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Comparison of Accuracy Value of Examination of Procalcitonin and C-reactive Protein in Pediatric Patients with Appendicitis in Central General Hospital (RSUP) H. Adam Malik and Regional General Hospital (RSUD) Dr. Pirngadi Medan.

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ABSTRACT

Diagnosis of acute appendicitis remains a challenge, especially in the age group of children. Delays in diagnosis lead to increased risk of serious complications such as perforation. Hence the absolute need for a diagnostic tool that is sensitive and specific. Objective to compare the accuracy values between Procalcitonin (PCT) and C-Reactive Protein (CRP) in diagnosing pediatric appendicitis. Cross-sectional study with descriptive and analytical analysis of the 31 patients under 18 years of age who present to the emergency department of RSUP H. Adam Malik with symptoms of appendicitis and appendectomy was performed from December 2014 until July 2015. Among all patients who participated in a research note that 14 (45.2%) patients with appendicitis are male and 17 (54.8%) are female, and the number of patients from the age group 12-18 years (58.1%) more than the age group <12 years (41.9%). A CRP level in patients with acute appendicitis was increased (91.7%), and they also have elevated complications (84.2%). Sensitivity and specificity of the diagnostic test was 84.2% and 8.3% respectively, as well as the accuracy of measurement of CRP levels was 54.8%. The range of values of CRP levels were very large for acute appendicitis i.e. 0.69 to 17.10 mg / l with a mean of 10.11 ± 4.74 mg / l and for complicated appendicitis of 3.70 to 19.70 mg / l with a mean 12.27 ± 4.82 mg / l. PCT levels was found to increase (91.7%) in patients with acute appendicitis, and in patients with complicated appendicitis also increased (100%). Sensitivity and specificity of diagnostic test area 100% and 8.3% respectively and an accuracy of measurement of PCT levels is 64.5%. The range of values of PCT levels are very large for acute appendicitis is 0.04 to 55.50 ng / ml with a mean of 10.60 ± 15.95 ng / ml and for complicated appendicitis of 0.75 to 151.70 ng / ml with a mean 15.98 ± 33.44 ng / ml. Examination of PCT in patients with appendicitis had a sensitivity of 100% and a specificity of 8.3% and has a value higher accuracy (64.5%) compared with CRP examination (54.8%) with a sensitivity of 84.2% and a specificity of 8.3% , PCT and CRP had an important role in supporting the clinical diagnosis of appendicitis in children.

Keywords: Appendicitis, Pediatric patients, PCT, CRP

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INTRODUCTION

Appendicitis is an inflammation of the appendix vermiformis and is a cause of acute abdomen. Appendicitis can be caused by infection or obstruction of the appendix [1]. If the diagnosis is late to be established, the appendix can perforate, resulting in peritonitis or abscess around the appendix. The rate of death reported due this disease was 0,3% and ncreased by 6,5% on perforation cases. The acute appendicitis incidence in children ranged from 1-8% [2]. Acute appendicitis is common in young age, approximately 40% of patients with acute appendicitis was found between the age of 10-30 years old. Ratio of male compared to female in teenagers approximately 3 : 2. The incidence of appendicitis in children less than 4 years old increased by 25 cases for every 10.000 cases in children aged 10-17 years old [3].

There are several diseases that resemble the symptoms of appendicitis based on clinical symptoms. The high rate of negative appendectomy was reported between 9-44%, has prompted efforts to develop a new diagnostic method has high sensitivity and specificity with relatively cheaper cost for the diagnosis of acute appendicitis in order to reduce the rate of negative appendectomy [1]. Procalcitonin (PCT) serves as one of the most important biochemical indicators which are closely correlated with the severity of the inflammatory reaction of the host against microbial infection. The diagnostic value of PCT is a marker of better than C-reactive protein which increased in inflammatory states. C-reactive protein (CRP) is a sensitive indicator of the bacterial infection, inflammation and tissue damage. CRP is a non-specific inflammatory mediators found that increasing the amount of serum, a sensitivity of 43% - 92% and a specificity of 33% - 95% for acute appendicitis. This gives the impression that CRP is more sensitive (> 90%) than WBC to detect the appendix perforation and abscess appendiks [4,5]. This study aims to determine the accuracy of the examination value procalcitonin and C-reactive protein in patients with appendicitis child.

MATERIALS AND METHODS

Population and Samples

This research was conducted at the Department of Pediatric Surgery ,H.Adam Malik Hospital and Dr. Pirngadi Hospital in Medan in December 2014 to July 2015. The samples were pediatric patients with a diagnosis of appendicitis and appendectomy was performed at t Adam Malik Hospital or Dr Pirngadi Hospital, Medan who come to the Emergency Room or to the clinic of pediatric surgery who met the inclusion criteria. The data collected will be processed and analyzed to assess the sensitivity, specificity, and accuracy checks.

Data Analysis

The result including the age of patients, level of CRP and PCT, histopathology analysis,were analyzed using T-test analysis, Mann-Whitney Test. bivariable analysis performed using chi square test and Continuity correction analysis.

RESULT AND DISCUSSION

Appendicitis Differences Based on Age

Table 1. Differences of Appendicitis Based on Age

Age (Years old)	Simple appendicitis (%)	Complication appendicitis (%)	Total (%)
<12	3 (25)	10 (52.6)	13 (41.9)
12 – 18	9 (75)	9 (47.4)	18 (58.1)
Total	12 (100)	19 (100)	31 (100)

X^2=2,306 *p=0,129*

From this study, 31 samples of pediatric patients with appendicitis studies that met the inclusion criteria were 14 (45.2%) male and 17 (54.8%) female. The number of patients appendicitis was higher at group of age 12-18 years old (58,1%) than group of age < 12 years old (41,9). From the 31 subjects, 12 patients (38.7%) had simple appendicitis and 19 patients (61.3%) suffered from complication appendicitis. The result was shown in Table.1

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Based on table above, simple appendicitis patients mostly aged 12-18 years (75%) while those of appendicitis complications mostly aged <12 years (52.6%). Based on the statistical test Chi-square, the value of p> 0.05 which showed no significant difference between simple appendicitis with complications of appendicitis based on age.

The differences of appendicitis based on level of CRP shown in Table. 2

Table 2. Differences of appendicitis based on level of CRP

Level of CRP	Simple appendicitis (%)	Complication appendicitis (%)	percentage (%)
Normal	1 (8.3)	3 (15.8)	4 (12.9)
Increase	11 (91.7)	16 (84.2)	27 (87.1)
total	12 (100)	19 (100)	31 (100)

X^2 = 0,003 *p=0,958*

CRP levels in patients with simple appendicitis generally increased (91.7%), while in patients with appendicitis complications also generally increased above normal (84.2%). From a statistical test with continuity correction p value> 0.05, which means there is no significant difference simple appendicitis with complications of appendicitis based on the levels of CRP.

Examination of PCT levels found in patients with simple appendicitis increased (91.7%) and in patients with appendicitis complications entirely to increase (100%). From a statistical test with continuity correction p value> 0.05, which means there is no significant difference simple appendicitis with complications of appendicitis based on PCT levels. The result was shown in Table.3

Table 3. Differences of Appendicitis based on level of PCT

Level of PCT	Simple appendicitis (%)	Complication appendicitis (%)	Percentage (%)
Normal	1 (8.3)	0	1 (3.2)
Increase	11 (91.7)	19 (100)	30 (96.8)
Total	12 (100)	19 (100)	31 (100)

Based on the table 4, the mean levels of CRP patients with simple appendicitis is 10,11 ± 4,74 mg / l, which is lower than mean levels of CRP patients with appendicitis complications 12,27 ± 4,82 mg / l. But from a statistical test by t-test , the p value obtained was p > 0.05 which showed no significant difference in CRP levels with appendicitis patients with simple appendicitis complications.

Table 4.Differences between CRP level and PCT level based on histopathology result

Laboratory examination	Histopathology result	N	Mean	Std. Deviation	Min - Max	Nilai p
CRP	Simple appendicitis	12	10.11	4.74	0.69 – 17.10	0.233*
	Complication appendicitis	19	12.27	4.82	3.70 – 19.70	
PCT	Simple appendicitis	12	10.60	15.95	0.04 – 55.50	0.584**

*T-test

**Mann-Whitney Test

Table 5. Distribution of study subjects in the examination of PCT levels compared with results of histopathology

PCT	Histopathology result		Total
	Complication Appendicitis	Simple appendicitis	
Increase	19(a)	11(b)	30
Normal	0(c)	1(d)	1
Total	19	12	31

Based on table 5, the sensitivity, specificity , accuracy, NPP and NPN obtained respectively was 100%; 8,3%; 64,5%; 63,3% and 100%. From the results of this study,the accuracy value of PCT level measurement was 64.5% which demonstrates the ability of this method to detect complication appendicitis properly.

Based on table 6, the sensitivity, specificity , accuracy, NPP and NPN obtained respectively was 84,2%; 8,3%; 64,5%; 54,8%, 59% and 25%. From the results of this study,the accuracy value of CRP level measurement was 64.5% which demonstrates the ability of this method to detect complication appendicitis properly. From the results of this study patients with appendicitis in children obtained 14 male patients (45.2%) and 17 (54.8%) were female and most are in the age group 12-18 years (58.1%) compared with the age group < 12 years (41.9%). Epidemiological data reported that acute appendicitis is common in young age as much as 40%. Patients with acute appendicitis was found between the age of 10-30 years. Ratio of men compared with women in their teens 3: 2. The incidence of appendicitis in children aged less than 4 years increased to 25 cases for every 10,000 children aged 10-17 years old [6]. Sack et al [7] reported late diagnosis of acute appendicitis in children is associated with increased risk of perforation and the best treatment choice is appendectomy.

Table 6. Distribution of subject study on CRP level examination compared with histopathology result

CRP	Histopathology result		Total
	Complication Histopathology	Acute appendicitis	
Increase	16(a)	11(b)	27
Normal	3(c)	1(d)	4
Total	19	12	31

Perforation is a complication of untreated acute appendicitis within 24-36 hours. In general, the longer the delay of diagnosis and surgery, then the possibilities of perforation also be greater. Risk of perforation after 36 hours after symptom onset at least 15%. Examination of C- Reactive Protein according to Sack et al is a sensitive indicator of the bacterial infection, inflammation and tissue damage, sensitivity of 43% - 92% and a specificity of 33% - 95% for acute appendicitis with abdominal. The results of this study found that CRP levels in patients with simple appendicitis generally rise above normal (91.7%), while in patients with complication appendicitis also generally increased above normal (84.2%) and based on statistical test t-test, the value of p obtained p > 0.05 which is showed no significant difference in CRP levels simple appendicitis patients with appendicitis patient complications. This is due to the value of CRP level range is very large for a simple appendicitis between 0.69-17.10 mg / l with an average 10:11 ± 4.74 mg / l and for appendicitis complications between 3.70-19.70 mg / l with an average 12:27 ± 4.82 mg / l.

CRP was formed as a result of the process of infection, inflammation, burns and malignancy. Acute phase response is followed by increased activity of coagulation, fibrinolytic, leukocytosis, systemic effects and changes in the levels of some types of plasma proteins such as CRP or hsCRP. CRP levels typically rise 6-8 hours after the fever and peaks 24 -48 hours. In normal individuals CRP <5 mg / L and can be increased to 30x the normal value on the response phase [8]. Similarly, examination of PCT level in patients with simple appendicitis generally increased (91.7%), while in patients with complications appendicitis also entirely increased above normal (100%) and statistical test by Mann-Whitney test which p value> 0.05 showed no significantly difference on PCT levels between simple appendicitis patients with complication appendicitis. This also due to greater range of values of PCT levels, for simple appendicitis between 0.04-55.50 ng / ml with a mean of 10.60 ± 15.95 ng / ml and for complication appendicitis between 0.75-151.70 ng / ml with a mean of 15.98 ± 33.44 ng / ml.

Procalcitonin induced by endotoxin produced by bacteria during a systemic infection. Infections caused by protozoa, non-bacterial infections (viruses) and autoimmune disease did not induce PCT. PCT levels appear rapidly within 2 hours after stimulation, peak reached after 12-48 hours and slowly decreased in 48 to 72 hours [9]. In a healthy individual normal plasma PCT concentrations are <0.5 ng / ml. In the case of microbial infections, severe systemic inflammation or sepsis, an increase of CALC-I gene expression with concurrent increase in the concentration of PCT in all tissues and cell types of the human body. Bacterial lipopolysaccharide and proinflammatory cytokin is the strongest trigger for the releasing of the PCT.

During viral infection, serum PCT concentrations increased slightly to 1.5 ng / ml, while the concentration of PCT for the bacterial infection reaching up to 1,000 ng / ml. PCT is correlated with the bacterial load and severity of the infection [10]. PCT examination to detect appendicitis complications with histopathological results of the diagnostic test has a sensitivity of 100% and specificity 8.3% From these results the accuracy of PCT measurement is 64.5%. Another study reported analysis of procalcitonin in different patient groups showed that serum procalcitonin test has a sensitivity as 95.65% and a specificity of 100%, based on histopathological diagnosis appendix accepted as standard [10]. Procalcitonin role as one of the most important biochemical indicators which are closely correlated with the severity of the inflammatory reaction of the host against microbial infections [11]. Statistical test examination of PCT and CRP in patients with appendicitis in this study, the accuracy of the examination of PCT was higher (64.5%) compared with CRP examination (54.8%).Serum PCT is a better diagnostic test than serum CRP measurements due to serum PCT can distinguish patients who come to hospital with abdominal pain but had normal appendix from the patients who are actual cases of acute appendicitis [12].

CONCLUSION

Examination of PCT in patients with appendicitis had a sensitivity of 100% and a specificity of 8.3% and has a value higher accuracy (64.5%) compared with CRP examination (54.8%) with a sensitivity of 84.2% and a specificity of 8.3%. PCT and CRP had an important role in supporting the clinical diagnosis of appendicitis in children.

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