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Original Article

Comparison of routine laboratory tests in acute appendicitis and intussusception in childhood

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Abstract

Aim: Acute appendicitis and idiopathic intussusception are two major causes of acute abdomen in childhood. In this study, we investigated the clinical, laboratory and radiological findings of these two surgical emergencies during the first presentation.

Material and Methods: In this study, we retrospectively reviewed the records of pediatric patients with acute appendicitis and idiopathic intussusception between 2015-2018. Patients were identified according to inclusion criteria.

Results: Physical examination findings were positive in all patients with acute appendicitis and idiopathic intussusception. White Blood Cell (WBC) [15.55] and C-Reaktif Protein (CRP) [3.75] were high in the laboratory test in patients with acute appendicitis. In patients with idiopathic intussusception, lactate dehydrogenase (LDH) [302] and CRP [0.6] were high and Ultrasound findings were positive. In addition, WBC [10,1 (5,07)] was normal in patients with idiopathic intussusception.

Conclusion: While WBC, CRP, physical examination is valuable in the diagnosis of acute appendicitis, physical examination, CRP, LDH and USG are valuable in the diagnosis of intussusception. In an Idiopathic intussusception patient, WBC may be normal at first admission.

Keywords: Childhood; Acute Appendicitis; Idiopathic Intussusception; Laboratory Findings; Clinical Findings; Radiological Findings.

INTRODUCTION

Acute abdomen is an emergency medical condition which accompanied by sudden intra-abdominal pain (1). Children with acute abdomen admitted to the emergency department constitute 8.1% of pediatric emergency patients (1). Some of the patients with acute abdomen in childhood are patients with acute appendicitis and intussusception, which require immediate surgical intervention and are life-threatening. Although acute abdomen is caused by different etiologic factors, clinical, radiological and laboratory findings are similar.

In children over 4 years of age, the most common cause of disease requiring surgical intervention is acute appendicitis (2). The most common reason for emergency intra-abdominal surgical intervention in children under 2 years of age is intussusception (3).

In this study, we investigated the laboratory and radiological findings of children admitted to the emergency department due to these two diseases.

MATERIAL and METHODS

This retrospective study started after the approval of Inonu University Scientific Research and Publications Ethics Committee (No: 2018/19-4). The records of all pediatric patients who were treated in our clinic between January 2015 and May 2018 for acute appendicitis and intussusception were examined. The records of 24 intussusception patients were obtained from the hospital records. The records of 34 acute appendicitis patients were obtained from the hospital records.

Inclusion criteria were determined in the study groups patients as follows: 1- Under 2 years old, idiopathic (no pathologic lead point) intussusception patient, 2- Uncomplicated intussusception patients (without necrotic intestinal segment and without intestinal perforation) 3-Acute appendicitis patient under 17 years old, 4- Uncomplicated acute appendicitis (non-perforated appendicitis and without plastron appendicitis) patients, 5- Patients who can be reached Laboratory findings.

Whole blood, biochemistry, C-reactive protein (CRP), age, gender, ultrasound (USG) findings of all patients in the study group was examined. In all patients, physical examination findings were specifically positive for the disease. Therefore, physical examination findings were

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not included in the statistical analysis. The data obtained were analyzed statistically. The normal reference values of the laboratory results were used to evaluate the results of the groups (4-5).

Statistical analysis

Group comparisons for quantitative data were made by Mann-Whitney U test. Continuity-corrected chi-square and Fisher's exact tests were used for qualitative data comparisons between groups. ROC analysis was applied for score generation and for the determination of best cut-off values. For each laboratory result best cut-off value was determined and for each a new variable was generated which was coded 1 or 0 as a factor with or without a risk factor for acute appendicitis. In addition, a total score was calculated as the sum of these new variables. Also, for total score a best cut-off value was determined by ROC analysis. Significance level was considered to be 0.05 in all analysis.

RESULTS

The statistical analysis of the laboratory results of the groups is shown in Table 1. The statistical analysis of the age distribution of the groups is shown in Table 1. The reference values of laboratory values in children are shown in Table 1 (4-5). The gender distribution of the groups and the positivity of the ultrasound findings and their statistical analysis were shown in Table 2.

Table 1. The statistical analysis of hematological. biochemical and age values of groups and their normal reference values

	Intussusception (n=24)	Appendicitis (n=34)	p-value	Normal reference values
AgeYear	1.5 (1.25)	10 (4.5)	<0.001	
Duration of symptoms h	14.7 (8-22)	13 (9-15)	NS	
CRP	0.6 (1.57)	3.75 (6.53)	0.012	0-0.35
WB	10.1 (5.07)	15.55 (4.8)	<0.001	4.3-10.3
HGB	11.2 (1.35)	12.65 (1.45)	<0.001	12-17.2
HCT	32.7 (3.1)	37.5 (4)	<0.001	35-50.3
PLT	381.5 (133.5)	286.5 (72.5)	<0.001	150-400
GLU	103 (6.25)	102 (16.75)	<0.001	70-105
BUN	10.1 (3.25)	10 (6)	0.002	8.4-21
CREA	0.4 (0.04)	0.5 (0.1)	<0.001	0.57-1.11
NA.	136 (4)	136 (3)	0.645	136-145
K	4.09 (0.68)	4 (0.31)	0.456	3.5-5.1
CL	104 (3)	106 (5.75)	0.235	98-108
CA	8.95 (1.12)	9.2 (0.8)	0.410	8.4-10.2
AST	31 (10.25)	20 (6.75)	<0.001	5.0-34.0
ALT	13.5 (7.25)	9.5 (7.75)	0.005	0-55
LDH	302 (65.25)	231 (37.5)	<0.001	125-260
GGT	8 (1)	9.5 (3)	0.089	7.0-21.0
TP	7.05 (0.75)	7 (0.47)	>0.05	6.4-8.3
ALB	3.8 (0.8)	3.85 (0.5)	0.450	3.5-5
Abdominal tenderness	24	34	>0.05	
Vomiting	24	34	>0.05	
Nausea	24	34	>0.05	

Table 2. Statistical analysis of groups, gender distribution and ultrasound findings

		Intussusception(n=24)	Appendicitis(n=34)	p-value
Gender	Male	13 (54.2)	24 (70.6)	0.315
	Female	11 (45.8)	10 (29.4)	
USG	Negative	0 (0)	7 (20.6)	0.034
	Positive	24 (100)	27 (79.4)	

There was no difference in gender distribution between the groups (Table 1). The age distribution of the appendicitis group was different from the other group and this difference was statistically significant [appendicitis group: 10 (4,5), Intussusception group: 1.5 (1.25)] (p<0,001) (Table 1). Among the biochemical results of the Intussusception group, lactate dehydrogenase (LDH) [302 (65, 25)] was found to be higher than the appropriate reference value for the age group (Figure 1), (Table 1).

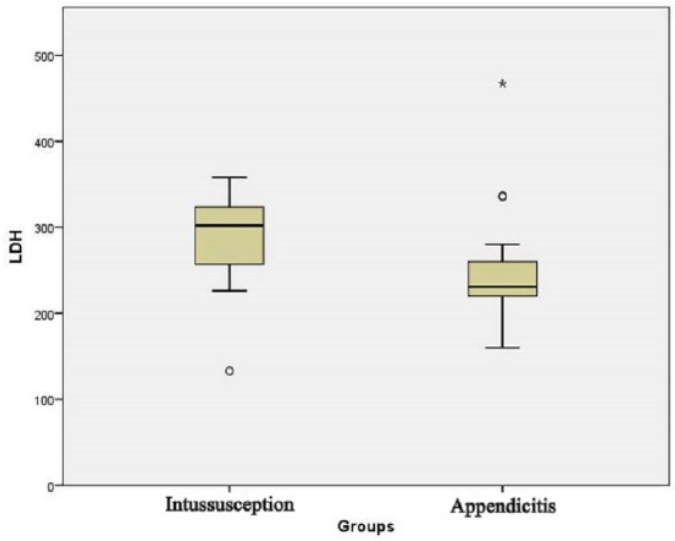

Figure 1. This image shows LDH levels of the groups

The C-reactive protein (CRP) result of the Intussusception group was higher than the normal reference value [0.6 (1.57)] (Figure 2), (Table 1).

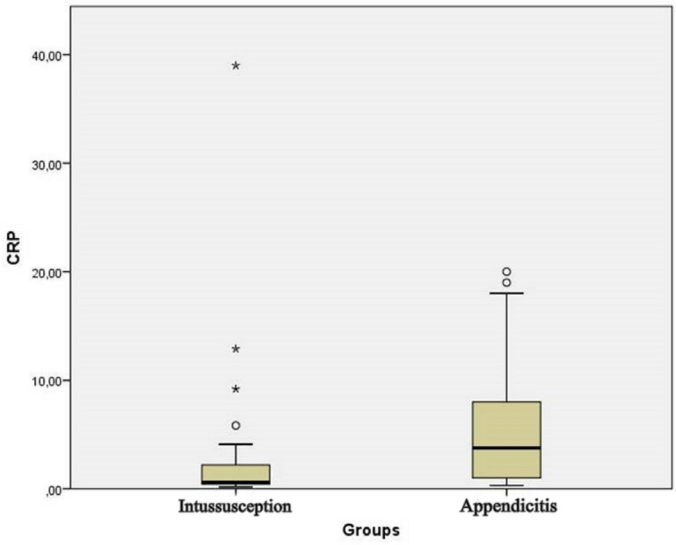

Figure 2. This image shows CRP levels of the groups

Whole blood analysis result of the Intussusception group, White Blood Cell (WBC) count was among the normal reference values [10,1 (5,07)] (Figure 3).

Biochemical analysis results of the appendicitis group were among the normal reference values (Table 1). Whole blood analysis result of the Appendicitis group, WBC count was higher than normal reference values [15, 55 (4, 8)]. Appendicitis group and Intussusception group were different from WBC count. The result of the Appendicitis group was higher and this result was statistically significant (p<0,001) (Table 1.). Appendicitis group CRP result was higher than normal reference values. Appendicitis group and Intussusception group, CRP values were different from each other. The CRP result of the appendicitis group was higher and this difference was significant (p<0,001) (Table 1).

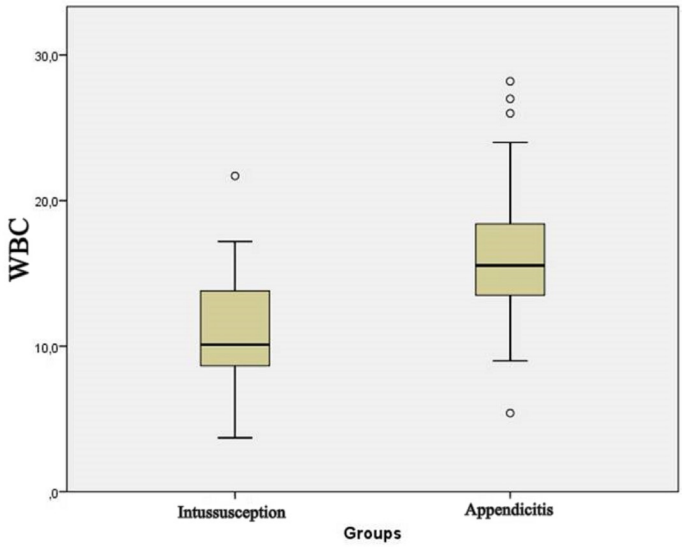

Figure 3. This image shows WBC levels of the groups

There was no statistically significant difference between the gender distributions of all groups (p <0.05) (Table 2). In ultrasound, the positive result in the disease specific findings was higher in the intussusception group and this difference was statistically significant (p <0.05) (Table 2).

For discrimination of acute appendicitis and intussusception we applied ROC analysis to the laboratory results which were out of the normal range values and also significantly different between the groups. According to best cut-off values determined by ROC analysis we generated a score consist of CRP, WBC and LDH results. Also, we applied a new ROC analysis to identify a cut-off for the generated score. To identify acute appendicitis, the best cut-off value for this score was determined as greater than 1. The diagnostic ability of the score seems to be useful for distinguishing diseases.

The diagnostic performances of each variable and the score are given by Table 3.The best cut-off values for acute appendicitis were CRP: > 0.77 WBC: > 13.9 LDH: < 280 (Table 3).

The best cut-off values for intussusception were CRP: < 0.77 WBC: < 13.9 LDH: > 280.

Table 3. Diagnostic performances of the CRP, WBC and LDH

	Best cut-off value for Acute Appendicitis	AUC (95% C.I.)	p	Sensitivity	Specificity
CRP	>0.77	0.695 (0.561-0.810)	0.008	0.824	0.625
WBC	>13.9	0.797 (0.670-0.891)	<0.001	0.706	0.792
LDH	<280	0.779 (0.651-0.877)	<0.001	0.625	0.912
Score	>1	0.888 (0.778-0.956)	<0.001	0.882	0.792

*AUC (Area under the ROC curve)
**Score is calculated as the sum of the CRP, WBC and LDH scores recoded as 0 or 1 according to best cut-off values

In children, it is not always easy to diagnose the acute abdomen. To determine the cause of acute abdomen in children, clinical, laboratory and radiological findings (Figure 4A-4B) should be evaluated together. However, sometimes this is not possible and the cause is understood as intra-operatively (Figure 5A-5B). In children with acute abdomen, radiological and laboratory findings do not necessarily require an abnormality. However, in children with acute abdomen symptoms, WBC is usually expected to be above normal in the complete blood count (6-7).

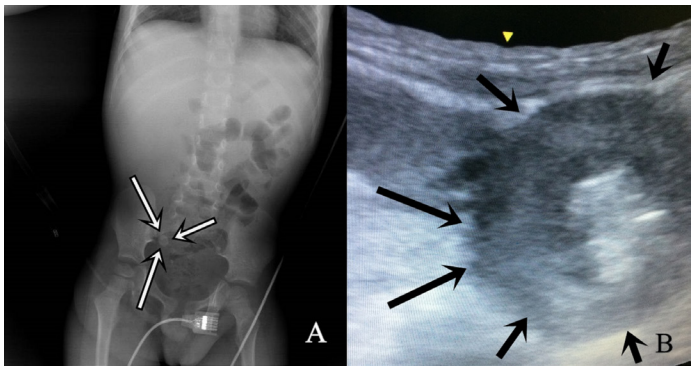

Figure 4 A. This image shows a plain abdominal x-ray of an acute appendicitis patient of a 6-year-old male. The arrows indicate fecality which causes appendicity

Figure 4 B. This image shows an ultrasound image of a 1.5-year-old male intussusception patient. Arrows indicate intestinal segment of intussusception (target sign)

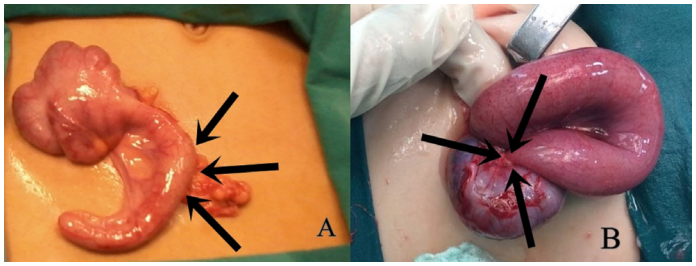

Figure 5 A. This image shows an intra-operative image of a 7-year-old male patient with an appendicitis. The arrows indicate the occluded and edematous portion of the lumen due to fecality.

Figure 5 B. This picture shows an intra-operative image of a 1.5-year-old male patient with an intussusception. Arrows indicate intestinal segment of intussusception (target sign)

For every child presenting with abdominal pain, certain laboratory tests should be performed. These laboratory tests are complete blood, routine biochemistry and CRP (8). Two common causes of acute abdomen complications in children are acute appendicitis and intussusception. We found some remarkable results when we did a literature search with the laboratory tests of these two diseases (9-11).

Kwan et al. in their study of acute appendicitis found that WBC was greater than 12 x 1000 mm3 in complete blood count (9). However, there is no study on the value of WBC in intussusception in the literature. In textbooks, we found that WBC level in intussusception may be related to the severity of clinical findings (10,11). WBC, CRP values indicate the body's response to inflammation.

In our study, we found that WBC and CRP were high in pediatric patients with acute appendicitis. In patients with idiopathic intussusception, we found that the number of WBC was lower than those of acute appendicitis. We found that WBC was within the normal range of reference values in patients with idiopathic intussusception. We found CRP values in idiopathic intussusception patients were higher than normal reference values.

Lactate dehydrogenase (LDH) is a intracellular enzyme that converts lactate and pyruvate to one another in the glycolytic pathway. It is found in all cells in the body. In all cases where cell destruction is increased, the LDH level increases (12). However, determination of this increase is not useful in the differentiation of malignant and benign diseases (12). The LDH level after birth is 400 IU / L, but it fall below 270 IU / L from the second month (13). In a 3-year-old, serum LDH level is considered normal up to 260 (13).

In this study, serum LDH level was higher in the intussusception group than the appendicitis group and the reference value. High levels of an enzyme found in the cell cytoplasm are an indicator of cell destruction.

In the literature, there is no study investigating the relationship between serum lactate dehydrogenase level and intussusception. However, Ordeanu et al. in their study, they claimed that there was no useful laboratory test in the diagnosis of intussusception (14).

WBC, CRP values indicate the body's response to inflammation (15). These values are affected by any event that causes inflammation. In a previous study, it was found that the systemic response started 20 h after the onset of symptoms in appendicitis (14). In another study, it was found that this response was developed 48 hours after the onset of symptoms in patients with intussusception (16-17). Systemic response develops earlier in patients with appendicitis.

Since the intussusception segment is covered with another intestinal segment in intussusception patients, we think that the systemic response does not start strongly until necrosis develops. However, we think that cellular destruction started at the time of first application. We believe that CRP and LDH levels may be useful in the diagnosis of intussusception before the systemic response is completed. In this study, physical examination findings of all pediatric patients were found to be positive for both acute appendicitis and intussusception. It was also found that ultrasound was more reliable than laboratory tests in patients with idiopathic intussusception.

CONCLUSION

Due to abdominal pain, Whole blood, routine biochemistry and CRP tests should be performed in infants under 2 years of age who are admitted to the emergency department. If CRP and LDH levels are found to be high in these tests, abdominal USG should be performed even if WBC is within normal reference values. This approach may prevent misdiagnosis in children with idiopathic intussusception. While WBC, CRP, physical examination is valuable in the diagnosis of acute appendicitis, physical examination, CRP, LDH level and USG are valuable in the diagnosis of idiopathic intussusception. In an idiopathic intussusception patient, WBC may be normal at first admission.

Competing interests: The authors declare that they have no competing interest.

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