disease of the abdominal cavity. The use of Modified Alvarado Score as a "first-pass" approach, together with additional ultrasound examination and observation in unclear clinical cases, helps to reduce negative appendectomy rate and complications associated with delayed diagnosis of acute appendicitis.

Keywords: *acute appendicitis, acute abdomen, appendectomy, Alvarado score*

Introduction

Acute appendicitis is one of the most common surgical emergencies. In civilian practice approximately 50% of cases of acute pain in the abdomen is caused by acute appendicitis and most often this pathology occurs among males in the age group from 18 to 30 [*Chhetri R, Shrestha M, 2005*]. The majority of the RA armed forces soldiers are males in age group of 18-40 years, so in military medical practice cases of acute abdominal pain conditioned with appendicitis are more common.

The diagnosis of acute appendicitis is primarily clinical, including history and physical findings, with additional assistance of laboratory data and instrumental studies. However, these symptoms are not very specific for acute appendicitis and

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often can mimic other acute abdominal conditions. Acute appendicitis is difficult to diagnose especially in the prodromal phase, which can lead to its further progression to perforation with significant morbidity and even mortality. Thus, decision making may be difficult especially for junior surgeons.

The accuracy of diagnosis hasn't improved much over the decades, the negative appendicectomy rate is therefore high, typically 15-30%, with most surgeons unwilling to risk missing the diagnosis. In women in whom gynaecological emergencies can mimic appendicitis this rate can be as high as 45% [*Hay J, 1992; Jones P et al., 1998; Douglas C et al., 2000; Shah S, Rashid M, 2004; Kozachenko A et al., 2009*]. The complications associated with unnecessary laparotomy, such as wound infection, postoperative hernia, intra-abdominal adhesions, relatively long period of incapacity for work are well common. The main cause of intra-abdominal adhesions in operated patients with intestinal obstruction is appendicectomy. The incidence of such adhesions may even be greater if the excised appendix is not inflammed [*Al-Fallouji M, 1998*]. On the other hand the cases of appendix perforation are also high 15-18% [*Andersson R et al., 1992; Drake F et al., 2014*] and up to 20% of cases of secondary peritonitis are associated with appendix perforation [*Doklestic S et al., 2014*].

Modern imaging examinations such as ultrasound, CT scan and laparoscopy are now available in case the diagnosis is unclear. In routine clinical practice, ultrasonography and CT scan are most often used to diagnose acute abdominal pathology. There are a lot of publications about sensitivity and specificity of ultrasound and CT scan to diagnose acute appendicitis, but it's clear that this imaging techniques are useless without proper clinical judgment. Ultrasound imaging is preferred in clinical practice because of its simplicity, non-invasiveness and cost effectiveness, its sensitivity ranges 44-98%, and specificity ranges 47-95% according to different authors data [*Garcia Peña B et al., 1999; Kaiser S et al., 2002; Hernanz-Schulman M, 2010; Sovtsov S, 2016*]. The sensitivity of ultrasound is lower in cases of retrocecal and pelvic localisation of appendix, in obese patients and bowel loops distention with gas and fecal matter. The results of ultrasound investigation are also largely dependent on the experience of a specialist. CT scan has the highest sensitivity and specificity among non-invasive diagnostic methods. Negative factors of CT scan are high cost, radiation exposure [*Mettler F et al., 2008; Guite K et al., 2011*]. We also have to note that not all hospitals are equipped with CT scanners and have 24-hour duty specialist. Several authors recommend to perform CT scan only in cases of difficult diagnosis [*Kushnir A, Zuev V, 2015; Atema J et al., 2015*]. In a prospective study of 1.630 patients with suspected appendicitis [*Petrosyan M et al., 2008*], it was found that the overall negative appendectomy rate in patients who underwent CT scan was similar to that in those who didn't. In another study [*Lee S et al., 2001*], it was found that neither CT nor US improves the diagnostic accuracy or the negative appendectomy rate, in fact, they may delay surgical consultation and appendectomy.

Summarizing the data of the literature, we want to emphasize that, although the use of laboratory and instrumental data is a valuable addition to preoperative diagnosis, clinical evaluation remains the basis of diagnosis and there is no single and common guideline for the diagnosis of acute appendicitis.

Several scoring systems, based upon clinical signs, symptoms and routine laboratory findings have been used to improve the diagnosis of acute appendicitis. The most frequently used is Alvarado score. The Modified Alvarado Score (MAS) is simple, fast, reliable, cost effective and reproducible system that can be used without expensive and complicated supportive measures [*Alvarado AA 2016*]. However, variations in sensitivities and specificities were observed when scores were applied to various population groups and clinical settings, and various studies have shown variable results, especially they were less valid in women. Current study is designed to assess the effectiveness of MAS use along with ultrasound examination and one-day follow up in hospital for diagnosis of acute appendicitis in mmilitary medical practice.

MATERIAL AND METHODS

The study was carried out at the general surgery department of Yerevan Garrison Military Hospital. A total number of 60 patients presenting with signs and symptoms suggestive of acute appendicitis were included in study. All the patients were admitted to hospital with the symptoms suggestive of acute appendicitis. The age range of the patients was 18-43 years, 52 patients were males and 8 females. The history of the disease with emphasis on complaints related to scoring parameters was taken, followed by detailed clinical examination. Routine investigations, including total and differential leucocyte count were carried out Chest X-Ray and ECG were made. On the basis of clinical findings, the total MAS was counted according to assessment scale presented in table1.

Patients participating in the study were divided into three groups in accordance with the value of the total Modified Alvarado Score.

Group I of 12 patients with 1-4 aggregate score was confirmed as low risk group. These patients were kept under hospital observation for 1-2 days, if the score doesn't rise they were discharged from the hospital.

Group II of 26 patients with 5-7 aggregate score, was defined as intermediate risk group. After initial assessment, additional instrumental studies such as ultrasound examination and the senior surgeon consultations was performed. The decision on surgery was based on collective assessment of clinical data. Those patients who did not undergo urgent surgery, were kept under observation and assessed repeatedly at the 4-6-hour intervals during 24-48 hours, to know whether the score rises or decreases. If score dropped to <4, patients were discharged, otherwise if score rose up to 8 or more they were operated.

Group III of 22 patients with aggregate score of 8-10 was confirmed as high-risk group. After initial assessment and ultrasound examination, in case other findings were absent, these patients were diagnosed acute appendicitis and urgent surgery was performed.

The ultrasound examination was performed in 58 patients. An ultrasound scan of the patients was performed using Toshiba-Aplio 400 scanner (Japan), with additional compression of abdominal wall. All the patients were examined with same experienced specialist. The abdominal cavity organs, pelvic organs and retroperitoneal space were assessed for differential diagnosis and exclusion of concomitant pathology. Ultrasound findings of acute appendicitis were considered positive as both direct and indirect appendicular signs, such as an increase in the diameter of the appendix cross section, rigidity of the appendix, which is manifested in insufficient compressibility as well as inflammatory changes in parenteral fatty tissue, peritoneal fluid in the pelvis or in the interstitial space, thickening of the wall of the cecum, incompatibility of periappendicular fat.

According to American College of Chest Physicians/Society of Critical Care Medicine Consensus Conference (1992) systemic inflammatory response syndrome was obtained as an objective marker of acute inflamatory process.

Clinical criteria of systemic inflammatory response syndrome

- Body temperature lower than 36°C or higher than 38°C
- Heart rate more than 90 beats per minute
- White blood cell count less than (4×10^9 cells/L) or more than (12×10^9 cells/L) or the presence of more than 10% of immature neutrophils (bands). Excess of band cells of more than 3% is called bandemia or a 'left-shift'.

TABLE 1

Modified Alvarado Score

Variables	Value
Migratory pain right iliac fossa	1
Anorexia	1
Tenderness right lower quadrant	2
Nausea/vomiting	1
Rigidity and/or rebound tenderness	1
Elevated temperature >37.0°C	1
Extra clinical signs (cough sign/ Rovsing's sign etc.)	1
Leucocytosis >10 x 10^9/l	2
Total score	10

Total 36 (60%) of the 60 studied patients underwent surgery. Open appendectomy was performed in all the cases. Definitive diagnosis was made during the surgery on the basis of visual assessment of morphological changes in the appendix, pathological process in the abdominal cavity and by histological examination. Histopathological examination of appendectomy specimens was performed in the department of pathology of Central Clinical Military Hospital. Negative appendectomy was defined as a specimen that microscopically contains no pathology (no evidence of inflammation, tumours, parasitic infestation and any other pathological abnormalities).

Results

All I group patients were discharged, 16 patients in II group and 20 patients in III group underwent surgery. No cases of such complications as peritonitis associated with appendix perforation were observed after admission to the hospital. In 3 cases among 36 patients who underwent surgery diagnosis was not confirmed during intraoperative examination and subsequent histological examination of the removed appendix, total negative appendectomy rate was 8.3%. After histological examination of removed appendixes diagnosis of catarrhal appendicitis was confirmed in 11 patients, phlegmonous appendicitis was confirmed in 18 patients, and 4 patients were hospitalized with gangrenous appendicitis.

The MAS values were compared to histopathological examination findings, the results are presented in (Table 2). Based on the data presented in the table, 2 sensitivity and specificity of MAS were calculated. Modified Alvarado score showed high diagnostic significance sensitivity of 90.9% and respectively specificity of 88.9%.

Our data is comparable to similar studies conducted by [*Alverez S et al., 1997; Fenyo G et al., 1997; Ijaz A et al., 2000; Arain G et al., 2001*] They reported negative appendectomy rate (10-16%). We attribute the high diagnostic accuracy of MAS to the fact that mainly military personnel, males aged 18-40 were involved in our study.

It's important to note that in I group with aggregate MAS of 1-4 no cases of acute appendicitis have been observed, that means we can use ≤4 score as cut-off value for non-surgical management of these patients, and in III group with aggregate MAS of 8-10 there were rare cases of negative appendectomy, which can be used as recommendation to perform surgery if the patient's MAS is ≥8. MAS was also useful for reducing the use of medically unnecessary imaging examinations such as CT scan and ultrasound in most of the patients with suspected acute appendicitis (patients of I and III groups). Meanwhile most authors consider routine imaging examinations such as ultrasound and CT scan for all cases of suspected acute appendicitis [*Rao P et al., 1998; Hernanz-Schulman M, 2010; Mostbeck G, 2016; Sokolov M et al., 2017*]. This point is more important for military medical practice, when the physician often has to deal with limited medical resources.

Table 2

The data of clinical examinations compared to the results of histopathological findings

Patients diagnosted by \ Patients		diagnosed appendicitis after histological examination	appendicitis excluded with histological examination
Data of modified Alvarado score scale			
Modified Alvarado Score Scale		33	27
appendicitis	33	30 true positive	3 false positive
appendicitis excluded	27	3 false negative	24 true negative
Data of ultrasound examinaton			
Ultrasound Examination		33	25
appendicitis	22	17 true positive	5 false positive
appendicitis excluded	36	16 false negative	20 true negative

Management of the patients with the MAS range of 5-7 yet remains the most important issue. Additional instrumental examinations such as ultrasound, observation and proper clinical judgment are required in such cases to avoid diagnostic mistakes. By using additional ultrasound examination, observation in our hospital unit and proper clinical judgment among patients of this group we were able to reduce the negative appendectomy rate and complications associated with late diagnosis of acute appendicitis. We managed to reduce negative appendectomy rate to 8.3% which is lower than most authors have presented in their reports.

The data of ultrasound examination was also compared to intraoperative and histological examination findings and the results are presented in table 2. Based on the data presented in table 2, the sensitivity and specificity of ultrasound examination were calculated, sensitivity was (17/33 × 100%) 51.5%, specificity (20/25 × 100%) 80%. The results of calculations show that only ultrasound examination cannot be used to diagnose acute appendicitis without clinical assessment, especially we showed low sensitivity in our study, which can lead to late diagnosis and complications. Ultrasound examination had high significance in identifying concomitant disease of the abdominal cavity and can be used as additional examination in doubt clinical cases to improve diagnosis accuracy.

Clinical presentation of systemic inflammatory response syndrome was positive in only 66.6% of patients with subsequently diagnosed acute appendicitis, but the clinical manifestation the syndrome was high among patients with diagnosed phlegmonous and gangrenous appendicitis, making up 92.3%. These findings suggest that systemic inflammatory response syndrome clinical sings cannot be used as an objective criterion for excluding acute appendicitis, but its presentation with concomitant abdominal pain indicates the presence of acute abdominal pathology and should alert the surgeon to decide on urgent operation.

Conclusion

Appendicitis can be a notoriously difficult diagnosis to make, especially for non-specialists and junior surgeons. It is important for the surgeon to make the right decision when the surgical treatment is needed. Protocol Based guidelines appear attractive as they make decision-making more simple. Based on the data obtained in this study, and also in accordance with the literature, we propose an algorithm for managing patients with suspected

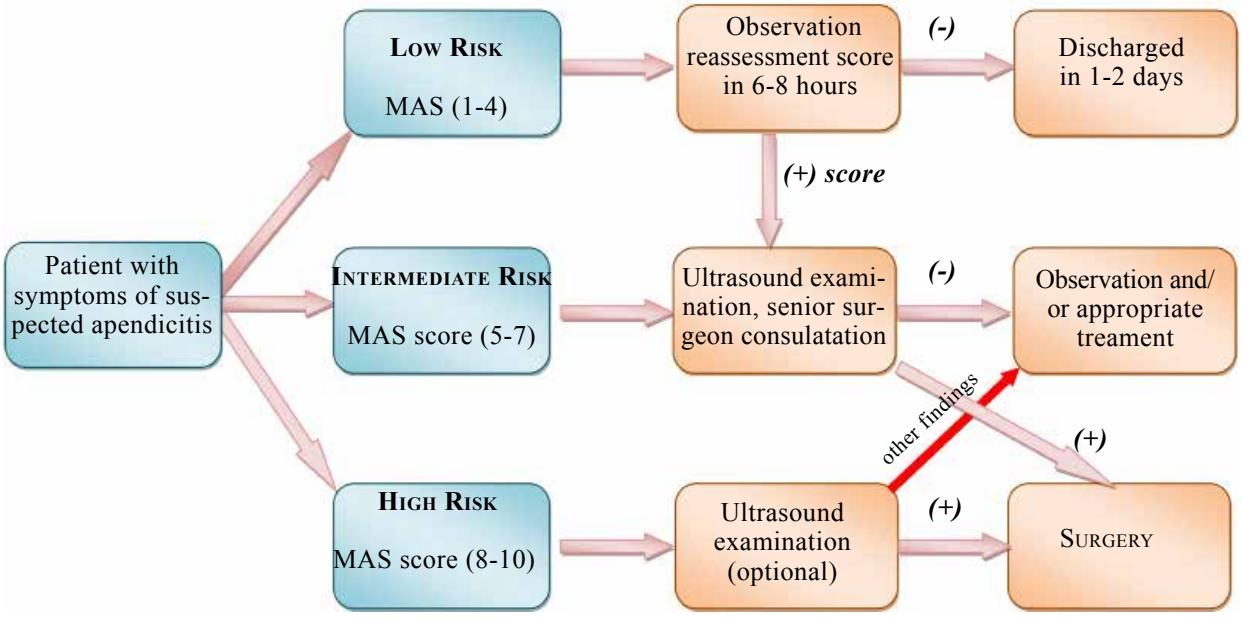

Figure. *Diagnostic algorithm for managing patients with symptoms of suspected appendicitis*

acute appendicitis that can be used in military hospitals. The diagnostic algorithm for managing patients with symptoms of suspected appendicitis is presented in the figure.

Objective and standardised diagnostic algorithm will be more useful especially to junior surgeons among duty staff of hospital, it can be easily applicable, accurate and reproducible in the diagnosis of appendicitis. The use of Modified Alvarado Score as "a first-pass" approach, together with additional ultrasound examination and observation in unclear clinical cases, is able to reduce the negative appendectomy rate and complications associated with delayed diagnosis of acute appendicitis. As Alvarado A. noted in his article, "As we all know, medicine is a combination of science and art, both of them equally important in the diagnosis of acute appendicitis, so we cannot discard one of them in favour of the other. It is for this reason that we cannot depend on the technological advances only but we should use our common sense and clinical experience to arrive to a correct diagnosis".

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