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Evaluation of Pediatric Appendicitis Score in Predicting Appendicitis

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Received: September 14, 2018; **Published:** November 30, 2018

Abstract

Background: The diagnosis of acute appendicitis carries significant difficulties, particularly in very young ages on which the history and physical examination are difficult. The clinical challenge is to diagnose appendicitis early enough to prevent perforation, while minimizing the number of negative appendicitis that are performed. The diagnosis of acute appendicitis is primarily clinical and the clinical scoring systems have been investigated as alternatives or adjuncts to diagnostic imaging.

Aim of the Study: Aim of the study is to establish the accuracy and applicability of using pediatric appendicitis scoring system (PAS) in evaluating acute appendicitis in pediatric age group.

Methods: A prospective cohort study was conducted in Al-Khansaa Teaching Hospital and Children Welfare Teaching Hospital, from January 2014 till November 2015. The study includes 143 patients aged from (3 - 13) years old referred from pediatric emergency unit or outpatient clinic with suspicion of acute appendicitis. All the obtained data were analyzed using pediatric appendicitis score (PAS) system which classifies the patients into 3 groups: Group (1): Patients with scoring (1-3) includes 38 patients, Group (2): Patients with scoring (4 - 6) includes 20 patients, while Group (3): Patients with scoring (7 - 10) includes 85 patients. Surgery was done to all patients of group 3 and thirteen patients of group 2. All removed appendix was sent for histopathological study.

Results: The median age of the 98 operated on patients was (8.9 years ± 2.6). The histopathological results of appendicitis were confirmed in 89 patients undergoing surgery (five patients of group 2 and 84 patients of group 3). There are twenty one (21.4%) patients having perforated appendicitis. There is significant association of positive histopathological findings with high PAS (≥ 7) scoring ($p < 0.0001$). The 8 parameters of PAS system shows accuracy as following: the right lower quadrant tenderness, anorexia and hop tenderness shows accuracy of 90.8%, 87.8% and 86.7% respectively, while leukocytosis, fever and nausea/vomiting shows accuracy of 83.7%, 80.6% and 63.3% respectively. Migration of pain and PMN neutrophilia shows the lowest accuracy rate. The sensitivity of PAS system was 94.4%, the specificity was 88.9%, the PPV was 98.8%, the NPV was 61.5% with overall accuracy of PAS system was 93.9%.

Conclusion: PAS system is easy, simple and useful tool in pre-operative diagnosis of acute appendicitis and can be used by pediatricians to reduce the number of admission to the hospital. Patients with scores of ≥ 7 show high probability of appendicitis and early operation is indicated, while patients with score of ≤ 3 rule out this disease. The CT scan and diagnostic laparoscopy is advocated for patients with score of (4 - 6).

Keywords: *Appendicitis; Pediatric Appendicitis Score*

Introduction

Abdominal pain is extremely common in children and may reflect variety of conditions, whenever it lasts for more than four to six hours and gets more intense, or it is associated with persistent vomiting and diarrhea, it must be taken seriously, and surgical cause ought to be excluded first [1]. Acute appendicitis is the most common cause of abdominal pain [2]. The diagnosis of acute appendicitis carries

significant difficulties, particularly in very young ages on which the history and physical examination are difficult and often causes "diagnostic delay" [2,3] which may result in a complicated disease process [4,5].

Appendicitis is an uncommon entity in young children and rare in infants [5]. It is classified as a surgical emergency and requires removal of the inflamed appendix [6]. The clinical challenge is to diagnose appendicitis early enough to prevent perforation, while minimizing the number of performed appendectomies with negative appendicitis [6]. Proportion of appendices that are normal on histologic studies identifies this problem with a negative appendectomy rate of less than 20% [7].

Rignald Fitz [2] first described appendicitis in 1886, and it has been recognized as one of the most common causes of severe acute abdominal pain worldwide.

Embryology

The appendix is derived from the midgut, and it appears as a diverticulum originating from the caecal swelling in the midgut during the 8th week of gestation. During both antenatal and postnatal development, the growth rate of the caecum exceeds that of the appendix, displacing the appendix medially toward the ileocecal valve [8].

Surgical Anatomy

The appendix is supplied by the appendicular artery (a branch of Ileocolic artery). The relationship of the base of the appendix to the caecum is constant, and is located at the convergence of the taeniae along the inferior aspect of the caecum, whereas the tip of the appendix may lie in a variety of locations, it can be found retrocecally, pelvic, subcaecal, preileal, right pericolic or sub hepatic [9].

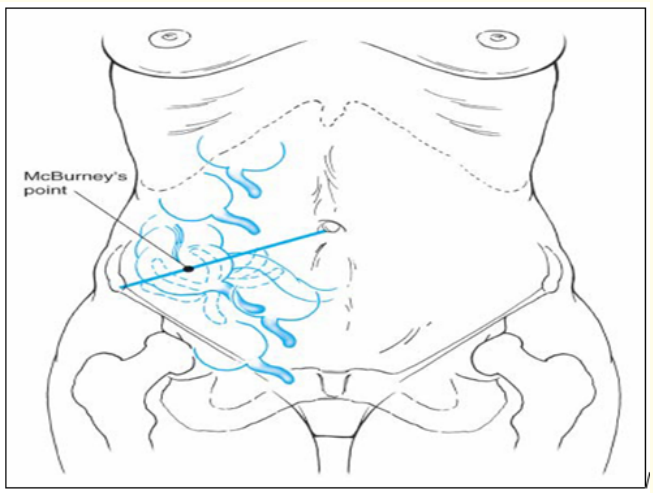

Figure 1: *Anatomical positions of the appendix [9].*

The anatomical considerations have significant clinical importance in the context of acute appendicitis. The appendix can vary in length (usually 6 - 9 cm in length) [9].

Pathophysiology

Acute appendicitis seems to be the end result of inflammation or a primary obstruction of the appendix lumen [10,11]. The appendix contains lymphoid tissue, for this reason it is also called (abdominal tonsil). If obstruction occurs, the appendix subsequently becomes filled with mucous and swells, increasing the pressure inside the lumen and the walls of appendix, resulting in thrombosis and occlusion of the small vessels with stasis of lymphatic flow, and the appendix becomes ischemic and then necrotic. As bacteria begin to leak out

through the dying walls, pus forms within and around the appendix and lead to pelvic collection which confined by omentum or sometime disseminated to other sites of the abdomen and leads to generalized peritonitis if not diagnosed early [11].

Differential Diagnosis

Appendicitis should be differentiated from [11]:

1. Gastroenteritis.
2. Mesenteric lymphadenitis.
3. Urinary tract infection.
4. Pneumonia.
5. Hepatitis.
6. Intussusception.
7. Meckel's diverticulitis.
8. Ovarian cysts and torsion.
9. Henochs-schonlein purpura.
10. Right ureteric stone.
11. Pancreatitis.
12. Inflammatory bowel disease.
13. Cholecystitis.
14. Pelvic inflammatory disease.
15. Mid-cyclic pain.
16. Pre herpetic stage of herpes zoster.
17. Endometriosis.

Diagnosis

Clinical Features: The clinical presentation of appendicitis closely correlates with the pathophysiology of the disease process. The most common initial symptom is vague abdominal pain. This pain is due to activation of the visceral pain fibers from distention of the appendix following obstruction. Pain is vague, nonspecific and commonly located in the periumbilical region as with distention of all midgut derivatives [12]. Also the patient may develop mild gastrointestinal symptoms before onset of pain, such as decrease appetite, indigestion or subtle change in bowel habits. Anorexia is a helpful symptom particularly in children, because hungry child rarely has appendicitis. Any sever gastrointestinal symptoms before the onset of pain, however should suggest an alternative diagnosis [13].

Fever, tachycardia and leukocytosis develop as a consequence of systemic inflammatory mediators released by ischemic tissues, white blood cells, and bacteria. The inflamed appendix then irritates the overlying peritoneum, typically by direct contact, this leads to focal peritonitis and localized right lower quadrant pain. This process explains the typical migrating pain from the umbilicus to the right lower quadrant. Any movement of the peritoneum will lead to an exacerbation of the pain. Thus, children will often demonstrate voluntary guarding of the right lower quadrant during the examination. Furthermore, children will usually resist walking and jumping due to the increased pain associated with such movement [12].

The most common finding on physical examination is focal tenderness in the right lower quadrant. Typically in children, only gentle pressure is required to elicit wincing, moving, or guarding. Applying pressure to a stethoscope while listening to the abdomen is a subtle way to palpate the abdomen in frightened children in whom it is difficult to obtain an accurate exam. Narcotic analgesics improve the comfort level of the patient, but do not alter the inflammatory process. Thus, tenderness will persist in patients receiving narcotics. Attempts to illicit rebound tenderness in children are uncomfortable, inaccurate, and should be avoided. An easier and more accurate method for determining the degree of peritoneal irritation is to ask the patient to walk or jump. Palpating a mass is difficult and often impossible due to the level of discomfort and guarding. Masses are more easily detected after induction of anesthesia. It is important to remember that localized tenderness is dependent on peritoneal irritation. Therefore, obesity, a retrocecal appendix, or an appendix that is walled off by omentum, mesentery, or small bowel may not be associated with localized tenderness, making the diagnosis more challenging [12].

Laboratory findings usually show mild leukocytosis, ranging from 10.000/mm3 to 18.000/mm3 and is often accompanied by polymorphonuclear predominance, white blood cells count above this level raise the possibility of a perforated appendix. C-reactive protein (CRP) is another helpful laboratory test; however, both CRP and WBC count are non-specific. Urine analysis can be useful to rule out urinary tract infection, although several white or red blood cells can be presented from ureteral or bladder irritation as a result of inflamed appendix [12].

Plain film of the abdomen shows an abnormal bowel gas pattern in patients with acute appendicitis but it is non-specific. The presence of a faecolith is rarely noted on a plain films, but if present, is highly suggestive of the diagnosis. However, plain radiographs can be of significant benefit in ruling out other pathology [13].

Sonography has been suggested as an accurate way to establish the diagnosis of appendicitis, with a reported sensitivity of 55 - 95% and a specificity of 85 - 98% [13,14]. The accuracy of ultrasound is known to be operator dependent and is affected by the presence of certain patient characteristics (pain, obesity) and by lack of confidence in a negative result due to difficulty in visualizing a non-inflamed appendix. The presence of an Appendicolith establishes the diagnosis, while the presence of thickening of appendicular wall and periappendicular fluid is highly suggestive of appendicitis [13].

Contrast CT scan is of great help in cases of diagnostic difficulties, and it is better than ultrasound in the diagnosis; however, there is evidence that exposure to ionizing radiation in childhood is likely to increase lifetime mortality risk from cancer [14,15]. CT scan may also delay the time of operation and, therefore, may increase the subsequent risk of perforation [16].

Diagnostic laparoscopy: The use of laparoscopy has increased from about 20% in 1998 to 70% in 2007. It is also associated with shorter hospitalization, fewer postoperative outpatient visits, decreased time off work, and earlier return to routine activity [12].

Clinical scoring systems

The diagnosis of acute appendicitis is primarily clinical and the clinical scoring systems have been investigated as alternatives or adjuncts to diagnostic imaging [17]. There are several available scores, recently reviewed by Kulik., *et al* [18]. In this systemic review, the Alvarado score and the Pediatric Appendicitis Score (PAS) were considered the most reliable. Pediatric Appendicitis Score (Table 1), composed by Samuel [19] in 2002; is the only score specifically developed for children between 4 and 15 years age, while other authors [18,20] in their studies had included children less than 4 years of age. This scoring system was designed to improve the diagnosis of appendicitis and was devised by giving relative weight to specific clinical manifestations. The (Table 1) lists eight specific indicators on which patients with score of ≥ 7 are almost certain to have appendicitis. Patients with score 4 to 6 have a suspicion of appendicitis; while scores of < 4 are compatible to exclude acute appendicitis [19].

History	Nausea/vomiting	1
	Anorexia	1
	Migration of pain (periumbilical to RLQ)	1
	Fever (> 38ºC, oral)	1
Exam	Tenderness in RLQ	2
	Cough, percussion, hop tenderness	2
Labs	Leucocytosis (>10000/mm^3)	1
	PMN neutrophilia	1
Total points: suspicious (4 - 6); obvious (≥ 7)		

Table 1: *Pediatric appendicitis Score for the Diagnosis of acute Appendicitis [19].*

Aim of the Study

We performed a prospective study to establish the accuracy and applicability of using pediatric appendicitis scoring system (PAS) in evaluating acute appendicitis in pediatric age group.

Materials and Methods

Study design: This is a prospective cohort study.

Study period: From January 2014 to November 2015.

Study setting: The study was conducted in Al-Khansaa Teaching Hospital in Mosul City till October 2014 and continued then after in Children Welfare Teaching Hospital/Medical City; Baghdad, Iraq.

Inclusion criteria: The study includes 143 patients, their ages ranged from (3 - 13) years old referred from pediatric emergency unit or outpatient clinic with symptoms of less than three days duration in whom the treating physician suspected to have acute appendicitis.

Exclusion criteria: Children with urological, gynecological or surgical problems other than appendicitis were excluded from the study.

Study protocol: All the patients were interviewed, examined and investigated; then data collection form was completed. The form contained information about patient's age, gender and the date of admission in addition to the date of operation and each of the eight PAS components that had mentioned in (Table 1) which includes: nausea/vomiting, anorexia, migration of pain from periumbilical to the right lower quadrant (RLQ) of the abdomen, fever of >38ºC, right lower quadrant tenderness and hop tenderness in the physical examination and leukocytosis of >10000/mm^3 with PMN neutrophilia (left shift > 7500/mm^3) in laboratory investigations. Each parameter is assigned 1 score except the physical signs (right lower quadrant tenderness and hop tenderness) which are assigned 2 scores for each, giving a maximum score of 10.

When the surgeon was unsure of the etiology of abdominal pain but suspected appendicitis, they ordered imaging investigations such as plain abdominal X-ray and abdominal ultrasound.

Data analysis: All the obtained data were analyzed using pediatric appendicitis score (PAS) which classified the patients into 3 groups:

- **Group (1):** Patients with scoring (1 - 3) includes 38 patients.
- **Group (2):** Patients with scoring (4 - 6) includes 20 patients.
- **Group (3):** Patients with scoring (7 - 10) includes 85 patients.

All patients in Group 2 and 3 were admitted to the hospital on which they kept on nothing per mouth and intravenous fluid, while patients of Group 1 were discharged and instructed to visit the outpatient clinic after one week to reassess and to ascertain the outcome. Surgery was done to all patients in group 3 and most of patients in group 2 after reassessing their scores 4 hours after admission. During operation the data of each patient is completed regarding type of incision and intra-operative findings. All removed appendices were sent for histopathological study. A negative appendectomy was defined as an appendectomy with negative histopathology.

Statistical analysis

Each patient assigned a serial identification number. The data were analyzed using Statistical Package for Social Sciences (SPSS) version 20.

The continuous data were represented by mean and range.

The categorical data presented as frequency and percentage tables.

The Chi-square and Yates correction for chi tests were used to assess the association between variables.

Reliability tests (Sensitivity, specificity, positive predictive value, negative predictive value and accuracy) were calculated.

P - Value less than 0.05 was used as the alpha level of significance.

Result

Patient's distribution according to PAS

According to pediatric appendicitis score (PAS), the patients were classified under three categories according to their scores: Group (1) includes 38 patients, they were unlikely to suffer from the disease and all were discharged home and instructed to visit the outpatient clinic after one week to reassess and to ascertain the outcome. Group (2) this includes 20 patients, they were doubtful but potential candidates suffering from the disease and so they were admitted and observed for 4 hours and reassess their scores again, seven patients of

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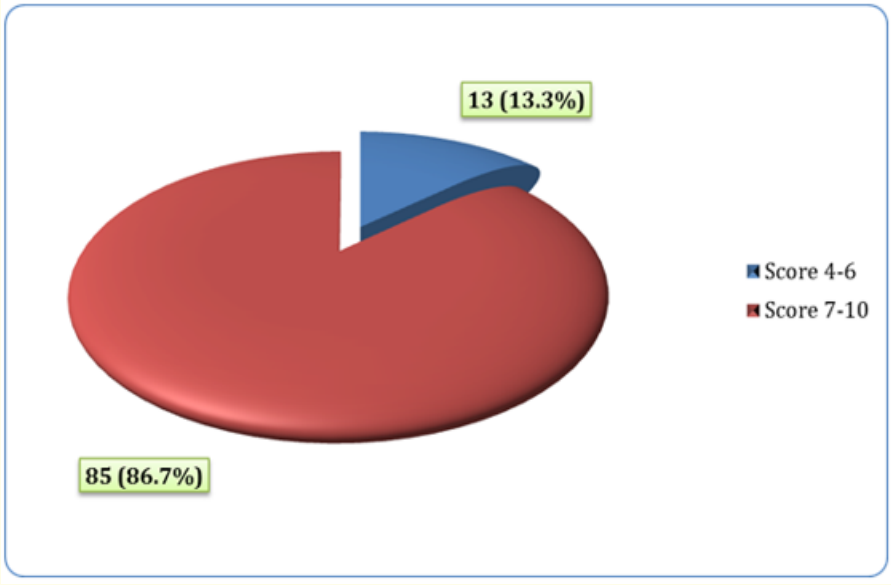

Figure 2: *Distribution of operated patients, according to PAS score, n = 98.*

Gender distribution

There are 62 (63.3%) male patients and 36 (36.7%) female patients among the operated on patients, as shown in figure 3.

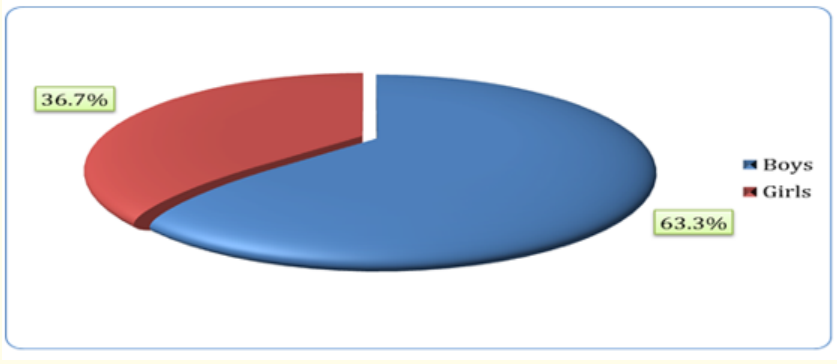

Figure 3: *Distribution of the operated patients, according to their gender.*

Age distribution

The median age of the operated on patients is (8.9 years ± 2.6). The age distribution is classified into three groups the first one is from 3 to 6 years, the second one is from (7- 9 years) and the last one is from (10 - 13) years. Table 2 shows the relation of patients' gender and age of presentation with appendicitis.

Age groups	Boys No. (%)	Girls No. (%)	Total No. (%)
(3 - 6) years	13 (21)	6 (16.7)	19 (19.4)
(7 - 9) years	25 (40.3)	9 (25)	34 (34.7)
(10 - 13) years	24 (38.7)	21 (58.3)	45 (45.9)
Total	62 (100)	36 (100)	98 (100)
$\chi^2 = 3.67$, df = 2, p-value = 0.16 (not significant at 0.05 level)			

Table 2: *Relation of patients' gender and age of presentation with appendicitis, n = 98.*

Boys mean age = 8.6 ± 2.5 years, range (4 - 13) years.

Girls mean age = 9.5 ± 1.5 years, range (3 - 11) years.

Overall mean age = 8.9 ± 2.6 years, range (3 - *13) years.*

Distribution according to histopathological findings

The histopathological findings of the operated on patients shows forty six (47%) patients have acute non-obstructive appendicitis, twenty two (22.4%) patients have obstructive acute appendicitis by faecolith and twenty one (21.4%) patients have perforated appendicitis. A negative histopathological result of appendicitis is seen in nine (9.2%) patients, as shown in table 3.

Histopathological findings	Number	Percent
Perforated appendicitis	21	21.4%
Obstructive appendicitis	22	22.4%
Acute non-obstructive appendicitis	46	47%
Normal appendix	9	9.2%
Total	98	100%

Table 3: *The distribution of the operated patients according to the histopathological findings.*

The accuracy of the PAS parameters

The table 4 summarized the 8 parameters of PAS system and their accuracy which shows that the right lower quadrant tenderness, anorexia and hop tenderness shows accuracy of 90.8%, 87.8% and 86.7% respectively, while leukocytosis, fever and nausea/vomiting shows accuracy of 83.7%, 80.6% and 63.3% respectively. Migration of pain and PMN neutrophilia shows the lowest accuracy rate (25.5% and 34.7%) respectively.

Parameters	Histopathological result No. (%)			SN	SP	Accuracy
	Positive	Negative	Total			
Nausea/vomiting	58 (65.2%)	5 (55.6%)	63 (64.3%)	65.2%	44.4%	63.3%
Anorexia	86 (96.6%)	9 (100%)	95 (96.9%)	96.6%	0.0%	87.8%
Migration of pain	17 (19.1%)	1 (11.1%)	18 (18.4%)	19.1%	88.9%	25.5%
Fever (> 38ºC, oral)	72 (80.9%)	2 (22.2%)	74 (75.5%)	80.9%	77.8%	80.6%
Tenderness in RLQ	89 (100%)	9 (100%)	98 (100%)	100.0%	0.0%	90.8%
Cough, percussion, hop tenderness	83 (93.3%)	7 (77.8%)	90 (91.8%)	93.3%	22.2%	86.7%
Leucocytosis (> 10000/mm^3)	77 (86.5%)	4 (44.4%)	81 (82.7%)	86.5%	55.6%	83.7%
PMN neutrophilia, left shift (> 7500/mm^3)	27 (30.3%)	2 (22.2%)	29 (29.6%)	30.3%	77.8%	34.7%

Table 4: *The accuracy of the PAS parameters.*

SN: Sensitivity; SP: Specificity.

Validity and sensitivity of PAS system

The validity tests of PAS system in comparison with histopathological findings of the operated patients as following: There are 84 out of 85 patients with positive histopathological findings among the high PAS (7 - 10) scoring, while there are only 5 out of 13 patients with positive histopathological findings among the lower PAS (4 - 6) scoring as shown in table 5.

The table 6 shows the sensitivity of the PAS scoring for positive histopathological results of 94.4% and positive predictive value of 98.8%, while the table 7 shows the specificity of the PAS scoring for negative histopathological results of 88.9% and the negative predictive value of 61.5%. The overall accuracy of the PAS scoring is 93.9%.

Positive		Histopathological results No. (%)		Total No. (%)
		Negative		
PAS scoring	7 - 10 (Positive)	84 (94.4)	1 (11.1)	85 (86.7)
	4 - 6 (Observation)	5 (5.6)	8 (88.9)	13 (13.3)
Total		89 (100)	9 (100)	98 (100)
Yates correction of Chi = 42.29, DF = 1, p < 0.0001 (significant at 0.05 level)				

Table 5: *Validity tests of the PAS system in comparison with histopathological findings.*

PAS scoring	Positive histopathological results
Score 7 - 10	84
Score 4 - 6	5
Total	89
Sensitivity	94.4%
PPV	98.8%

Table 6: *PAS scoring sensitivity and PPV for positive histopathological results.*

PPV: Positive Predictive Value.

PAS scoring	Negative histopathological results
Score 7 - 10	1
Score 4 - 6	8
Total	9
Specificity	88.9%
NPV	61.5%
Accuracy	93.9%

Table 7: *PAS scoring, specificity and NPV for negative histopathological results.*

NPV: Negative Predictive Value.

Patient's prediction of PAS scores system

The prediction of operated patients according to histopathological results can be illustrated in table 8.

Prediction	Number
True positive	84
False negative	5
False positive	1
True negative	8
Total	98

Table 8: *The prediction of operated patients according to histopathological findings.*

Early post-operative complications

There was 3 patients of perforated appendix had surgical site wound infection that need readmission after discharge for treatment and recovered uneventfully.

Discussion

Despite the fact that acute appendicitis is a common surgical emergency, it still carries significant diagnostic difficulties by the young trainee surgeons who are the first ones to face the condition. Diagnosis of acute appendicitis is not an easy task particularly in young children who found difficulty in communication and localization of the pathology precisely, in addition that the presence of pathological process may render the child irritable and anxious.

In the current series, there are 36 (36.7%) female patients and 62 (63.3%) male patients which goes with Maala Bhatt., *et al.* [6] Subhajeet., *et al.* [21] who found that the female patients were 35% and 36.3% respectively, while male patients were 65% and 63.6% respectively. The median age of patients in this study is 8.9 ± 2.6 year which goes with Samuel [19] who found the median age of 9.9 ± 3.3.

In developing countries, including Iraq there are limitations in using the radiological imaging, so the clinical picture is the mainstay in diagnosing the acute appendicitis. Misdiagnosis and negative appendectomy still do occur at quite a high rate, so various scoring systems are being used to aid the diagnosis of acute appendicitis and bring down the negative appendectomy rates. The Pediatric Appendicitis Scoring (PAS) system [19] at 2002 is the most recent score system used in predicting acute appendicitis in pediatric age group.

According to the histopathological results, there are twenty one (21.4%) patients having perforated appendicitis in this series, this percentage is similar to Samuel [19] who found (18 - 20)% perforation rate, but it is lower than Martin Salö., *et al*. [22] who found 33.3% perforation rate. This might be because the last series includes younger (< 4 years) and older (≥ 4 years) children with significantly more sever inflammation among the younger one [22], while the former series [19] were using nearly the same age group as this series. The negative appendectomy rate was (9.2%) and this result resembles to Maala Bhatt., *et al.* [6], Jawaid., *et al*. [23] and Martin Salö., *et al*. [22] who found 8.8%, 7% and 6.9% respectively. But it is lower than Richard., *et al.* [24] which were 16.4%. It is universally accepted that the current range of negative appendectomy is 13 - 17% [12].

In this series, the PAS system shows accuracy of the right lower quadrant tenderness, anorexia and hop tenderness of 90.8%, 87.8% and 86.7% respectively, while leukocytosis, fever and nausea/vomiting shows accuracy of 83.7%, 80.6% and 63.3% respectively. PMN neutrophilia and migration of pain shows the lowest accuracy rate of 34.7% and 25.5% respectively. These readings showed that the physical signs like right lower quadrant tenderness and cough/hop tenderness are more important in diagnosis of acute appendicitis than the symptoms and laboratory tests and this is in agreement with Samuel [19] who assigned these variables as a single variable of score 2 for each. The high accuracy of anorexia elicit that hungry child rarely has appendicitis [13]. Migration of pain and PMN neutrophilia showed the lowest sensitivity rate of 19.1% and 30.3% respectively; contradict to Samuel [19] who found sensitivity rate of 98%, 81% respectively, this can be explained by limited number of patients in the current series comparing to Samuel [19]. The low accuracy of migration of pain can be explained by difficulty of a child to localize and describe pain [22].

There are 84 out of 85 patients with positive histopathological findings among the high PAS (7 - 10) scoring, while there are only 5 out of 13 patients with positive histopathological findings among the lower PAS (4 - 6) scoring. These readings show significant association of positive histopathological findings with high PAS scoring ($p < 0.0001$). This result indicates that the cut point of 7 shows high probability of appendicitis and no need for further observation or investigations. Patients with scores of ≤ 3 rule out appendicitis as they visit the outpatient clinic after one week and no one of them need further surgical intervention during that period. Patients with (4 - 6) scoring should be admitted and re-evaluated after few hours of nothing per mouth and giving adequate intravenous fluid. If the score decreases;

which were seen in 7 patients, they had been discharged and no one of them need further intervention during a week of follow up, while the 13 patients in whom the score remains the same or increase, they had undergone surgery. The high unnecessary appendectomy in the group 2 is imperative not to miss or delay a needed appendectomy as there is risk of perforation with greater morbidity in the short term potentially leading to late complications of adhesive intestinal obstruction and infertility (in females). Now the CT imaging [16] and diagnostic laparoscopy [25] are increasingly being advocated in this group of patients.

In the present series, the PAS sensitivity was (94.4%) which goes with Malaa Bhaat., *et al*. [6] and Samuel [19] who found sensitivity of 97.6% and 100% respectively. While Martin Salö., *et al.* [22] found sensitivity of 70.5% for older children (≥ 4 years old). The specificity was (88.9%) which is consistent with Samuel [19] and Malaa Bhaat [6] who found 92% and 95% respectively, while Martin Salö., *et al*. [22] found 14.2% specificity for older children (≥ 4 years old). These low sensitivity and specificity of Martin Salö., *et al*. [22] can be explained that they used the cut point at score 6, while Malaa Bhaat., *et al*. [6], Samuel [19] and this series are using the cut point of 7.

In this series, the positive predictive value was (98.8%) compared with Jawaid., *et al*. [23] and Chan MY., *et al*. [26] which was 97% and 97.6% respectively, while the negative predictive value was 61.5%, which is near the Subhajeet., *et al.* [21] who found 69.8%, but it is lower than Malla Bhaat., *et al*. [6] and Samuel [19] who found the NPV of 97.7% and 99% respectively [27].

Conclusion

- The Pediatric Appendicitis Scoring (PAS) system is easy, simple and useful tool in pre-operative diagnosis of acute appendicitis and can work effectively in routine practice.
- The physical signs (right lower quadrant tenderness and cough/hop tenderness) showed high accuracy in diagnosis of acute appendicitis.
- The high accuracy of anorexia elicit that hungry child rarely has appendicitis.
- Patients with scores of ≥ 7 show high probability of appendicitis and early operation is indicated to avoid complications of per foration.
- Patients with score range of (4 - 6) require admission and need re-evaluation for possible deterioration of clinical condition and earliest possible intervention.
- Patients with score of ≤ 3 rule out acute appendicitis.
- The application of PAS system improves diagnostic accuracy and possibly reduces the complication rates.

Recommendations

- Appendicitis is a disease of high index of suspicion.
- Early referral of patients with suspicion of acute appendicitis by Pediatricians and General Practitioners to reduce the perfora tion rate and its complications.
- The PAS system can be used in pediatric emergency unit or outpatient clinic by pediatricians to improve the diagnostic quality, early referral and reducing number of admission to the hospital.
- The PAS system need more research time and more patient numbers to establish definite cut point score regarding who will be discharged safely and who will be operated on.
- The CT scan and diagnostic laparoscopy is advocated for patients with score of 4 - 6.

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