Correlation between Alvarado Score and Intra-Operative Findings In Acute Appendicitis

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Abstract

Background: acute appendicitis remains the most common abdominal surgical emergency in both developing and developed countries, appendectomy considered as most frequent operation performed, the diagnosis of acute appendicitis still a surgical dilemma due to wide range of differential diagnosis, that's why many diagnostic scores had been developed to reduce the rate of unnecessary appendectomy and to avoid post-operative complications of unnecessary surgery, also to reach accurate diagnosis and to avoid missed cases.

Aim of study: to evaluate sensitivity, specificity and accuracy of Alvarado score in pre-operative diagnosis of acute appendicitis.

Setting: Al-Yarmuk Teaching Hospital / Department of Surgery.

Patients and Methods: a prospective study of 225 patients whom were admitted to the department of surgery as emergency cases from Jan.2019 to Jan. 2020. Data were collected for each patient included age, gender, duration of pain, past medical and surgical history, temperature, leucocyte count, abdominal ultrasound, general urine examination, type of an aesthesia, intraoperative findings and post-operative complications, all data were analyzed by Alvarado score.

Results: the majority of cases were in the age group (11-20) 98 patients (43.6%), with accurate intra-operative diagnosis of acute appendicitis (88.89%) after using the Alvarado score in the diagnosis pre-operatively. The negative appendectomy rate was 27 cases (12.0%) which lies within the worldwide range of other studies.

Conclusion: the Alvarado score can be applied easily in a simple way by junior as well as senior doctors to reach accurate diagnosis of acute appendicitis in cases of right iliac fossa pain, to reduce the rate of unnecessary surgery.

Keywords: Acute appendicitis, Alvarado score, Appendectomy, Intraoperative findings.

العلاقة بين نقاط الفارادو والنتائج العملية الجراحية في حالات التهاب الزائدة الدودية الحاد

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الخلاصة

الخلفية : يبقى التهاب الزائدة الدودية الحاد هو الأكثر شيوعا بين حالات البطن الطارئة في البلدان المتقدمة والنامية ،يعتبر استئصال الزائدة الدودية من العمليات المتكررة بكثرة ،في يومنا هذا يبقى تشخيص هذا المرض معضلة بسبب وجود مجموعة واسعة من التشخيص التفريقي ،لهذا السبب وجدت أنظمة نقاط متعددة لتقليل معدل استئصال الزائدة الدودية السلبي ولتجنب مضاعفات ما بعد العمليات لعملية جراحية غير ضرورية ،كذلك للتوصل الى تشخيص دقيق ولتجنب الحالات الفائتة.

الهدف من الدراسة : لتقييم مدى حساسية ودقة نظام نقاط ألفارادو في تشخيص التهاب الزائدة الدودية الحاد قبل العملية.

المكان : قسم الجراحة / مستشفى اليرموك التعليمي

المرضى والطرق : دراسة مستقبلية شملت 225 مريضاً تم ادخالهم الى قسم الجراحة كحالات طارئة في الفترة ما بين كانون الثاني / يناير 2019 وحتى كانون الثاني / يناير . 2020 تم جمع البيانات لكل مريض وشملت العمر ،الجنس ،مدة الألم ،التاريخ المرضي الباطني والجراحي ،درجة الحرارة ،تعداد كريات الدم البيضاء ،فحص السونار للبطن ،تحليل الادرار العام ،نوع التخدير ،النتائج داخل العملية
ومضاعفات ما بعد العملية .جميع البيانات تم تحليلها باستخدام نظام نقاط ألفارادو.

- **النتائج:** الغالبية العظمى من المرضى كانوا في الفئه العمريه (11-20)أي 98 مريض ،(% 43.6)
تشخيص دقيق لالتهاب الزائدة الدودية الحاد (% 88.89) بعد استخدام نظام نقاط ألفارادو في التشخيص

قبل العملية . معدل استئصال الزائدة الدودية السلبي كان (% 12.0) والذي يقع داخل المعدل العالمي لدراسات أخرى.
الاستنتاج : ممكن تطبيق نظام نقاط ألفارادو بسهولة بشكل بسيط بواسطة الأطباء المبتدئين وكذلك الأطباء الأقدمين للوصول الى تشخيص دقيق لالتهاب الزائدة الدودية الحاد في حالات ألم الحفرة الحرقفي الأيمن ،لتقليل معدل العمليات الغير ضرورية.
كلمات مفتاحية: التهاب الزائدة الدودية الحاد، نقاط ألفارادو، استئصال الزائدة الدودية، اثناء عملية الزائدة الدودية.

Introduction

Acute Appendicitis remains the most common abdominal emergency in both developing and developed countries, and it affects the life and activity of seven percent of the general population who underwent appendectomy for acute appendicitis, from this percentage; 12% were males and 25% were females [1]. In 1886 Reginald Heber Fitz described the classical symptoms and signs of acute appendicitis as a disease entity [2]. Acute appendicitis first described in 1889 by McBurney in NewYork and was the first who point out the importance of early surgical intervention, although early appendectomy done by R. Lawson Tait in 1880 [3]. The commonest age incidence of acute appendicitis is during the 2nd and 3rd decades of life, it is rare in infants and after the middle age [4]. Male:Female ratio of acute appendicitis is equal before puberty, 3 : 2 ratio in teenagers up to the age of 25, after that it became 1.4 : 1 , female incidence of acute appendicitis is 1 : 35, male incidence is 1 : 50 [5]. The appendix is a 7.5-10 cm blind muscular tube with mucosal, submucosal, muscular and serosal layers, its base lies at the confluence of the three taeniae coli of the caecum. The inner linning of the appendix is columnar epithelium (colonic type), crypts, Kluchitsky cells at the base of the crypts giving rise to carcinoid tumor. The appendix is located retrocecal (64%), pelvic (32%), subcecal (2%), pre-ileal (1%) and post-ileal (0.5%) [6]. The mesoappendix lies at the lower surface of the mesentry of the ileum, in childhood it is transparent thus its blood vessels are visible, in adults it became fatty thus obsecuring the appendicular artery, the superior mesenteric artery gives rise to the ilio-colic artery which branches into upper and lower divisions; from the lower division of ilio-colic artery the appendicular artery (end artery) is originated, sometimes there is an accessory appendicular artery; both of them are end arteries and liable to thrombose in the late inflammatory phase in acute appendicitis [6][7]. The appendix has an important role in both secondary immune function (i.e maturation of B-lymphocytes and production of IgA) and maintaining the gut microbiota (i.e it acts as a reservoir for beneficial gut bacteria) [8]. During appendicitis;lymphoid hyperplasia narrows the lumen of the appendix leading to luminal obstruction, continues mucus secretion and inflammatory exudation leads to increase the intra-lumenal pressure obstructing the lymphatic drainage, oedema, mucosal ulceration and bacterial translocation to submucosa. If this condition progresses; further distention of the appendix will occur leading to venous obstruction and ischemia which leads to bacterial invasion of the muscularis properia producing acute appendicitis. Then ischemic necrosis develop leading to gangernous appendicitis and free bacterial contamination of the peritoneal cavity which is a potential for generalized peritonitis unless it is surrounded by omentum and small intestinal loop to contain the contamination [9]. Risk of perforation increases with the extremes of ages, obese patients, immunosuppression, Diabetis mellitis, faecolith obstruction, pelvic appendix, previous abdominal surgery. At this stage patient might develope diffuse peritonitis and systemic sepsis syndrome due to presence of comorbidities and delayed presentation [10][11].

Aim of the study

To evaluate the sensitivity, usefulness, validity and accuracy of the Alvarado score in the pre-operative diagnosis of acute appendicitis.

Patients and Methods

A prospective study of 225 patients with provisional diagnosis of acute appendicitis for one year (1st of Jan. 2019 – 1st of Jan 2020), all patients were admitted from casuality to the surgical ward in Al-Yarmuk Teaching Hospital, Baghdad. All patients presented with right iliac fossa pain for various periods of time with various past medical and surgical history. All patients were interviewed, examined and investigated by laboratory tests (leucocyte count and general urine examination) and radiological examination (pre-operative ultrasound). Age, gender, presenting symptoms, duration of complaint, physical, intr-operative findings and the type of anaesthesia were introduced into data sheet. Data collected had been analysed by the Alvarado score, pre-operative ultrasound findings and intra-operative findings. Our target was the patients who gained a score > 7 in which the decision of surgery was taken by the on call surgical team for twelve months during which this study was conducted. Later on these data filled in special proforma designed for each patient. Exclusion Criteria:

Any patient who gained Alvarado score below five had been excluded immediately from this study and discharged home with advice to be followed up either by phone or in the out patient clinic. All patients who gained Alvarado score between (5-6) had been kept under observation for 12-24 hours and reexamined frequently; the patients who gained score seven or more had been admitted and prepared for appendectomy, the patients who had improvement of symptoms and signs; discharged with symptomatic treatment and adviced to be on follow up; among them there were six patients who came after 24 hours with increased right iliac fossa pain, reexamined and evaluated by other surgical teams and gained score seven and more and operated later on. The female patients who presented with symptoms of acute appendicitis and turned to have a positive pregnancy test or with documented ovarian cyst by ultrasound; those had been sent to the gynaecological and obstetric department for further evaluation and management and had been excluded from our study.

All patients with known medical diseases such as pyelonephritis, D.M, Irritable bowel disease, typhoid disease, liver diseases, coagulopathies and chronic pancreatitis who presented with right iliac fossa pain had been examined and investigated then referred to medical emergency for further evaluation and management; those had been excluded from our study. 219 patients in this study underwent surgery because their score was more than seven, six patients kept under observation and discharged then operated by other surgical teams. All Appendicies had been examined macroscopically during surgery and classified into innocent, catarrhal, suppurative, perforated and appendicular mass. Also classified into with or without other pathologies, with or without collection. All specimens were sent for microscopic examination (histopathology) to confirm diagnosis and to identify the exact type of acute appendicitis for each patient.

Results

The current study was included 225 patients with suspected appendicitis, with in the mean age (24±10) years and the main age group was in group between (11-20) years old, females 134 patients (59.56%) were more than males 91 patients (40.44%), 217 patients (96.4%) were under general anesthesia and only eight patients (3.6 %) underwent spinal anesthesia table (1) and figure (1).

Table (1) Demographic characteristics of the patients

	Age	No.	%
Age Group	≤10	6	2.7
	11-20	98	43.6
	21-30	75	33.3
	31-40	28	12.4
	41-50	14	6.2
	51-60	2	0.9
	61-70	2	0.9
Mean±SD			24±10

Table (2) shows the distribution of patients regarding to the duration of pain the current study revealed that the most common group were in time between 13-24 hours (80 patients) (35.6%) and the least group were in time > 72 hours (8 cases) (3.6%).

Table (2) Duration of pain of the studied group (n=225)

Duration/hours	No.	%
≤12	52	23.1
12-24	80	35.6
25-36	49	21.8
37-48	15	6.7
49-60	12	5.3
61-72	9	4.0
>72	8	3.6
Total	225	100.0

Table (3) shows that the majorities (207 cases) (92.0%) of the patients with no medical history whether a disease or bad habit, four patients (1.8%) were smokers, three patients (1.3%) were asthmatic, three patients had hypertension, two patients (0.9%) were DM, one patient had arrhythmia, one patient had cardiac catheterization before, one patient was pregnant, one patient had history of epilepsy, one patient was known to have Nephrotic syndrome and one patient was smoker and alcoholic.

Table (3) Distribution of the patients according to the past medical history

Past medical history	No.	%
None	207	92.0
Arrhythmia	1	0.4
Asthmatic	3	1.3
cardiac cath.	1	0.4
D.M	2	0.9
Epileptic	1	0.4
HTN	1	0.4
HTN+ orthopnea	1	0.4
HTN+ penicillin allergy	1	0.4

Nephrotic syndrome	1	0.4
Pregnant	1	0.4
Smoker	4	1.8
smoker+ alcoholic	1	0.4

Table (4) shows that the majorities (213 patients) (94.7%) presented with no surgical history, seven patients (3.1%) were with previous Caesarian section, one case (0.4%) for each of the fallowing; laparotomy for bullet injury, laparotomy for D.U, laparotomy for IO+C/S, Pfinnesteil+ Rt. Oophorectomy, Tonsillectomy+ adenoidectomy.

Table (4) Distribution of the patients according to the past surgical history

Past surgical history	**No.**	**%**
None	213	94.7
C/S	7	3.1
laparotomy for bullet injury	1	0.4
laparotomy for D.U	1	0.4
laparotomy for IO+C/S	1	0.4
Pfinnesteil+ Rt. Oophorectomy	1	0.4
Tonsillectomy+ adenoidectomy	1	0.4

As shown in table 6, 192 of the patients were presented with appendicitis (Inflamed, suppurative, gangrenous, perforated and appendicular mass), which means that positive appendectomy in (87.3%), and negative appendectomy was found in 27 cases (12.0%) [17 cases (7.6%) with ruptured ovarian cyst, eight cases (3.6%) with normal app., two cases (0.9%) with ectopic pregnancy]. Six cases (2.7%) were operated later on by other surgical teams and proved to be acutely inflamed appendix.

Table (6) Distribution of the patients according to intra-operative finding

Intra-operative finding	**No.**	**%**
App.	192	87.3
ruptured ovarian cyst	17	7.6
Normal	8	3.6
Ectopic pregnancy	2	0.9
App. (operated later on by other teams)	6	2.7
Total	225	100.0

Table 7 shows the distribution of the intra operative finding according to Alvarado score: the majorities of the patients finding were found in group I (7-8 score) (189 patients) and 30 patients in group II (9 score), six cases with score < 7 which gained more than that later on.

Table (7) Distribution of the intraoperative finding according to Alvarado score

intra-op.	**Alvarado score**			
	group I (7-8 score)		**group II (9 score)**	
	No.	**%**	**No.**	**%**
App.	162	72.0	30	13.3
ectopic pregnancy	2	0.9	0	0.0
Normal app.	8	3.6	0	0.0

ruptured ovarian cyst	17	7.6	0	0.0

As shown in table (8) and figure (2), inflamed appendicitis were found in more than half of appendicitis (111 cases) (57.8%), supportive in 69 cases (35.9%), appendicular mass in six cases (3.1%), perforated appendicitis in four cases (2.1%) and Gangrenous appendicitis in two cases (1.1%).

Table (8) type of appendicitis according to intra-operative finding

Intra operative finding of type of appendicitis	No.	%
Inflamed App.	111	57.8
Suppurative App.	69	35.9
Appendicular mass	6	3.1
perforated App.	4	2.1
Gangrenous appendicitis	2	1.1
Total	192	

Table (9) revealed that the confirmed appendicitis (true positive) cases was found in 192 patients and those not an appendicitis (False positive) was 19 patients, the (False negative) were six cases and the (True negative) were eight cases. The accuracy test was calculated by those equations: 9: Validity test (n=225)

Table (9) Confirmed appendicitis

Confirmed Appendicitis	Not Appendicitis	Total No.
(True positive) 192	(False positive) 19	211
(False negative) 6	(True negative) 8	14
198	27	225

The results are: sensitivity = 96.97%, specificity = 29.63%, PPV= 90.99%, NPV = 57.14%, accuracy = 88.89%.

Discussion

From the results analyzed in the current study we found that the main age group were in between 11-20 years (98 patients) and females (134 patients) were more than males (91 patients) when it represents more than half (59.56%) of the studied group. Jalil A, in his study carried on a sample of 262 patients, found that more than half were male (58 %) and the rest (42%) were females and majority of the patients (90.45%) were in their 2nd and 3rd decades of life. (33) According to the literature, the incidence of negative appendectomy ranges between 11 and 40 %(34-36). This different in rate may be attributed to the difficulties in making the diagnosis. Which is in agreement with that found in the current study which revealed that negative appendectomy was found in (12.0%) of the patients included in the study. Moreover our results is are agreement with Nasiri S et al, when he reported that the negative finding were found in rates about (11%) of the patients included in their study to assess diagnostic value of both ultrasound and modified Alvarado scoring system in acute appendicitis.[12] Limpawattanasiri C, in his study mentioned that many studies have showed that the Alvarado scoring system can significantly reduce the incidence of negative appendectomy.[13] Other studies reported high rate of normal appendix as in Kanumba et al, who reported that the incidence rate of negative appendectomy was 33.1 %,[14] Memon A. et al, reported high incidence rate of the normal appendix was (28.7%).[15] Moreover, Tekeli M et al, in his study found that the incidence of negative appendectomy was more than in our study (25.3 %).[16] While In Al Hashemy AM, revealed that the incidence rate of false positive appendectomy was 27.3%,[17] which is still high than that we concluded which may be attributed to the

difference in sample size number as our study sample size were about twice than the later study. We found that 18 patients (8%) in our study have significant past medical history such as diabetes mellitus, hypertension, asthma and cardiac problems; which resulted in either delayed hospital presentation or delayed surgery because of anesthesia and medical evaluation before the operation, this elapsed period of time played a rule in increasing the Alvarado score for each patient during re-examination just before surgery, and we found the appendix is markedly inflamed and even complicated in certain cases, these situations resulted in both increased operative time and increased hospital stay days. The past abdominal surgical history was positive in 11 patients (5.3%). The patients with this kind of history developed minimal symptoms and signs of acute appendicitis and gained Alvarado scores just at the cut off point. These patients had an inflamed appendix which deserved a higher scores than the ones they gained already. We think that this discrepancy may be due to intraabdominal adhesions from the previous surgeries. So the patients who came with right iliac fossa pain and have previous abdominal surgery should be evaluated carefully before taking the decision to discharge them and better to lower the cut off point < 7 to avoid missed cases.

Conclusion

The use of Alvarado score to diagnose acute appendicitis in emergency cases of right iliac fossa pain is characterized by being easy, fast, applicable, simple and non-invasive method depending on detailed history, good physical examination and vital signs correlation. It can be used by junior as well as senior doctors in both peripheral and teaching hospitals to reach accurate diagnosis and to avoid unnecessary surgery, thus to reduce post-operative complications.

Recommendations:

- More period of time and much bigger groups of patients were needed for further future study.
- To practice on using Alvarado score in emergency right iliac fossa pain cases who arrive to casuality to diagnose acute appendicitis.
- Alvarado score should be used routinely in the pre-operative diagnosis inpatient with clinical features suggestive of appendicitis to reduce morbidity and mortality in Iraqi patients.

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