

## Is Pediatric Appendicitis Score Sufficient to Make the Diagnosis of Acute Appendicitis Among Children?

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### Abstract

- Background** Children with acute abdominal pain represent most of the admitted cases to the pediatric surgical department, one third of these cases are acute appendicitis. Early diagnosis of “no appendicitis” or “appendicitis” on the basis of pediatric appendicitis score could potentially save emergency department's time and resource use and could avoid time cost and risks for further evaluation.
- Objective** Evaluation of Samuel scoring system in diagnosing children with acute appendicitis and their need for surgery.
- Methods** One hundred and twelve patients aged between 5 to 15 years who presented with abdominal pain suggestive of acute appendicitis were studied. A complete data from patients were analyzed by using Samuel score. The clinical findings used by previously mentioned scoring system were analyzed to determine reliability of pediatric appendicitis score (PAS). The Final diagnosis was determined by histopathological report for patients' undergone appendectomy.
- Results** The mean (median, SD) score for children with acute appendicitis and non-acute appendicitis were 4.9 (5, 1.8) and 4.6 (5, 1.7) respectively. No variable (of the known signs and symptoms regarded as pathognomonic for acute appendicitis) shows a significant value in the diagnosis of acute appendicitis. A PAS of  $\geq 4$  had a sensitivity, specificity, Positive predictive value (PPV), and Negative predictive value (NPV) of 0.78, 0.27, 0.87, and 0.16 respectively.
- Conclusion** The diagnosis of acute appendicitis and the need for surgery is still a matter of clinical judgment which can be built with practice, and although the PAS could provide useful diagnostic information in children with suspected acute appendicitis, it cannot be used as sole method for determining the need for surgery.
- Key words** Pediatric Appendicitis Score (PAS), acute appendicitis, appendectomy.

### Introduction

Children with acute abdominal pain represent most of the admitted cases to the pediatric surgical department; one third of these cases being acute appendicitis<sup>(1)</sup>. Time and patience are required to evaluate child with acute abdominal pain, morbidity result from late diagnosis or negative appendectomy. Definitive diagnosis of acute appendicitis is

made in only 50-70% of children at the time of initial assessment<sup>(2)</sup>. This reflects the proportion of appendices that are normal on histological studies and negative appendectomy rate of 10-30%<sup>(3-5)</sup>. CT scan had been used to decrease the rate of negative appendectomy, but this carries a significant risk as a result of increased exposure to ionizing radiation and may result in increased health care costs<sup>(6-8)</sup>.

The "MANTRALS" score was proposed by Alvarado in 1986 as a method to predict acute appendicitis in adult <sup>(9)</sup>, and a lot of modified scores had been used to predict acute appendicitis in children. Recently, Samuel from England published a simple pediatric appendicitis score (PAS); in 2002, on the basis of a cohort of children 4 to 15 years old. The PAS ranges from 0 to 10 <sup>(10)</sup>. Early diagnosis of "no appendicitis" or "appendicitis" on the basis of PAS potentially could decrease emergency department time and resource use and could avoid time, cost, and risks for further evaluation <sup>(11-14)</sup>.

The intention of our study is to evaluation Samuel scoring system in diagnosing children with acute appendicitis and their need for surgery.

**Methods**

A prospective observational study was conducted from January 2012 to October 2012 at Al-Yarmook Teaching Hospital and Central Teaching Hospital for Pediatrics in Baghdad. The study included 112 patients aged between 5 to 15 years, who presented with abdominal pain suggestive of acute appendicitis. A complete data from patients were analyzed by using Samuel score (Table 1).

**Table 1. Samuel Score system**

Variables		Score point value
Anorexia		1
Nausea/vomiting		1
Right lower quadrant tenderness		2
Cough/hopping/percussion/tenderness in the right lower quadrant		2
Migration of pain		1
Elevation in temperature ("Pyrexia," ≥37.3°C)		1
Leukocytosis ≥10 000 cells/mm <sup>3</sup>		1
Differential WBC with 75% polymorphonuclear cells or *ANC ≥ 7500 cell/mm <sup>3</sup>		1
Score system	not appendicitis with recommendation of observation	≤5
	appendicitis with recommendation of surgery	≥6

\*ANC: absolute neutrophil count

A written informed consent was taken from parents of patients below 7years while informed agreement was obtained from children older than this age. Patients who had appendicular mass with periappendiceal abscess, history of previous abdominal surgery (including Appendicectomy), chronic medical illness, nonverbal children & had previous abdominal radiological imaging (within previous 2 weeks) were excluded from the study. Two independent evaluations of clinical findings used by previously mentioned scoring system were done to determine inter observer reliability; the period between the two assessments was 15 minutes to eliminate changes in the patient's condition.

Final diagnosis was determined by histopathological report for patients undergone appendicectomy. Statistical analyses for all data obtained in this study were carried out using Pearson Chi-square test at 0.05 level of significance and Student-t-test.

**Results**

One hundred and twelve patients had been recruited to the current study that fulfilled the inclusion and exclusion criteria with their age ranging from 5-15 years. Ninety seven patients (86.6%) had pathologically proven acute appendicitis, while 15 patients (13.4%) had no acute appendicitis according to the

histopathological results. The age and sex distributions were illustrated in table 2. The mean (median, SD) score for children with acute appendicitis and non-acute appendicitis were 4.9

(5, 1.8) and 4.6 (5, 1.7) respectively. No studied variable (of the known signs and symptoms) shows a significant value in the diagnosis of acute appendicitis (Table 3).

**Table 2. The demographic characteristics of patients included in the study**

Variables	Appendicitis patients N = 97	Non Appendicitis patients N = 15
PAS mean ± S.D (Range)	5 ± 1.9 (1-9)	4.7 ± 1.8 (1-7)
Nausea and Vomiting	70 (72%)	11 (73%)
Anorexia	61 (63%)	11 (73%)
Migratory Pain	49 (50.5%)	9 (60%)
RIF tenderness on palpation	59 (61%)	8 (53%)
RIF tenderness on Coughing/hopping/percussion	47 (48%)	5 (33%)
Fever ≥ 37.3°C	50 (51%)	7 (47%)
Leukocytosis WBCs. ≥ 10000 cell/mm <sup>3</sup>	55 (57%)	9 (60%)

RIF = right iliac fossa

To establish a cutoff point for the diagnosis of acute appendicitis, a score of 4 showed that 76 patients with acute appendicitis undergone appendectomy (78.3%), while 21 patients (21.7%) were sent home (they have histopathologically confirmed acute appendicitis) as an end result. On the other

hand, 11 patients (73.7%) who had negative histopathological results undergone appendectomy (Table 4). These results were obtained when applying ROC curve (Fig. 1) which revealed an area under the curve of 0.542 (95% confidence interval [CI], 0.393-0.691).

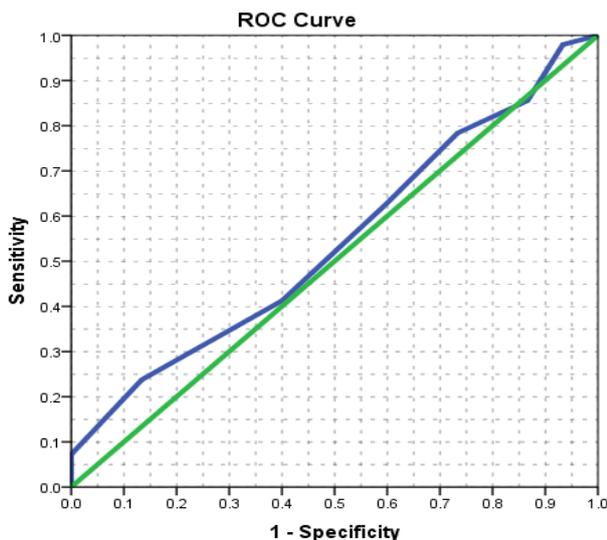
**Table 3. The value of variables with regards to the histopathological results**

Variables		Total		Histo-pathologically positive	
		No.	%	No.	%
Age (years)	5 – 9	44	39.3	39	88.6
	≥ 10	68	60.7	56	86.2
Gender	Male	66	58.9	60	90.9
	Female	46	41.1	37	80.4

**Table 4. The PAS according to histopathological findings**

PAS score	Histopathologically positive		Histopathologically negative	
	No	%	No	%
1	2	2.1	1	6.7
2	12	12.4	1	6.7
3	7	7.2	2	13.4
4	15	15.4	2	13.4
5	21	21.6	3	20.0
6	17	17.5	4	26.6
7	16	16.5	2	13.4
8	5	5.2	-	-
9	2	2.1	-	-
Total	97	100%	15	100%

$\chi^2=3.795$ ; d.f.=8; P value=0.875 (Not significant)



**Fig. 1. The ROC curve for PAS and the area under the curve results**

**Discussion**

The PAS developed by Samuel in 2002 using symptoms, signs, and laboratory findings, the score range from 0-10, and the cutoff value for the appendicectomy was equal or greater than 6. From that date a few studies had been conducted and they show different result. In our study we exclude the ANC from the score due to laboratory limitation so our score range from 0-9.

In this study there was no significance for each variable in the diagnosis of acute appendicitis, and there was no identified significant cutoff value for the indication of appendicectomy. These results are due to many limitations which consist of the sample evaluated for possible acute appendicitis, as determined by pediatric emergency physician, which differs from other study sample. We should keep in mind that symptoms, signs, and laboratory results are affected by the time of presentation and duration of symptoms; so, any comparison should account for it<sup>(15)</sup>. Ultimately the value of scoring depends on clinicians' experience in assessing children, and therefore, always involves some subjectivity and interpretation. The experience of clinicians and their individual threshold to declare the presence of signs will always allow variability<sup>(15)</sup>.

In this study, we found that the best cutoff value as an indication for appendicectomy is equal or greater than 4, which had a sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of 0.78, 0.27, 0.87, and 0.16 respectively. In other studies the cutoff value was different than the original one by Samuel<sup>(10)</sup>. In Schneider *et al*<sup>(15)</sup> they found that the same cutoff score of 6 or greater had a PPV of 54%, a sensitivity of 82% and specificity of 65%; while, in Bhatt *et al*<sup>(16)</sup> found a sensitivity of 92.8%, specificity of 69.3%. In contrast Goldman *et al*<sup>(17)</sup> found that a PAS of 7 or greater (rather than 6) gave a sensitivity of 94%, and a specificity of 98%. Katherine *et al*<sup>(18)</sup> found a score of 6 had a sensitivity of 88.4%, a specificity of 50%, a PPV of 67%, and NPV of 97%.

In comparing the appendicitis group from non-appendicitis group (according to histopathological results), we found that the PAS mean  $\pm$  SD (range) were  $5 \pm 1.9$  (1-9),  $4.7 \pm 1.8$  (1-7), had no significant value ( $P > 0.05$ ). The area under the ROC curve was 0.542 (95% CI, 0.393-0.691) and it was not significant.

In conclusion, the diagnosis of acute appendicitis and the need for surgery is still a matter of clinical judgment which can be built with practice, and although the PAS could provide a useful diagnostic information in children with suspected acute appendicitis, it cannot be used as a sole method for determining the need for surgery.

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