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ORIGINAL ARTICLE

## Risk factors of delayed diagnosis of acute appendicitis in children at Zagazig University Hospitals

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### ABSTRACT

**Background:** Acute appendicitis is most common surgical cause of acute abdomen in children but its diagnosis presents significant difficulties and delayed diagnosis result in complications. **Aim:** Aim of the work is to avoid the risk factors of delayed diagnosis of acute appendicitis there for to achieve early diagnosis of acute appendicitis to avoid complications.. **Methods:** This study was carried out in emergency unit of pediatric surgery Department, Zagazig University Hospitals. The study was retrospective and included patients with acute appendicitis who underwent appendectomy during the period from February 2019 to august 2019. Cases were classified into 2 equal groups, according to time interval between start of symptoms and final diagnosis. Delayed group (more than 24 hours interval) and non delayed group (more than 24 hours interval). **Results:** we compaire between two groups including history taking, ultrasound, CT abdomen done for 4 patients. prior local clinic. fever, diarrhea, CRP,PAS and elevated TLC were significantly associated with delayed group (with p value 0.005 for diarrhea, p value 0.00 for fever P value for CRP 0.034) **Conclusion:** We suggest that child with abdominal pain associated with fever and anoxia and elevated TLC should be evaluated by surgeons especially if pain progressively increased to avoid delay in diagnosis of acute appendicitis.

**Keywords:** Appendicitis, Delayed diagnosis, Child, Risk factors.

### INTRODUCTION

Acute appendicitis is the most common surgical cause of acute abdomen in children and its diagnosis has significant difficulties so that, early clinical diagnosis is often not straightforward (1).

The typical presentation is para umbilical pain which is usually described as dull and becomes sharp when localized to the right iliac fossa where. It is also exacerbated by coughing, sneezing or movement.

This pain is usually associated with nausea, anorexia, vomiting and low grade pyrexia. One or two episodes of loose stools may pass. Vomiting usually occur after abdominal pain in appendicitis while it usually occurs before pain

in gastroenteritis. On examination, there is low grade pyrexia, oral fetor, mild dehydration and tachycardia. Tender right iliac fossa with rebound tenderness indicates localized peritonitis. There may be increased urinary frequency with a pus cells in urine (2, 3)

The diagnosis of appendicitis in children is problematic because many present with symptoms and signs that resemble other common but self-limiting causes. They often lack classic clinical features seen in adults. This poses a challenge for the treating physician in making a timely diagnosis (4). Moreover, difficulties of history taking and physical examination particularly in infants and younger

children often cause ‘diagnostic delay’ before appendicitis is eventually diagnosed (5).

Late diagnosis and surgical intervention is regarded as an important cause of morbidity in acute appendicitis. Delay in treatment results in complications like perforation, but there are controversies as to whether preadmission or post admission delay is more important. Death due to acute appendicitis is now rare (mortality rate, 0–2.4%).(6).

As the late presentation of acute appendicitis can proceed to gangrene and perforation, it needs to be diagnosed and treated as early as possible. In children, the perforation occurs within 8 to 24 hours while in adolescents and young children it occurs within 36 hours (7).

**The Aim of work:** to avoid the risk factors of delayed diagnosis of acute appendicitis and accordingly, prevention of complications.

**Objectives:** To identify the risk factors of delayed diagnosis of pediatric appendicitis presenting to zagazig university hospitals.

#### SUBJECTS AND METHODS

This study was carried out in emergency unit of pediatric surgery Department, Zagazig University Hospitals, The study included 62 patients with operated appendectomy divided in two groups.

Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

#### Inclusion criteria:

Patients with appendectomy and postoperative evidence of appendicitis. Both sexes were included and age limit was 12 years.

#### Exclusion criteria:

Patients with coincidental chronic or neoplastic diseases.

#### Methods:

Patients during the study period were divided into two categories according to time interval between first symptom and

appendectomy (less than and more than 24 hours).from each category, random sampling was used to make two groups with 31 patients in each (stratified random sampling).The groups were delayed (> 24 h) and non delayed groups (< 24 h).

Patients files were reviewed and data were collected:

#### History data included:

All subjects gave a complete full history taking including demographic features (age and sex), Prior local clinic visit/s, Clinical symptoms (pain, pain shift, anorexia, nausea, vomiting, diarrhea, dysuria, constipation, painful cough). Analysis of symptoms (onset, course, and duration, what increase and what decrease).

#### Clinical Examination:

General examination and vital signs (Temperature, pulse, blood pressure and respiratory rate)

Local examination: Inspection of the abdomen, Palpation of the abdomen with good examination of right iliac fossa to detect tenderness or rebound tenderness, deep pressure in the left iliac fossa for detection if there is pain at RT iliac fossa ( Blumberg’s sign) , stretching the ilio psoas muscle by having the patient lie on the left side with slowly extend patient's right thigh for detection of Psoas sign, Abdominal percussion to evaluate the presence of cough tenderness ,gaseous distension or shifting dullness, abdominal auscultation to evaluate the intestinal sounds.

Pre-interventional investigations include

routine laboratory investigations: Complete blood count (CBC) ,liver function test including :Serum bilirubin (direct – total) ,Kidney function test,CRP,Coagulation profile(PT,PTT,INR).

Image study : Abdominal ultrasound: to confirm the diagnosis and search for the complication (appendicular abscess – appendicular mass – peritoneal collection ... etc) ,CT abdomen and pelvis with iv and oral contrast in some cases.

Preparation:Antibiotic (3<sup>rd</sup> generation cephalosporin's).

Procedure:Anesthesia used was general or spinal according to evaluation of anastheologist. Appendectomy was done either open or laparoscopic according to hospital facilities.

Post-Operative:the patients received medical treatment including antibiotic (3<sup>rd</sup> generation cephalosporin's), anti-stress ulcer (ranitidine) and IV fluids(maintenance fluids) which were stopped when intestinal sounds became audible. Then patients started oral fluids.

#### **Materials and Statistical analysis:**

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis

The study is Retrospective study , carried out in emergency unit of pediatric surgery Department, Zagazig University Hospitals included 62 patients with acute appendicitis undergo appendectomy with equal number in each group below age of 12 year.

The data collected included the patient's characteristics, symptoms at presentation (e.g., abdominal pain, migrating pain, nausea, vomiting, diarrhea, fever, and anorexia), temperature, history of any recent prior medical visit, admission course, duration of symptoms, physical examinations (tenderness, rebound tenderness), laboratory examinations (e.g., white blood cell, polymorph nuclear leukocyte [PMNL], C- reactive protein [CRP]), and radiological findings. Each patient's pediatric appendicitis score (PAS) were calculated. The PAS is an efficient diagnostic tool of appendicitis using the symptoms, signs, and laboratory tests results.

The patients were classified into 2 groups, according the time interval from the initial visit to the hospital to the final diagnosis before the appendectomy: 24 hours or more (delayed group) and less than 24 hours (non delayed

group).

A total of 62 children were underwent appendectomies during the study period.

### **RESULTS**

we compared between two groups including history taking ultrasound , CT abdomen done for 4 patients.

#### **1-Demographic characteristics:**

##### **Age , sex distribution between studied groups:**

Age was distributed as  $8.93\pm 1.96$  and  $8.7\pm 2.35$  between delayed and not delayed with no significant difference between groups, regarding sex distribution there was no significant difference between groups.

##### **2- Symptoms and signs distribution between studied groups:**

Prior local clinic visit was significantly associated with delayed cases ( $P=0.02^*$ ). common sign and symptoms at presentation for the delayed group and non delayed group. right lower quadrant (RLQ) tenderness, vomiting, and nausea were frequent symptoms of appendicitis children in both group. Diarrhea at presentation was observed more frequently in the delayed group. Among the signs and symptoms, diarrhea ( $P=0.005^*$ ) show significant differences. Most of the appendicitis children have a 1–3 days symptom duration. The duration of symptoms was significantly longer in the delayed diagnosed group ( $P<0.00$ ). Fever were significantly associated with delayed cases ( $P=0.00^{**}$ ) (figure 1). and percussion cough show significant association with delayed group with ( $P=0.001^{**}$ ) (figure 2).

##### **3-Lab distribution between groups:**

the laboratory test results between the 2 groups. The delayed group has Delayed cases significantly associated with high WBCs and PMNL and with positive CRP.

##### **4- PAS distribution between groups and PAS**

is significantly associated with delayed group with average value of 9.(figure 3).

Hospital stay duration significantly longer in delayed group than not delayed group with average duration( $4.53\pm 1.3$  day)for delayed group and ( $1.06\pm 0.7$ ) for not delayed group.

**Table (1):** Demographic characteristics of patients with acute appendicitis

			Delayed (N=31)	Not delayed (N=31)	t/X <sup>2</sup>	P
<b>Age</b>			<b>8.93±1.96</b>	<b>8.7±2.35</b>	<b>0.417</b>	<b>0.679</b>
<b>Sex</b>	<b>Female</b>	<b>N</b>	<b>17</b>	<b>19</b>	<b>0.26</b>	<b>0.607</b>
		<b>%</b>	<b>54.8%</b>	<b>61.3%</b>		
	<b>Male</b>	<b>N</b>	<b>14</b>	<b>12</b>		
		<b>%</b>	<b>45.2%</b>	<b>38.7%</b>		
<b>Body mass index</b>	<b>Average</b>	<b>N</b>	<b>19</b>	<b>31</b>	<b>14.88</b>	<b>0.00**</b>
		<b>%</b>	<b>61.3%</b>	<b>100.0%</b>		
	<b>Obese</b>	<b>N</b>	<b>12</b>	<b>0</b>		
		<b>%</b>	<b>38.7%</b>	<b>0.0%</b>		

**Table (2):** Symptoms and signs distribution between studied groups

			Group		Total	X <sup>2</sup>	P
			Delayed	Not Delayed			
Symptoms duration / Hours			<b>65.87±10.87</b>	<b>19.0±4.71</b>	<b>-8.214</b>	<b>0.00**</b>	
Prior local clinic visit	No	<b>N</b>	<b>14</b>	<b>23</b>	<b>37</b>		
		<b>%</b>	<b>45.2%</b>	<b>74.2%</b>	<b>59.7%</b>		
	Yes	<b>N</b>	<b>17</b>	<b>8</b>	<b>25</b>	<b>5.42</b>	<b>0.02*</b>
		<b>%</b>	<b>54.8%</b>	<b>25.8%</b>	<b>40.3%</b>		
Anorexia	No	<b>N</b>	<b>0</b>	<b>6</b>	<b>6</b>		
		<b>%</b>	<b>0.0%</b>	<b>19.4%</b>	<b>9.7%</b>		
	Yes	<b>N</b>	<b>31</b>	<b>25</b>	<b>56</b>	<b>6.64</b>	<b>0.01*</b>
		<b>%</b>	<b>100.0%</b>	<b>80.6%</b>	<b>90.3%</b>		
Vomiting	No	<b>N</b>	<b>18</b>	<b>15</b>	<b>33</b>		
		<b>%</b>	<b>58.1%</b>	<b>48.4%</b>	<b>53.2%</b>		
	Yes	<b>N</b>	<b>13</b>	<b>16</b>	<b>29</b>	<b>0.58</b>	<b>0.44</b>
		<b>%</b>	<b>41.9%</b>	<b>51.6%</b>	<b>46.8%</b>		
Diarrhea	No	<b>N</b>	<b>17</b>	<b>27</b>	<b>44</b>		
		<b>%</b>	<b>54.8%</b>	<b>87.1%</b>	<b>71.0%</b>		
	Yes	<b>N</b>	<b>14</b>	<b>4</b>	<b>18</b>	<b>7.82</b>	<b>0.005*</b>
		<b>%</b>	<b>45.2%</b>	<b>12.9%</b>	<b>29.0%</b>		
Fever	No	<b>N</b>	<b>7</b>	<b>22</b>	<b>29</b>		
		<b>%</b>	<b>22.6%</b>	<b>71.0%</b>	<b>46.8%</b>		
	Yes	<b>N</b>	<b>24</b>	<b>9</b>	<b>33</b>	<b>14.57</b>	<b>0.00**</b>
		<b>%</b>	<b>77.4%</b>	<b>29.0%</b>	<b>53.2%</b>		
Nausea	No	<b>N</b>	<b>14</b>	<b>18</b>	<b>32</b>		
		<b>%</b>	<b>45.2%</b>	<b>58.1%</b>	<b>51.6%</b>		
	Yes	<b>N</b>	<b>17</b>	<b>13</b>	<b>30</b>	<b>1.03</b>	<b>0.309</b>
		<b>%</b>	<b>54.8%</b>	<b>41.9%</b>	<b>48.4%</b>		
P. cough	No	N	5	18	23		

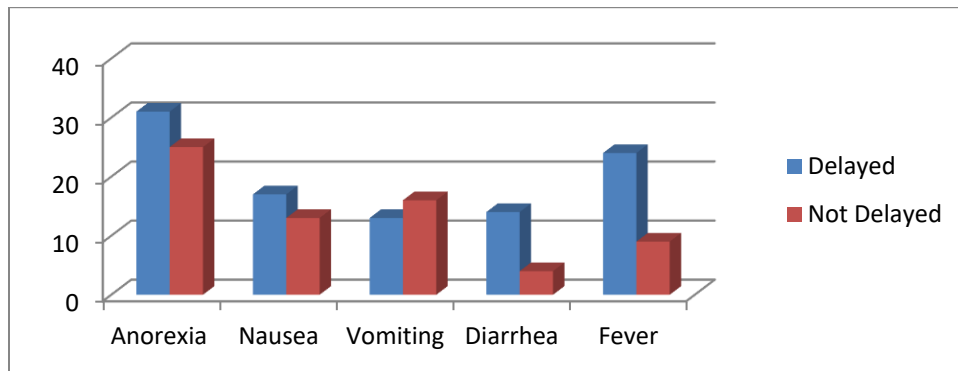
		Group		Total	X <sup>2</sup>	P	
Tender	Yes	%	16.1%	58.1%	37.1%	11.68	0.001* *
		N	26	13	39		
	-VE	%	83.9%	41.9%	62.9%	1.01	0.313
		N	0	1	1		
+VE	%	0.0%	3.2%	1.6%	0.62	0.43	
	N	31	30	61			
Rebound	-VE	%	100.0%	96.8%	98.4%	0.62	0.43
		N	10	13	23		
	+VE	%	32.3%	41.9%	37.1%	0.26	0.61
		N	21	18	39		
Per tnd	-VE	%	67.7%	58.1%	62.9%	0.26	0.61
		N	16	18	34		
	+VE	%	51.6%	58.1%	54.8%	0.26	0.61
		N	15	13	28		

Table (3): Lab distribution between groups

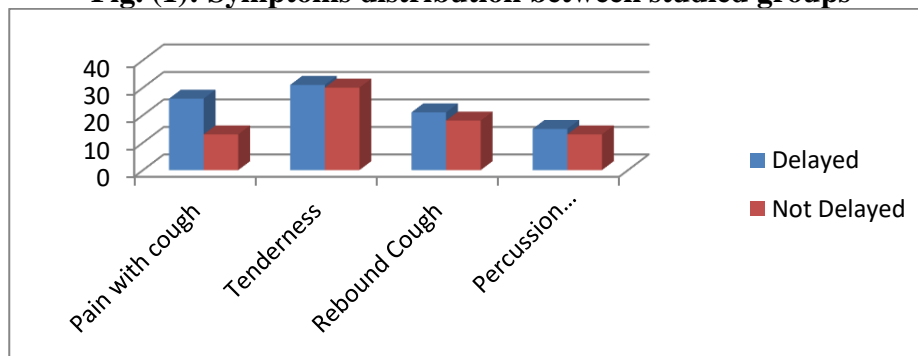
		Group		Total	X <sup>2</sup>	P	
		Delayed	Not Delayed				
WBC	Normal	N	0	8	8	9.18	0.002*
		%	0.0%	25.8%	12.9%		
	High	N	31	23	54	9.18	0.002*
		%	100.0%	74.2%	87.1%		
PMNL	Normal	N	0	8	8	4.54	0.034*
		%	0.0%	25.8%	12.9%		
	High	N	31	23	54	4.54	0.034*
		%	100.0%	74.2%	87.1%		
CRP	-VE	N	16	24	40	4.54	0.034*
		%	51.6%	77.4%	64.5%		
	+VE	N	15	7	22	4.54	0.034*
		%	48.4%	22.6%	35.5%		
Total		N	31	31	62		
		%	100.0%	100.0%	100.0%		

Table (4): PAS distribution between groups and Hospital stay duration distribution between studied groups

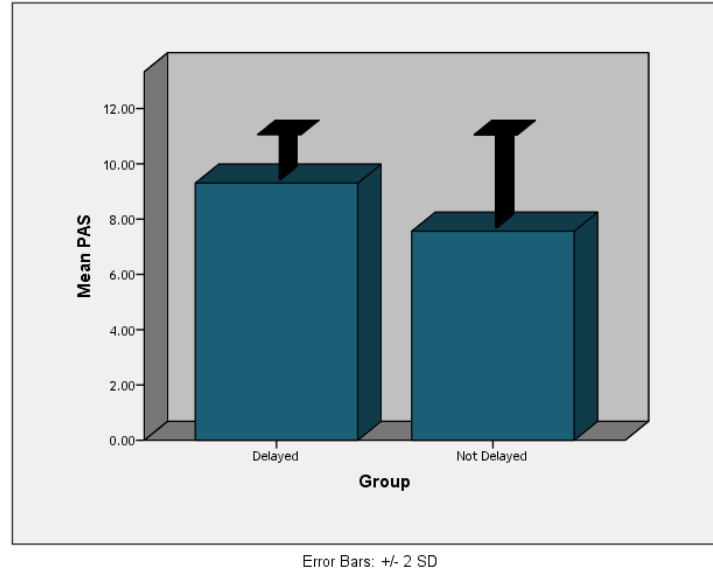
	Delayed (N=31)	Not delayed (N=31)	X <sup>2</sup>	P
PAS	9.3±0.83	7.56±1.7	5.045	0.00**
Hospital Stay (days)	4.53±1.3	1.06±0.7	-10.502	0.00**



**Fig. (1): Symptoms distribution between studied groups**



**Fig. (2): Medical Signs distribution between studied groups**



**Fig. (3): Pediatric Appendicitis Score in both groups.**

## DISCUSSION

In our study there were 62 patients included in the study with mean age as  $8.93 \pm 1.96$  year in non delayed group and mean age  $8.7 \pm 2.35$  year this mean of age is supported by [vc cappendijk](#) and

[fwhazebroek\(9\)](#) with no significant difference between groups

In our study the duration of symptoms is important indicator for delayed diagnosis of acute appendicitis as we found delayed group has longer duration of symptoms than non

delayed group with mean of 3 days and p value 0.00 this is supported by **Bickell NA, et al** (10). In our study we found patients who has prior local clinic visit to physician and pediatricians are significantly associated with delayed group than non delayed group with p value 0.02 .

children's symptoms are abnormal and require further medical evaluations. Lack of verbal skills necessary to accurately present appendicitis related symptoms and the non specific symptoms at the early stage often mis diagnose appendicitis as gastroenteritis also analgesics especially diclofenac and antibiotic drugs are among the risk factors of perforated appendicitis this is supported by.( **Rothrock SG et al** (11)and .( **Zahra Soleimani et al**)(12).

In our study fever and diarrhea were an important risk factors for delayed diagnosis of acute appendicitis with p value 0.005 for diarrhea and p value 0.00 for fever .

Watery diarrhea also was found among patients with delayed diagnosis of acute appendicitis differentiated from viral gastroenteritis by pain which progressively increase in acute appendicitis also in viral gastroenteritis symptom's usually associated with upper respiratory tract infection supported by **Cappendijk and Hazebroek**(13).

Also supported by **Gamal and Moore**(14) who presented a table showing that diarrhea is very often a concomitant symptom in appendicitis, but failed to acknowledge this as a significant symptom.

In our study we investigated the value of TLC and CRP patients with suspicion of appendicitis and correlated the values with the intra-operative findings. TLC was found to have high sensitivity (74.1%), (100%), to both groups non delayed and delayed diagnosed cases of acute appendicitis.

CRP( nonspecific inflammatory mediator) : >5 mg/L was found to have high sensitivity (77.4%) for diagnosis of complicated appendicitis.

Normal levels of both TLC and CRP rule out a diagnosis of complicated appendicitis but do not necessarily rule out acute appendicitis. This

is in contrast to the findings of **KhanMn et al**(15) who have suggested that normal TLC with normal CRP levels decrease the possibility of AA and that the patient can be discharged without more reviews.

A combination of TLC (>10000/mm<sup>3</sup>) and CRP (>5mg/L) had high sensitivity detect complicated appendicitis. this is confirmed by **Mujahid Ahmad et al.**(16) in their study.

In contrast to study done by **Jea Yeon Choi et al**(17)they found no significant differences in the laboratory test results between the delayed group and non delayed group..

So we assume that this results can give a high suspicion to the development of complication in acute appendicitis when all markers are raised and if all the two markers (WBC and CRP) levels were normal in a patient with suspicion of AA; the presence of inflamed appendix is unlikely and re-evaluation of the patient over a period of time is perhaps a better option than proceeding to operation.

it's better not to depend on the evaluation with WBC alone, the combination of all inflammatory markers will reduce the incidence of negative appendectomy

In our study we used pediatric appendicitis score as scoring system in diagnosis of acute appendicitis . PAS mean in our study for cases with early diagnosed acute appendicitis is  $7.56 \pm 1.7$  and PAS mean for cases with delayed diagnosed acute appendicitis is  $9.3 \pm 0.83$  so we suppose that increase value of PAS associated with possibility of complicated acute appendicitis and delayed diagnosis .

So that pediatric appendicitis score is a valuable aid in diagnosing childhood appendicitis especially in resource limited supported by **Kambalabettu Zohara Parveen et al**(18)

Early diagnosis and intervention remain the most promising means of reducing the morbidity, mortality, and discomforts for the child, as well as the cost supported by **Jea Yeon Choi et al** (17)

## CONCLUSION

Fever ,diarrhea ,prior local clinic visit ,CRP,PAS and elevated TLC are associated with delayed diagnosis of acute appendicitis.

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