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Role of C Reactive Protein and WBC Count in the Diagnosis of Acute Appendicitis and Its Predictive Value in Assessing the Severity of the Disease

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Abstract

Introduction: *Acute appendicitis is still one of the commonest surgical emergencies. The diagnosis is primarily clinical based on the typical presentation of right lower quadrant pain, nausea and vomiting with tenderness and guarding in right iliac fossa. The clinical experience of the surgeon decides the accuracy of the diagnosis which is difficult in 30 – 40% of cases despite available diagnostic modalities. Apart from a careful history and clinical examination, blood inflammatory markers also help in the diagnosis and management of acute appendicitis. Various inflammatory markers have been estimated like white cell count, C Reactive Protein and polymorph percentage. This study is conducted to estimate the role of sensitivity and specificity of total white cell count and C Reactive Protein in patients clinically diagnosed as suffering from acute appendicitis and their correlation with histopathology reports to assess their role in diagnosing complicated acute appendicitis.*

Materials and Methods*: Patients admitted with clinical diagnosis of acute appendicitis to department of general surgery, Thanjavur Medical College & Hospital, Thanjavur during January 2016 to January 2017 were included in the study. Clinical examination was made and the signs and symptoms were recorded in the proforma. Patients presenting with appendicular mass or abscess, treated conservatively and patients who refused to give consent were excluded from this study. Blood samples were collected on admission before surgery for estimation of total WBC count and CRP estimation. Then the patients underwent appendicectomy and the resected appendicular specimens were sent for histopathological examination and the results were collected. Based on the histopathological report the cases were grouped under two categories complicated acute appendicitis and uncomplicated acute appendicitis depending on the presence or absence of perforation and gangrenous changes. Then the data were entered into excel 2007 and statistical analysis were made to find the significance of total white cell count and C reactive protein values in diagnosing acute appendicitis and their correlation with complication like perforation or gangrenous changes.*

Observation: *The total number of study subjects participated was 150 cases and among them 43 cases were complicated acute appendicitis and 107 cases were uncomplicated acute appendicitis. The age distribution was 71 cases (46.5%) were less than 25 years and 79 cases (53.5%) were 25 years and above. Out of the*

150 cases 106 (70.7%) were males and 44 (29.3%) were females making a ratio of 2.4: 1. Right iliac fossa pain and tenderness and Mc Burney's tenderness were present in all 150 cases (100%) while migratory pain was noticed only in 76 cases (50.7%). Guarding and rigidity were seen in 67 cases (44.7%). C reactive protein was positive in 119 cases (79.3%) and negative in 31 cases (20.7%). In complicated acute appendicitis C reactive protein values were > 25 mg/dl in 40 cases (93%) and only in 35 cases (32.7%) in uncomplicated acute appendicitis group. Total white cell count was >11150 cells/cmm in 33 cases (76.7%) in complicated acute appendicitis and in uncomplicated acute appendicitis 47 cases (43.9%) only and making a total of 80 cases (53.3%).

Keywords: *Acute Appendicitis, C reactive protein, WBC count, histopathology.*

OBJECTIVES

- To assess the role of C-reactive protein and white cell count in the diagnosis of acute appendicitis and its predictive value in assessing the severity of the disease.
- To study the value of preoperative C - reactive protein and WBC count in diagnosing acute appendicitis.
- To correlate its value in grading of Acute Appendicitis as compared to Histo-pathological reports.

INTRODUCTION TO THE STUDY

The appendix is commonly described as Vermiform Appendix, in Latin Vermin means wormlike. It is a blind diverticulum of about 6-10 cms. in length from the intestines and it contains masses of lymphoid tissue. Its origin is from the posteromedial aspect of the cecum inferior to the ileocecal junction. The appendix has got a short mesoappendix which is a short triangular mesentery of appendix attached to the cecum and proximal part of the appendix. The appendix first appears at the 8th week of gestation as an out pouching from caecum and gradually rotates to a medial location as the gut rotataes and becomes fixed to right lower quadrant. The appendix is described as retrocecal, pelvic, subcecal, preileal or right pericolic depending on the position of the tip of the appendix but the relationship between the base of the appendix and the cecum remains constant. The most common position is retrocaecal. The convergence of the taenia coli at the junction of the cecum with the appendix is a useful landmark to identify the appendix.

The appendix is supplied by the appendicular artery, a branch of the ileocolic artery and the venous drainage is in to the superior mesenteric vein through the ileo colic vein. Lymphatic drainage is into the lymph nodes in the mesoappendix and the ileocoliclymphnodes. Efferent lymph vessels form the ileocolic nodes drain into the superior mesenteric lymphnodes.

The sympathetic and parasympathetic nerves from the superior mesenteric plexus supply the appendix. From the lower thoracic part of the spinal cord the sympathetic fibres originate and the parasympathetic nerve fibres are derived from the vagus nerves.

Previously for a long time appendix was erroneously viewed as a vestigial organ with no known function but now it is a well recognised immunologic organ that actively participate in the secretion of immunoglobulins, particularly immunoglobulin A. A potential relationship has been now attached between appendectomy and development of inflammatory bowel diseases. Radford Smith (2002) stated that "Appendectomy may protect against the subsequent development of inflammatory bowel disease, however the mechanism is unclear".

The lumen of appendix is small in relation to its length and this configuration may predispose to closed loop obstruction. When the appendiceal lumen is blocked the intraluminal pressure increases upto 60cms of water due to continued mucus secretion. This leads to elevated pressure in the appendiceal wall and results in localised perfusion defects which leads to loss of mucosal integrity and subsequent bacterial invasion. This leads to necrosis of appendiceal wall and

perforation of appendix. If this progresses slowly and diagnosis is delayed, an abscess can result due to walling off of the inflammatory process by the adjacent organs and omentum. If this progression is much faster it leads to gangrene and this leads to free perforation into peritoneal cavity. Perforation and abscess formation may also lead to fistula formation to adjacent organs. The most common cause of abdominal pain which is surgically correctable is acute appendicitis but the diagnosis remains difficult in many instances. Some of the signs and symptoms may not be present in all instances. An early diagnosis is essential, as a delay in diagnosis may lead to gangrene and perforation. This increases morbidity and mortality significantly while on the other hand an incorrect diagnosis leads to an unnecessary surgery, although not catastrophic, often subjects these patients to an unnecessary operation.

During development appendix is formed as a midline structure, so the classic presentation is pain that starts in the region of the umbilicus and then migrates to the right iliac fossa. This is due to localised peritoneal inflammation which occurs approximately within 24 hrs. Migratory pain is present only in 70% of cases and rest of the patients have discomfort in right lower quadrant. Cough, or increase in intra abdominal pressure due to movement or valsalva manoeuvre worsens this pain. 75% of cases present with vomiting and anorexia always accompanies appendicitis. Obstipation or diarrhoea is present in few cases. Low grade fever up to 101*F (38.3*C) may be present.

Physical findings depends on the anatomic position of the inflamed appendix is and whether the organ has already ruptured or not. In uncomplicated acute appendicitis vital signs are minimally changed, temperature elevation is rarely > 1* C and the pulse rate is normal or slightly elevated. If there is high fever or tachycardia they point toward a complicated acute appendicitis.

Patients with appendicitis lie supine, with the right thigh drawn up, because the movements increase pain. Tenderness is often maximal at Mc Burney's point.

Many blood inflammatory markers have been identified and developed but basically they are all non specific markers. C-Reactive Protein (CRP) is one of the blood inflammatory marker extensively studied and used as an inflammatory marker. CRP is a member of pentraxin family of proteins which have a cyclic non covalent pentavalent structure. Interleukin-6, IL-1 B and glucocorticoids induce hepatic CRP synthesis and release . In humans CRP is an important acute phase protein which increases by 1000 fold following infection, inflammation or tissue damage.CRP exhibits calcium dependent binding of its principle ligand, phosphocholine a constituent of fungal and bacterial cell walls .This activates complement cascade and phagocytic response. An elevated CRP is one of the many downstream indicators of inflammation. The test for CRP is a simple and effective screening test for occult bacterial infection and tissue injury.

MATERIALS AND METHODS

All patients diagnosed as acute appendicitis clinically at Thanjavur Medical College Hospital were analysed prospectively for a period of one year. Data on patient's age, clinical findings, WBC count, C-reactive protein (CRP) and histopatho-logical findings were recorded and Statistical analysis carried out.

INCLUSION CRITERIA

- Patients clinically diagnosed with acute appendicitis.

EXCLUSION CRITERIA

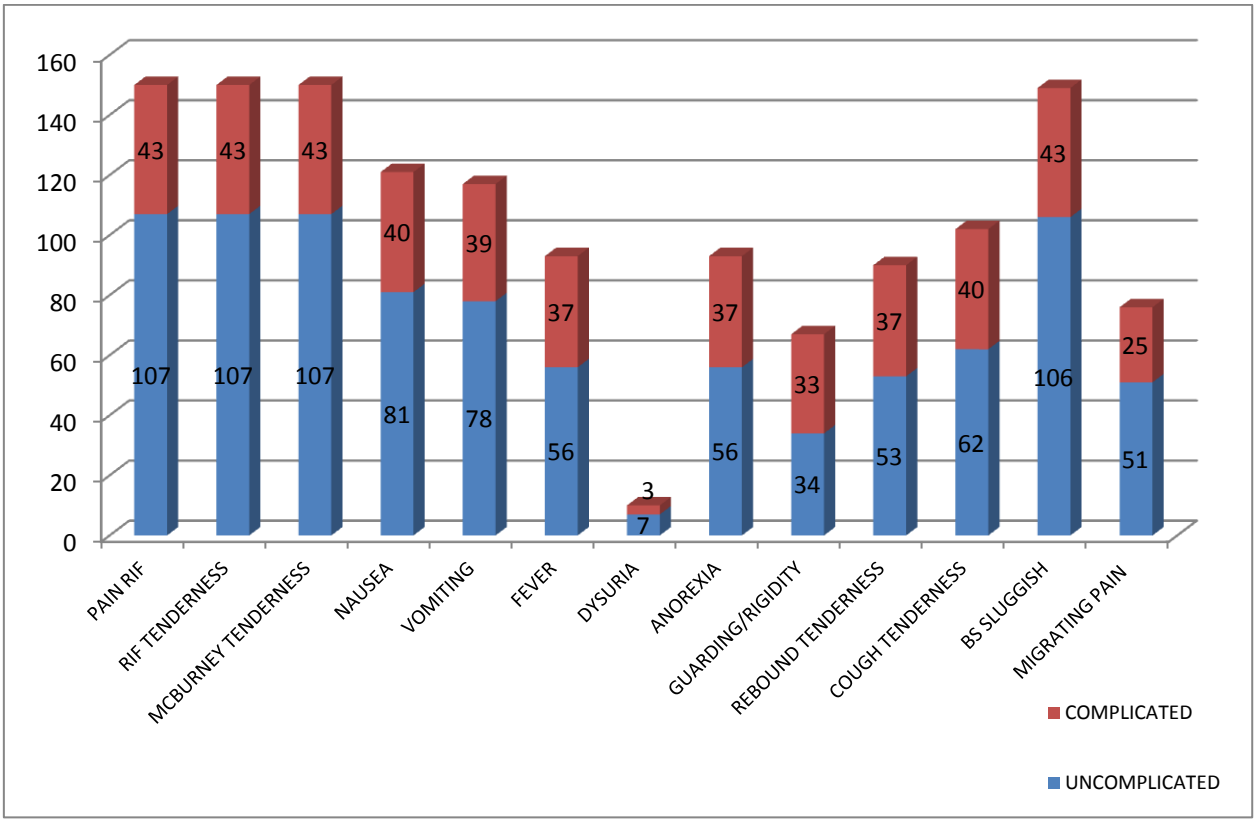
- Patients less than 12 years of age
- Appendicular mass
- Withdrawal / Refusal of consent

RESULTS

The acute appendicitis study subjects were divided in to Uncomplicated acute appendicitis (UCAA) (acute suppurative appendicitis) and Complicated Acute Appendicitis (CAA) based on the presence of gangrenous changes or

perforation. The two groups were compared in respect of their age, gender, WBC, Polymorph and CRP counts. The clinical symptoms of total subjects were described in terms of percentages. The continuous variables were compared by students independent 't' test. The categorical variables were associated by χ^2 (Chi-square) test. The above analysis and interpretations were carried out by the statistical package IBM SPSS statistics 20. The p-values less than 0.05 ($p<0.05$) were considered as significant in two test.

The total study subjects participated was 150. Out of 150, 106(70.7%) and 44(29.3%) were males and females. The mean age was 28.65 years. The difference of age between the gender 5.2 years was not statistically significant P>0.05). Among the total subjects 47.3% were below 25 years and 52.7% of them 25 and more ages. Among the 150 cases studied, uncomplicated acute appendicitis was present in 107 cases and complicated acute appendicitis was present in 43 cases with gangrenous changes or perforation.

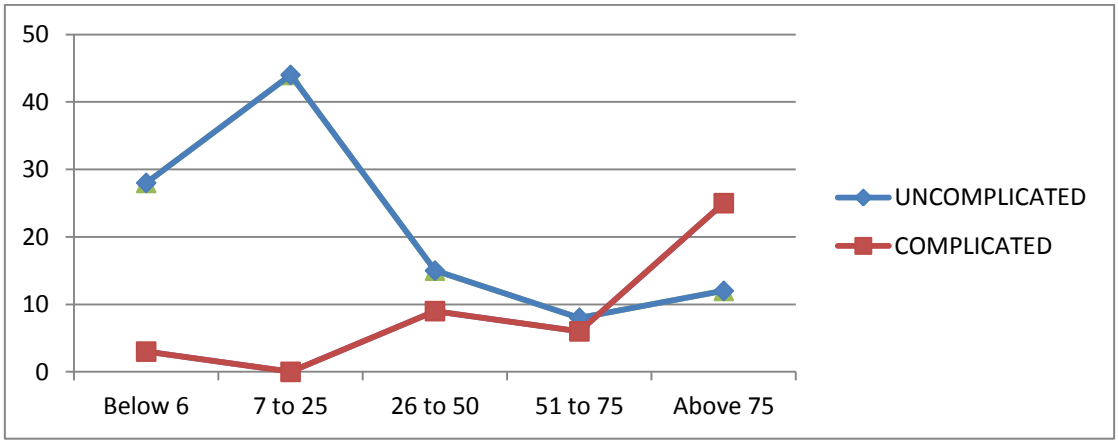


INFLAMMATORY MARKERS

The mean ages of uncomplicated and complicated acute appendicitis were 29.31 years and 27.02 years respectively. The difference of 2.29 years was not statistically significant (P>0.05). The WBCs were 11,836.92 and 16,248.84 with difference of 4411.92 was statistically significant (P<0.05). The mean polymorph of uncomplicated acute appendicitis and complicated acute appendicitis were 71.93% and 83.05% respectively. The difference 11.12% was statistically significant (P<0.05). Mean CRP 27.9 of uncomplicated acute appendicitis was significantly lesser than the mean CRP of complicated acute appendicitis 75.35 ($p<0.05$) and this is statistically significant.

COMPARISON OF AGE, WBC, POLYMORPH AND CRP BETWEEN UNCOMPLICATED AND COMPLICATED APPENDICITIS

	Mean	S.D	t	Statistical inference
AGE				
Un complicated (n=107)	29.31	11.612	1.156	.249>0.05 Not Significant
Complicated (n=43)	27.02	9.041		
TOTAL COUNT				
Un complicated (n=107)	11836.92	5265.786	-4.693	.000<0.05 Significant
Complicated (n=43)	16248.84	5054.954		
POLYMORPHS				
Un complicated (n=107)	71.93	15.822	-4.269	.000<0.05 Significant
Complicated (n=43)	83.05	10.092		
CRP				
Un complicated (n=107)	27.89	28.434	-8.802	.000<0.05 Significant
Complicated (n=43)	75.35	33.198		



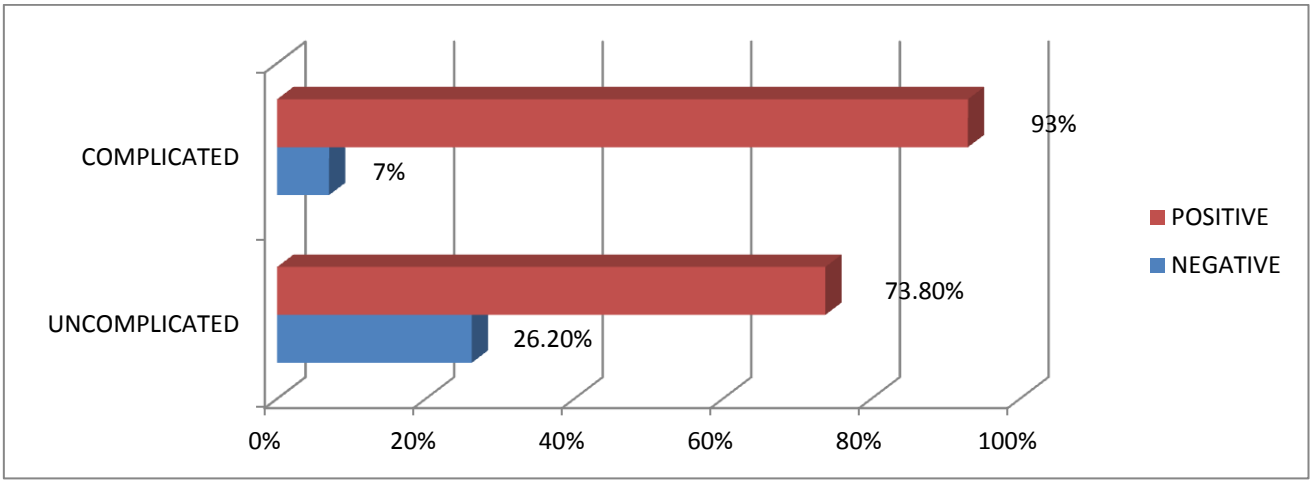
CRP values in UCAA and CAA mg/dl

CRP VALUES	UNCOMPLICATED APPENDICITIS NO.	PERCENTAGE	COMPLICATED APPENDICITIS NO.	PERCENTAGE
Below 6	28	26.2%	3	7.0%
7 to 25	44	41.1%	0	.0%
26 to 50	15	14.0%	9	20.9%
51 to 75	8	7.5%	6	14.0%
Above 75	12	11.2%	25	58.1%

POSITIVE AND NEGATIVE CRP VALUES IN UCAA AND CAA

CRP VALUES	UNCOMPLICATED APPENDICITIS NO.	PERCENTAGE	COMPLICATED APPENDICITIS NO.	PERCENTAGE
NEGATIVE	28	26.2%	3	7.0%
POSITIVE	79	73.8%	40	93.0%

X^2=6.891,p=0.009, p<0.01



Specificity and Sensitivity for different Values of CRP

CRP level	Sensitivity	Specificity
≥ 5.5	97.7	20.6
≥26.5	90.7	68.2
≥27.5	88.4	70.1

Total count values in UCAA and CAA mg/dl

TOTAL COUNT VALUES	UNCOMPLICATED APPENDICITIS NO.	PERCENTAGE	COMPLICATED APPENDICITIS NO.	PERCENTAGE
Below 11150	60	56.1%	10	23.3%
Above 11150	47	43.9%	33	76.7%

X^2 =13.274, p=0.000, p<0.001

Specificity and Sensitivity for different Values of total count

Total Count	Sensitivity	Specificity
≥ 10,950	81.4	52.3
≥ 11,150	76.7	56.1
≥ 11,550	74.4	59.8

SUMMARY

Acute appendicitis is still one of the commonest surgical emergencies. The diagnosis of acute appendicitis is primarily clinical and a typical patient presents with right lower abdominal pain, nausea and vomiting and has got tenderness and guarding in right iliac fossa on examination. The definite diagnosis of appendicitis still remains a clinical decision augmented by appropriate tests. Total white cell count has remained an important factor in the definite diagnosis of appendicitis but this can be very non-specific at times. Recently interest has grown in other inflammatory markers which could be helpful in diagnosing appendicitis and C- reactive protein is one of them. A high degree of diagnostic accuracy is required to reduce the incidence of negative appendectomies which still remains around 20 %. Negative appendectomies are one of the burdens facing not only the general surgeon but also the patient and society as a whole, since appendectomy, as any other operation, results in socio-economic impacts in the form of lost working days and declined productivity.

Blood inflammatory markers such as white blood cell counts and C-reactive protein levels are performed in patients clinically diagnosed as suffering from acute appendicitis. The importance of these investigations on decision making regarding further management has been studied widely [1,2]. There are reports which have investigated the value of the raised serum CRP values in improving the diagnosis of acute appendicitis [3]. Studies have shown that elevated

levels of inflammatory markers increase the probability of acute appendicitis [4], whereas others have concluded that patients with right lower quadrant pain with a normal WBC count and CRP level are unlikely to have acute appendicitis [4,5]

This study was conducted to assess the sensitivity and specificity of total white cell count and C-reactive protein in patients clinically diagnosed as suffering from acute appendicitis. To assess the role of C Reactive Protein in grading the severity of acute appendicitis by correlation with histopathologicalreports .

H.C.Kim et al. (2011) in their study on evaluation of relationships between blood inflammatory markers and CT findings concluded that total white cell count better detects early appendiceal inflammation and an elevated CRP level better detects perforated appendicitis [6].

The study by Hyoung-Min Moon by multivariate analysis demonstrated that C-reactive protein was an independent predictor for complicated appendicitis (odds ratio, 1.371; 95% confidence interval, 1.155 to 1.628; P < 0.001) The cut-off value of C-reactive protein was set at 7.05 mg/dL by using receiver operating characteristic curve (0.805; sensitivity, 57.6%; specificity, 98.3%).In conclusion, in patients who have already been diagnosed as having appendicitis and for whom surgery has already been scheduled, if the value of C-reactive protein is higher than 7.05 mg/dL, to the surgeon should anticipate complicated appendicitis, decide on an appropriate operation time, select antibiotics, and explain the prognosis to the patient [7].

Present study (2014-2015) includes a total of 150 cases, who were all admitted with the clinical diagnosis of acute appendicitis, investigated and had undergone appendicectomy. Based on the histopathology report they were grouped as complicated acute appendicitis and uncomplicated acute appendicitis depending on the presence of gangrenous changes or perforation. We had 43 cases (28.67%) in CAA and 107 cases (71.33%) in UCAA. The mean ages of uncomplicated acute appendicitis and complicated acute appendicitis were 29.31 years and 27.02 years respectively. The difference of 2.29 years was not statistically significant (P>0.05). This when compared with other studies has a low incidence of complicated cases which may be due to few paediatric cases and few elderly patients in the series. Out of 150 cases studied 106 cases (70.7%) and 44 cases (29.3%) were males and females respectively making a ratio of 2.4:1. This value is higher than the values of 1.2 to 1.3:1 as seen in other studies [8,9].

Signs and symptoms such as pain RIF, RIF tenderness and Mc Burney's tenderness were 100.0% in both groups. Migratory pain history was present in 76 cases (50.7%), dysuria in 10 cases (6.7%) and bowel sounds were present in 149 cases (99.3%) .These incidences had not been significantly associated with either CAA or UCAA. Fever in 93 cases (62%), guarding/rigidity in 67 cases (44.7%), nausea 121 cases (80.7%), vomiting in 117 cases (78%), anorexia in 93 cases (62%), rebound tenderness in 90 cases (60%) and cough tenderness in 102 cases (68%) were significantly associated with complicated acute appendicitis.

Laboratory studies can be helpful in the diagnosis of acute appendicitis but no single test is definitive. Blood inflammatory markers such as total white cell counts and C-reactive protein levels are performed in patients suspected of having acute appendicitis. A total white cell count is perhaps the most useful laboratory test and the count is slightly elevated in UCAA, but may be quite elevated in CAA. Mild increase in total white cell count ranging from 10000 to 18000 cells per cumm. is usually present in patients with UCAA and is often accompanied by a moderate polymorphonuclear predominance. Total white cell counts are variable and white cell count above this level increases the possibility of a perforated appendix with or without an abscess. In the present study the total white cell count was more than 11,150 cells/cmm in 33 cases (76.7%) in CAA and 47 cases (43.9%) in UCAA. The total

white cell count has a mean value of 11,836.92 cell/cumm in UCAA and 16248.84 cells/cumm in CAA with a difference of 4411.92 cells/cmm . The polymorph percentage was more than 78% in 30cases (69.8%) in CAA and 45cases (42.1%) in UCAA. The mean polymorph of UCAA and CAA were 71.93 and 83.05 respectively. The difference 11.12 was statistically significant (P<0.05) [10,11].

In many studies the accuracy of CRP in diagnosing acute appendicitis and the increase in CRP in acute appendicitis with perforation or gangrenous changes, which is related to the severity of appendiceal inflammation is well documented [12,13]. In the present study out of 14 cases in Complicated Acute Appendicitis group 1 case (7.2%) was CRP negative and 13 cases (92.8%) were CRP positive. The CRP values ranged from 27 to 140mg/dl with a mean value of 71.4mg/dl. In the other Uncomplicated Acute Appendicitis group of 37 cases CRP was positive in 28cases (75.6%) and negative in 9cases (24.4%) and the CRP values varied from 7 to 110mg/dl with a mean value of 27.1mg/dl. Mean CRP of 27.1mg/dl in UCAA was significantly lesser than the mean CRP of 71.4mg/dl in CAA and this is statistically significant (p<0.001). The receiver-operating characteristic (ROC) curve indicated that the cut off value of CRP is 26.5mg/dl and at this point the sensitivity is 92.8% and specificity is 75.8% and the Youden index is highest (0.686).

In our study of 150 cases the preoperative estimation of CRP is helpful in diagnosing acute appendicitis and is indicative of complications if the values are high. Even though the total white cell count did not show a statistically significant good correlation in diagnosis of acute appendicitis the increase in total white cell count in CAA cases were very significant. The mean value of CRP is 27.89 in UCAA and 75.35 in CAA which is significant p<0.05.

Rothrock SG (2000) in his study concludes that "Our study highlights the diagnostic predictability of White cell count and CRP for simple acute appendicitis and a perforated appendix. A higher sensitivity of CRP than the WCC in the diagnosis of simple acute appendicitis has been reported in a few studies [14]. This study results are almost the same as our study.

Preoperative C reactive protein value and total white cell count in clinically diagnosed cases of acute appendicitis contribute to the diagnosis and grading of severity of the disease. Positive C reactive protein value (>6mg/dl) is a good marker of acute appendicitis and a high C reactive protein value is an indicator of complicated acute appendicitis.

REFERENCES

1. Ortega-Deballon P, Ruiz deAdana-Belbel JC, Hernández-Matías A, García-Septiem J, Moreno-Azcoita M. Usefulness of laboratory data in the management of right iliac fossa pain in adults.Dis Colon Rectum 2008;51:1093–9.
2. Khan MN, Davie E, Irshad K. The role of white cell count and C-reactive protein in the diagnosis of acute appendicitis.J Ayub Med Coll Abbottabad 2004;16:17–19.
3. Gurleyik E, Gurleyik G, Unalmişer S. Accuracy of serum C-reactive protein measurements in diagnosis of acute appendicitis compared with surgeon's clinical impression. Dis Colon Rectum. 1995;38(12):1270–1274.
4. Yang HR, Wang YC, Chung PK, Chen WK, Jeng LB, Chen RJ. Laboratory tests in patients with acute appendicitis.ANZ J Surg 2006;76:71–4.
5. Khan MN, Davie E, Irshad K. The role of white cell count and C-reactive protein in the diagnosis of acute appendicitis.J Ayub Med Coll Abbottabad 2004;16:17–19.
6. H C Kim MD, D M Yang MD,C M Lee MD, W Jin MD, D H Nam MD,J Y Song MD, and J Y Kim MD Acute appendicitis: relationships between CT-determined severities and serum white blood cell counts and C-reactive protein levels. Br J

Radiol. 2011 December; 84(1008): 1115–1120

7. Hyoung-Min Moon, Beom-Seok Park, and Duk-Jin Moon. Diagnostic Value of C-reactive Protein in Complicated Appendicitis . J Korean SocColoproctol. 2011 June; 27(3): 122–126.
8. Vargas HI, Averbook A, Stamos MJ: Appendiceal mass: Conservative therapy followed by interval laparoscopic appendectomy. *Am Surg*60:753, 1994.
9. Haller JA, Shaker IJ, Donahoo JS, et al: Peritoneal drainage versus non-drainage for generalized peritonitis from ruptured appendicitis in children. *Ann Surg*177:595, 1973.
10. Sheikh MuzamilShafi, MisbhaAfsheen and FarooqA..Reshi Total Leucocyte Count, C-reactive Protein and Neutrophil Count: Diagnostic Aid in Acute Appendicitis Saudi J Gastroenterol. 2009 April; 15(2): 117–120 .
11. Zimmerman MA, Selzman CH, Cothren C, Sorensen AC, Raeburn CD, Harken AH. Diagnostic implications of C - reactive protein. Arch Surg. 2003;138:220–4.
12. Eriksson S, Granstrom L. Laboratory tests in patients with suspected acute append-icitis. ActaChir Scand. 1994;155:117–2.
13. Shakhatreh HS. The accuracy of C-reactive protein in the diagnosis of acute appendicitis compared with that of clinical diagnosis. Med Arh. 2000;54:109–10.
14. Rothrock SG, Pagane J Acute appendicitis in children: emergency department diagnosis and management. Ann Emerg Med 2000;36:39–51.