# "A PROSPECTIVE STUDY TO EVALUATE DIAGNOSTIC EFFICACY OF SERUM CRP LEVELS IN CLINICALLY DIAGNOSED CASES OF ACUTE APPENDICITIS, CONFIRMED BY HPR"

**BY**

**REG NO. BH0119003**

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# Endorsement

This is to certify that the dissertation entitled **"A PROSPECTIVE STUDY TO EVALUATE DIAGNOSTIC EFFICACY OF SERUM CRP LEVELS IN CLINICALLY DIAGNOSED CASES OF ACUTE APPENDICITIS, CONFIRMED BY HPR"** is a bonafide research work done by **REG NO. BH0119003.**

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# ABBREVIATIONS

| | | |
|---|---|---|
| AA | - | Acute appendicitis |
| CECT | - | Contrast enhanced computed tomography |
| CRP- C | - | reactive protein |
| ESR | - | Erythrocyte sedimentation rate |
| HPE | - | Histopathological examination |
| HPR | - | Histopathologogy report |
| ITP | - | Immune thrombocytopenic purpura |
| KLES | - | Karnataka Lingayat Education Society |
| MI | - | Myocardial infarction |
| NPV | - | Negative predictive value |
| PID | - | Pelvic inflammatory disease |
| PMN | - | Polymorphonuclear lymphocytes |
| PPV | - | Positive predictive value |
| TLC | - | Total leucocyte count |
| USG | - | Ultrasonography |
| WBC | - | White blood cells |

# ABSTRACT


**"A PROSPECTIVE STUDY TO EVALUATE DIAGNOSTIC EFFICACY OF SERUM CRP LEVELS IN CLINICALLY DIAGNOSED CASES OF ACUTE APPENDICITIS, CONFIRMED BY HPR"**

**INTRODUCTION**:

Acute appendicitis is one of the most common cause of an acute abdomen demanding surgical intervention. Diagnosis of acute appendicitis is made by taking proper clinical history, thorough physical examination, radiological and blood investigations. The diagnostic accuracy of the classical muprhy's triad of acute appendicitis is less than 80%. Addition of imaging like ultrasound or CECT of abdomen and pelvis will increase the diagnostic accuracy to not more than 90 %, especially in elderly, females and toddlers. Hence there is a need for more sensitive markers to increase the diagnostic yield in acute appendicitis. CRP can be used as an inflammatory marker. Measurement of CRP in suspected appendicitis may improve accuracy of diagnosing acute appendicitis. CRP levels can also help distinguishing pathological types, the degree of inflammation and severity (simple or complicated) which can be used as a tool for reference index for surgery.

**OBJECTIVE:**

1. To evaluate the diagnostic efficacy of serum C-reactive protein levels in histopathologically diagnosed cases of appendicitis.

2. To determine sensitivity, specificity, predictive value of negative and positive test of CRP in diagnosis of AA.

3. To interpret how CRP levels can be used effectively to enhance the diagnostic yield of acute appendicitis.

**METHODOLOGY**:

Preoperatively blood for CRP will be withdrawn from patients of appendicitis on admission. All specimens of appendix will be subjected to histopathologic examination postoperatively which will be taken as final diagnosis, result of CRP will be correlated with histology reports to evaluate the role of CRP in diagnosing appendicitis. Sensitivity, specificity, positive and negative predictive values will be calculated.

**RESULT**S:

Majority of the patients were in age group of 20 to 29 years and majority were males 55%. Of the 14 patients who had chronic appendicitis on HPE, 42% (6 patients) had positive CRP, 58 % (8 patients) had negative CRP. Of 86 patients who had acute appendicitis on HPE, 91% (79 patients) had positive CRP , 9% (7 patients) had negative CRP. In acute appendicitis group 13 patients (16%) out of 86 patients had perforated appendicitis and 73 (84%) had acute suppurative appendicitis on HPE. In all 13 patients of perforated appendicitis CRP value was more than 50 mg/L. The sensitivity and specificity of serum CRP is 91.86 % and 42.86 % respectively. The positive predictive value is 90.80% and negative predictive value is 46.15%. The overall diagnostic accuracy is 85 %.

**CONCLUSION**:

Although acute appendicitis is one of the commonest abdominal surgical emergency, its diagnosis is still challenging, CRP levels are useful in evaluation of acute appendicitis, if used wisely they may spare a category of patients not only a

nonessential surgical procedure but also unnecessary hospitalization for observation. CRP more than 50 mg/L is an indicator of perforated appendicitis. When the concerned surgeon is in dilemma whether to manage patient conservatively with antibiotic and clinical observation or go ahead with surgical intervention, CRP levels can be a useful aid in the diagnosis.

**Keywords: C-reactive protein, appendicitis**

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# INTRODUCTION

Acute appendicitis is one of the most common cause of an acute abdomen demanding surgical intervention. Diagnosis of acute appendicitis is made by taking proper clinical history, thorough physical examination, radiological and blood investigations. It is basically an inflammatory state either due to catarrhal inflammation or due to obstructive appendicitis. There are many physical signs and laboratory parameters which may suggest ongoing inflammation in the body like pulse rate, fever, leukocytosis but these mentioned deranged parameters may be associated with some other underlying condition too. There are also many atypical presentations of acute appendicitis.

Moreover many non-inflammatory and inflammatory conditions may present in the same way appendicitis presents, hence diagnosis becomes difficult sometimes. The diagnostic accuracy of the classical muprhy's triad of acute appendicitis, 1. periumbilical pain shifting later over Mc Burney's point; 2. fever with increased WBC count 3. anorexia, vomiting and nausea is less than 80%. Addition of imaging like ultrasound or CECT of abdomen and pelvis will increase the diagnostic accuracy to not more than 90 %, especially in elderly, females and toddlers.[1]

Precise and correct diagnosis is crucial as acute appendix demands urgent operative intervention while other similar conditions like right illiac fossa pain and tenderness secondary to pelvic inflammatory disease, may not require surgery. On the other hand overcautious approach and delayed diagnosis will negatively impact the outcomes in acute appendicitis cases. Hence there is a need for more sensitive markers to increase the diagnostic yield in acute appendicitis.

C reactive protein (CRP) is a an annular ring shaped pentameric prototypical acute phase reactant protein found in blood plasma whose levels are elevated in response to inflammation. Normal concentration of CRP is 0.8 mg/dl to 3.0 mg/dl, but in acute bacterial inflammation it increases to more than 10 mg/dl. Immediately after a single stimulation, de novo synthesis of CRP starts in the liver. Levels increase to more than 5 mg/dl in 6 hours and peaks in 48 hours. Plasma half-life of it is 19 hours and is constant under all conditions. Circulating CRP concentration depends on the rate of its synthesis. Rate of synthesis of CRP is directly proportional to the intensity of the inflammatory pathological process responsible for stimulating its production.[2]

Once the stimulus stops circulating CRP levels decrease immediately equivalent to CRP clearance rate from the plasma. C-reactive protein plays a pivotal contribution in opsonization and activation of complement system. Measurement and documentation of CRP values can be useful -

1. In increasing the diagnostic yield
2. To determine the severity and progression of disease
3. To evaluate the response to the treatment given.

The focus of this study is to investigate CRP values as an inflammatory marker in patients with acute appendicitis. This study will also investigate whether CRP is a surgical indication marker as well as diagnostic marker for the decision of an emergency surgery for acute appendicitis.

# OBJECTIVE

1. To evaluate the diagnostic efficacy of serum C-reactive protein levels in histopathologically diagnosed cases of appendicitis.

2. To determine sensitivity, specificity, predictive value of negative and positive test of CRP in diagnosis of AA.

3. To interpret how CRP levels can be used effectively to enhance the diagnostic yield of acute appendicitis.

# REVIEW OF LITERATURE

History review: It 1886 Reginald Fitz distinguished appendix as a cause for right iliac fossa pain and proclaimed the term 'appendicitis'. Claudius Amyand, a British surgeon is credited for performing the very first appendectomy in 1735. In 1889, Charles McBurney explained the McBurney point. In 1982, it was Kurt Semm who performed the very first fruitful laparoscopic appendectomy. [3] [4]

**Appendix embryology:**

The subordinates of the midgut are:

• Small intestine

• Appendix, caecum and ascending colon along with right two third of the transverse colon.

The cecal diverticulum erupts in the sixth week of intrauterine life as a swelling on the antimesenteric side of the caudal appendage of the midgut circle (Fig 1A)

The length of the appendix increases quickly such that during childbirth it is a usually long cylinder arising from the distal end of the cecum. (Fig 1B, 1C)

After birth the wall of the cecum develops rapidly, so that that the appendix comes to enter its medial side. (Fig 1D, 1E)

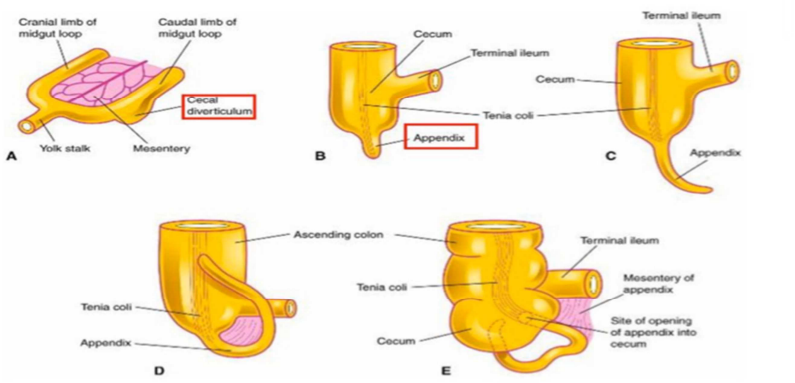



**Fig 1: Development of appendix**

The base of appendix generally lies where the three tenia coli join at the surface of caecum, 2.5 centimeters below and posteromedial to ileocecal confluence.[5] In inadequate rotation of the gut, caecum may lie at a higher level below the liver in connection to gall bladder and duodenum. In this position signs of acute appendicitis may mimic as that of acute cholecystitis.[6]

As in few cases when the caecum is mobile and long the appendix may lie within the pelvis. Rarely, caecum and appendix is positioned to left iliac fossa in cases of situs inversus totalis, in such patients acute appendix mirrors sigmoid colon acute diverticulitis.

Most frequent position of vermiform appendix is retro-caecal (75%) followed by pelvic (20%) and paracaecal (2%). Other less common positions are preileal, subcecal and postileal.

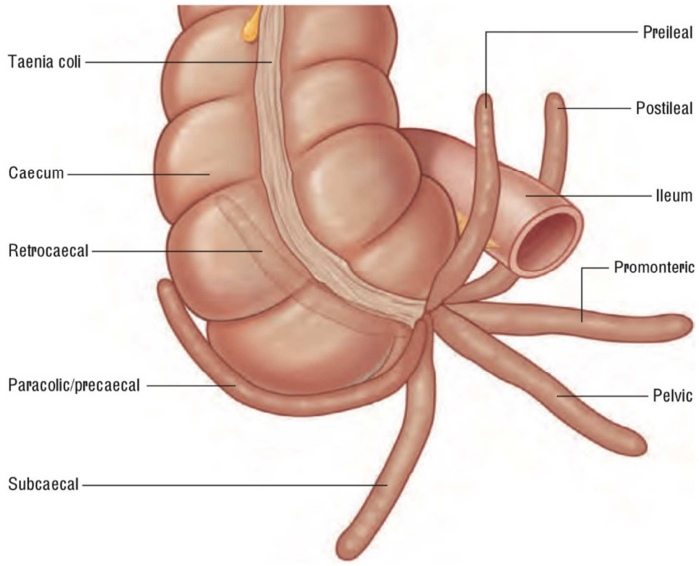



**Fig 2: Positions of appendix**

The posteromedial side of the caecum offers starting point to the vermiform appendix. Anteriorly it is associated with the omentum and ileum. Posteriorly it is related to iliopsoas muscle.

Appendiceal wall has following layers from inner to outer: mucosa, submucosae which is rich in lymphoid tissue, circular and longitudinal muscle layers and outermost serosal layer. The mesentery of terminal ileum gives rise to mesentery of appendix. Fold of Treves is the only antimesenteric fat pad which connects appendix and terminal illeum. Mesentery of appendix incorporates appendicular artery which supplies appendix.

Blood supply of the appendix :

Arterial supply of vermiform appendix is through appendicular artery, which originates from the ileocolic artery. Venous drainage is by appendicular vein which drains into the ileocolic vein. In some cases an accessory branch from posterior caecal artery can supply appendix; which is named after Dr. T Sheshachalam who described it for the first time. [7]

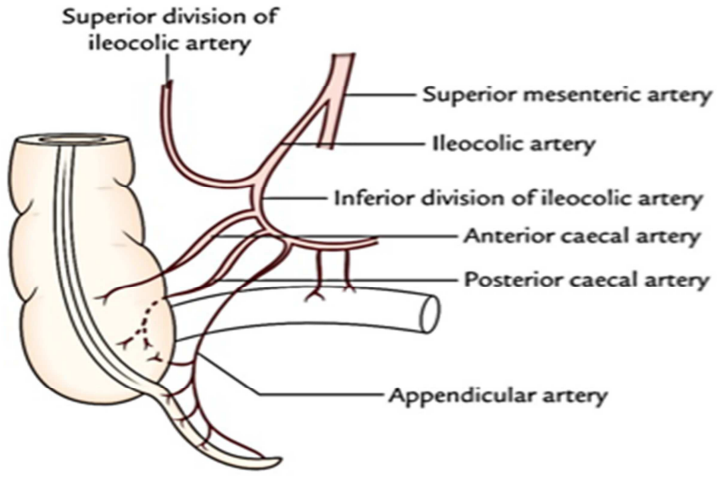



**Fig 3: Arterial blood supply of appendix**

**Lymphatic drainage:**

Lymphatics of appendix drains into the anterior ileocolic group of lymph nodes which again in turn drains into superior mesenteric group of lymph nodes.

**Nerve supply:**

Appendix is supplied by superior mesenteric plexus, vagus forms the parasympathetic supply and sympathetic supply comes from T10 to T12 level.

**Acute Appendicitis:**

It is inflammation of appendix. It is the commonest reason for acute abdomen. Occlusion of the lumen being the main culprit. There is 12 % chances for men and 25 % for ladies to undergo surgery for appendicitis in a lifetime, with around 7 % experiencing appendectomy during their lifetime. It is most common in twenties to forties of life and is more common in male counterpart.

**Etiology**

Diminished dietary fiber and more consumption of refined sugars leads to formation of fecoliths and resultant block of appendicular lumen. Intestinal parasites like pinworm, oxyuris vermicularis and even ascariasis lumbricoides can multiply in the appendix and obliterate the lumen.

**Pathogenesis**

Obstacle in the lumen is the overwhelming reason for a ruptured appendix. Appendicoliths (fecoliths) being most frequently seen cause. Others being, lymphoid tissue hypertrophy, tumors, seeds found in vegetables and intestinal parasites.

There is an anticipated sequelae of occasions prompting appendiceal burst. The proximal obstacle of the appendiceal lumen delivers a shut circle check with continuing discharge by the appendiceal mucosa creating enlargement. The luminal

limit is very less and even a less amount of secretion distal to impediment rises pressure in lumen.

Appendicular distention invigorates the stretch fibers, delivering obscure dull pain around umbilicus. With progression in distention of appendix, firstly venous outflow will be reduced and arterial blood flow will be maintained initially leading to engorgement or enlargement of appendix and at later stage arterial blood flow also get stopped leading to ischemia and subsequent perforation. The zone with the least fortunate blood supply endure the most. Ellipsoidal infarcts are seen in the antimesenteric border of appendix[8].

Microscopy:

The mucosa is edematous, hyperemic, penetrated with polymorphonuclear leucocytes and in spots with putrefaction. There is additionally polymorphs penetration found in submucosa and muscularis layer. Vascular thrombosis is common in perforated appendicitis. The lymphoid follicles are hyperplastic, and necrotic. The veins of the serosa are frequently widened and on the serous surface there might be a fine fibrinous exudate. More often than not, a limited part in the wall of appendix is totally necrotic. The fibro-fatty tissue of the mesoappendix is generally edematous and hyperemic.

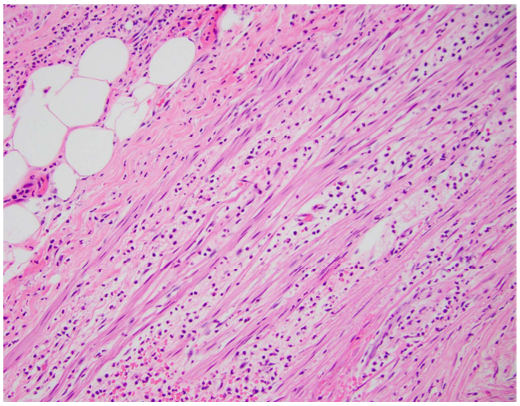


**Fig: 4 Histology of acute appendicitis**

Bacteriology

Typical gastrointestinal tract flora is present in appendix such as facultative Escherechia Coli (aerobes) and Bacteroides. (anaerobes) The culture report of peritoneal fluid is quite helpful in proving polymicrobial character of flora in cases of perforated appendicitis.

Clinical highlights:

Pain is the main manifestation. Firstly located in periumbilical area because of dermatomal innervation and with involvement of overlying regional parietal peritoneum it gradually gets focused to right iliac fossa. Varieties in the anatomic position of appendix represent changing head loci of pain.

Anorexia is usually associated with an acute appendix. Vomiting is present in majority of cases. First symptom to occur usually is loss of appetite after which pain in abdomen ensues and following that vomiting starts.

Signs:

Physical signs are governed by anatomic position of the appendix.

1) Classical rebound tenderness over Mc Burney point.

2) On examination, pressure is applied at RIF and suddenly on removal of the pressure patient will have pain - this is known as Blumberg's sign (rebound tenderness).

3) On palpation and applying pressure on LIF, patient starts having pain in RIF because of shifting of intestinal loops in RIF which in turn irritates the parietal peritoneum - this is called as Rovsing’s sign.

4) On doing hyperextension of right hip, patient can feel pain in right iliac fossa because of psoas muscle irritation by retrocaecally placed appendix (Cope psoas test).

5) On doing internal rotation of right hip joint, patient feels pain in RIF secondary to obturator internus irritation by appendix placed in pelvic position (Cope obturator test).

6) On digital rectal examination tenderness can be present in right side of rectum, usually seen in pelvic appendicitis.

7) A triangle bounded by pubic symphysis, ASIS and umbilicus is known as 'Sherren's triangle'. In cases of acute appendicitis hyperaesthesia can be present in this triangle. [9]

**Varying features as per age/condition:**

Infants: chances are very rare, but if acute appendicitis is there, it is associated with high chances of perforation and mortality too. Children: localization does not occur effectively as omentum is underdeveloped, hence chances of developing peritonitis is more in them. It requires prompt surgical intervention. Elderly: It is usual to find gangrenous and perforated appendicitis in them.[10] Pregnancy: By virtue of the gravid uterus, appendix tends to displace higher up in the abdomen due to this, pain is located much higher and lateral as compared to the usual presentation. After second trimester there is significant increase in maternal mortality by ten folds and also associated with premature labor.

**SCORING SYSTEM**

**Alvarado Score**

This system consists of 4 symptoms, 1 sign and 3 labarotory findings.

There is one point each for vomiting, anorexia, rebound tenderness, migratory pain to RLQ, fever, neutrophilia and two points each for pain in RLQ and white blood cell count more than ten thousand per cubic millimeter in blood.

Total score is ten, less than four is less likely suggestive of appendicitis and more than eight is highly suggestive of acute appendicitis. [11]

**Tzanakis score:**

Four points are given for right iliac fossa tenderness, two points are given for white blood cell counts greater than twelve thousand in blood, three points are given for rebound tenderness and ultrasonography findings confirming acute appendicitis is awarded with six point.

A total more than eight is highly suggestive of acute appendicitis.[12]

**Imaging Modalities:**

ULTRASONOGRAPHY

Ultrasound abdomen pelvis is usually done to count out other similar mimicking conditions such as tubal ectopic pregnancy, stones in right ureter. USG also identifies the presence of appendicular mass or abscess. [13]

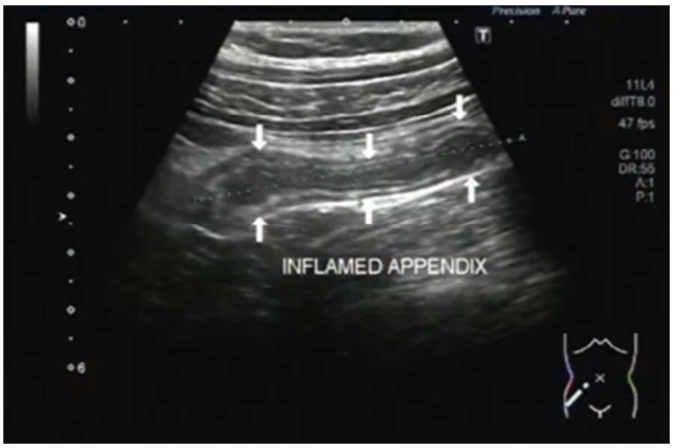



**Fig: 5 USG view of acute appendicitis**

COMPUTERIZED TOMOGRAPHY

Contrast enhanced CT scan plays a pivotal role to precisely diagnose acute appendicitis in unsure cases, especially in old patients since clinical signs are not much profound and appreciable in them.

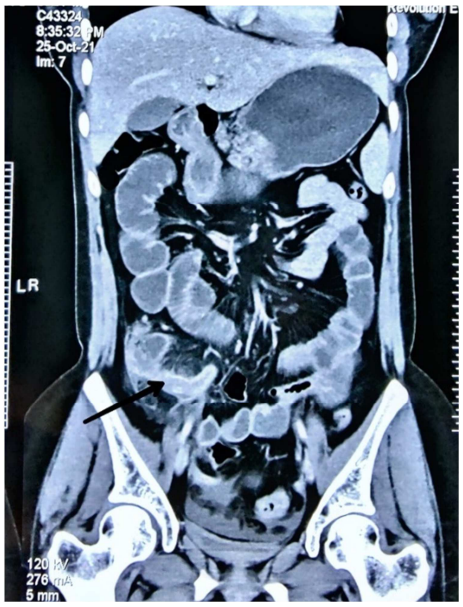



**Fig 6: CT scan shows dilated appendix (black arrow)**

**Differential Diagnosis**

- Twisted or ruptured ovarian cyst
- Meckel's diverticulum and its inflammation - common in children
- Mesenteric lymphadenitis
- Rupture ectopic pregnancy (right sided)
- Crohn's inflammatory bowel disease -common in old patients
- Right ureteric stone/ colic
- Salpingitis / oophoritis/ both

**TREATMENT**

**Antibiotics**

Most patients with severely inflamed appendix are overseen by brief careful removal of the appendix. It is always wise to give preoperative antibiotics to cover broad spectrum of microorganisms and reduces chances of intraabdominal abscess formation. In cases of perforated appendicitis parenteral antibiotics are given even after surgery till the patient is not febrile, usually second generation cephalosporin or quinolone/ metronidazole is administered.

**SURGERY** – Appendicectomy

Methods or Approaches:

1) Open approach
2) Laparoscopic approach: gold standard nowadays

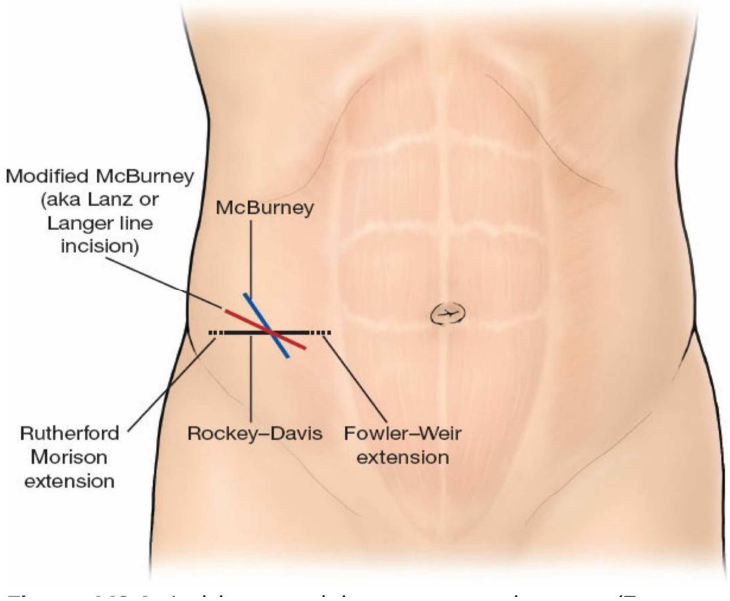



**Fig: 7 Incisions for open appendectomy**

OPEN APPENDECTOMY:

Under all aseptic precautions parts are painted and draped, grid iron incision is taken and same is deepened to visualize fibres of aponeurosis of external oblique muscle. These fibers are split along it's fibers. Internal oblique muscle fibers are separated along its fibers and likewise transversus abdominis muscle fibers were separated along its fibers. Peritoneum is opened.

Where the taenae coli meet there the base is identified. Mesoappendix dissection is done and mesoappendix with appendicular artery ligated. Appendicular base crushed, doubly ligated and cut. Antiseptic is applied at stump. [14]

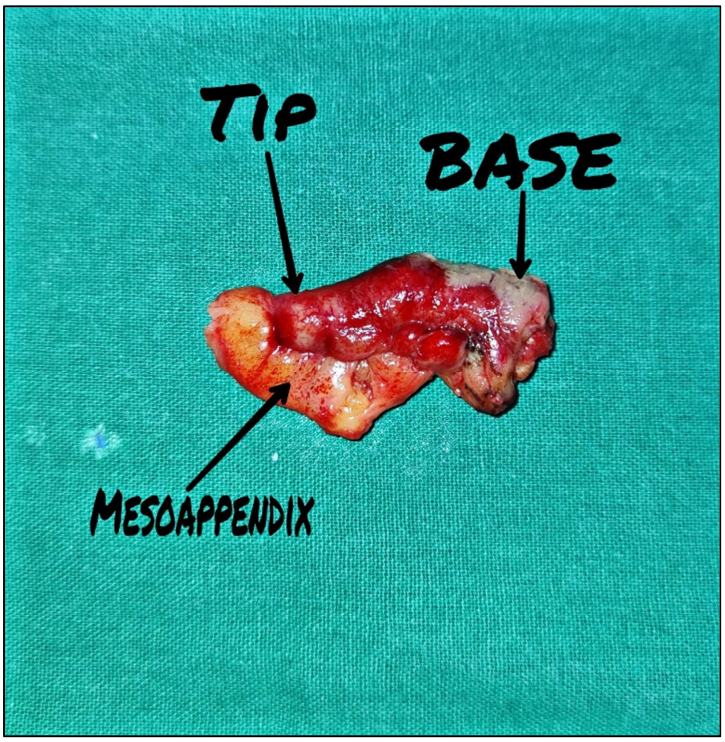



**Fig: 8 Specimen of acute appendicitis**

LAPAROSCOPIC APPENDECTOMY

Under all aseptic precautions parts painted and draped, 10 mm umbilical port is placed, under direct vision 10 mm supra umbilical port and 5 mm port on left side lateral to rectus muscle in between initial two ports are placed. Appendix is visualized in right iliac fossa, mesoappendix dissected and appendicular artery clipped. Base of the appendix is doubly ligated with Roeder's knot and cut above the knot with proximal ligation with another knot. Specimen is retrieved via 10 mm umbilical port. Nowadays single incision laparoscopic appendectomy is also popular with outstanding cosmetic outcome. [15]

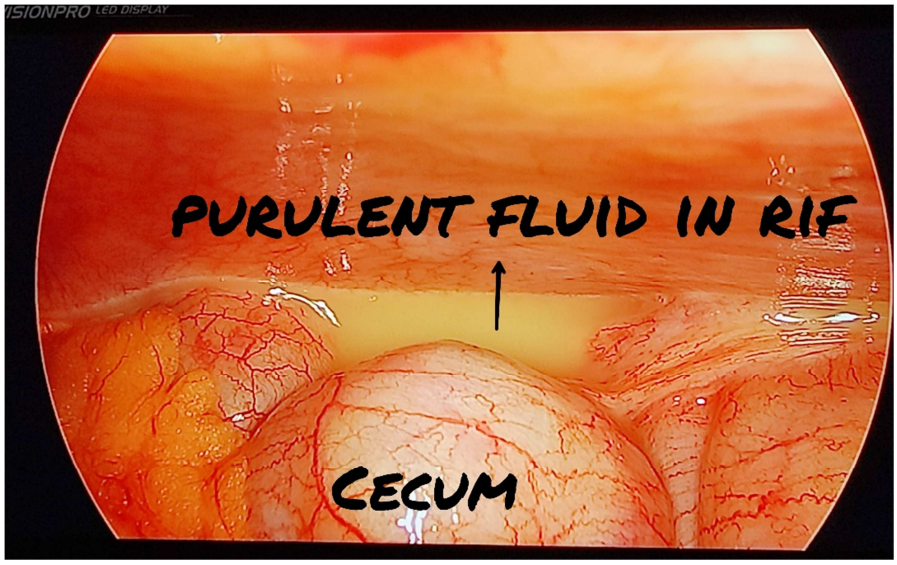



**Fig 9: Laparoscopic view of appendicitis with purulent fluid present in right iliac fossa**

# CRP

C reactive protein is an acute inflammatory marker. The plasma concentration of acute phase reactant proteins increases or decreases with varying degrees of inflammation. They can be classified as positive or negative reactants. Positive reactants indicate increased plasma concentration and negative reactants indicate decreased plasma concentration in response to stimuli.

C-reactive protein was first discovered in 1930 by T. Francis and W.S. Tillet at Avery lab in Rockfeller institute. It was initially thought that CRP might be a pathogenic secretion since it was elevated in a variety of illnesses, including cancer. The later discovery of hepatic synthesis (made in the liver) demonstrated that it is a native protein. CRP was first identified as a substance in the serum of patients with acute inflammation. The substance underwent a reaction with the capsular c- carbohydrate antibody of pneumococcal bacteria. Thus the name CRP was derived.

CRP is a 224- residue protein with a monomer molar mass of 25106 Daltons.[17] CRP gene is located in short arm of chromosome 1.[16] CRP has high binding capacity for bacterial phosphocoline, phosphatidylcholine and sphingomyelin of cell membranes in eukaryotes. CRP can detect internal ligands like damaged cell membranes, plasma proteins, phospholipids, nuclear RBP components and cells undergoing apoptosis. CRP also has got high affinity to external ligands like capsular, phospholipid or cell body elements of bacteria, parasite, fungi and plant particles also. Its main function is to bind and detoxify endogenous toxic substances produced as a result of tissue damage. [18]

Following are the CRP functions:

1. Opsonization of particles for phagocytosis process. (anti-infective effect)

2. CRP helps in the release of PMNs from capillaries, prevent adhesion of WBCs to vessels of healthy tissue and enhances the monocytic release of anti-inflammatory molecules from monocytes.

(anti-inflammatory)

3. Stimulates the complement system (scavenging action)

Factors affecting CRP levels:

1. Ethnicity: Whites have lower levels than blacks

2. Body mass effect: Levels are directly proportional to body weight.

3 Gender: Men have lower levels than women

4. Exercise: decreases the CRP levels

5. Alcohol: decreases its levels

Methods for detection of CRP:

1. Enzyme linked immunoassay

2. Visual agglutination

3. Immunodiffusion

4. Immunoturbidometry

CRP is an prototype pentameric nonspecific acute phase reactant protein produced by the liver in response to inflammation or infection. CRP in blood increases after tissue damage or once inflammation sets in. [19]

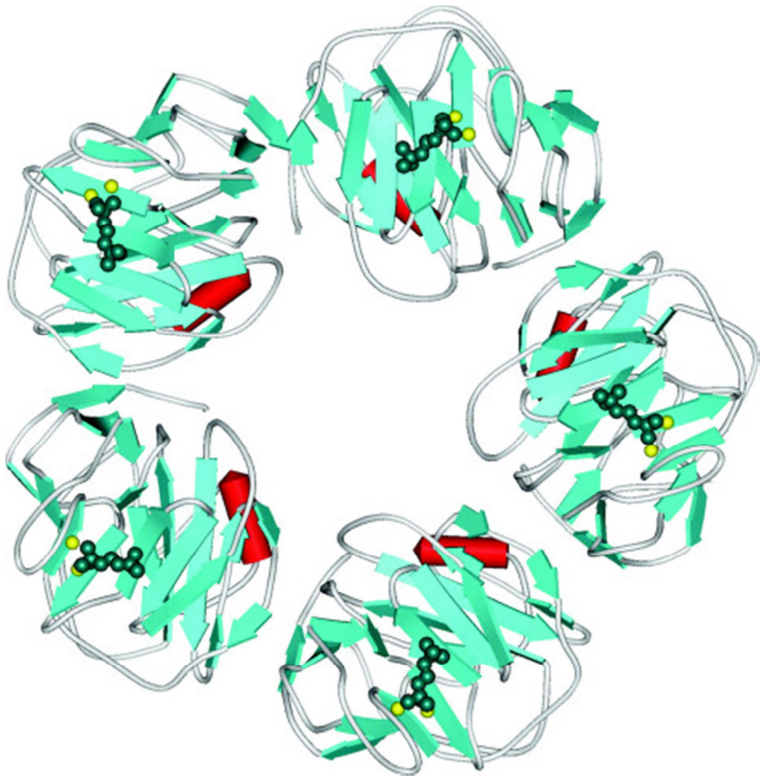


**Fig 10: Pentameric structure of CRP.**

CRP enhances cell mediated immunity by promoting phagocytosis, accelerating chemotaxis and activating platelets. It usually increases 8 to 12 hours after trauma or infection, peaks in one to two days. The CRP levels remains elevated with ongoing tissue destruction/ inflammation. Its half-life is constant, and therefore its level is mainly determined by the rate of production and hence the severity of precipitating cause. [20] With inflammation CRP level rise. This is mainly induced by Interleukin-6's action on the gene responsible for transcription of CRP during the acute phase of an inflammatory or infectious process.

CRP has both anti-inflammatory and pro-inflammatory properties, plays an important contribution in the clearance and identification of foreign particles and cells which are damaged by binding to phospholipids, phosphocoline, histone, chromatin, and fibronectin.[21] Via Fc receptors CRP activates phagocytic cells to enhance the

clearance of damage/ apoptotic cells, foreign pathogens and debris. The classical complement pathway can also be activated by CRP. However, this can be pathological when the classical complement pathway is activated by autoantibodies. This displays phosphocoline arm in the acute immune response such as ITP. Tissue damage is worsened in certain cases by of the complement and thus cytokines related to inflammatory process. [22]

The levels of CRP rise & fall rapidly with the onset, removal of the inflammatory stimulus respectively as compared to ESR which is an indirect test for inflammation. Persistently raised CRP levels can be seen in chronic inflammatory condition like rheumatoid arthritis. Elevated C- reactive protein exists in many chronic and acute conditions which can be non- infectious or infectious. Markedly raised CRP level however are most frequently associated with an infective cause. [23]

Lab have no standard in present though the results are reported in mg/L or mg/dL. Normal concentration of CRP is 0.8 mg/L to 3.0 mg/L, but in acute bacterial inflammation it increases to more than 10 mg/L.

Less than 0.3 mg/L- Normal (level seen in healthy adults). 0.3 to 1.0 mg/L: Normal / minor increase (can be seen in pregnancy, depression, diabetes, obesity, gingivitis, periodontitis, common cold, cigarette smoking, genetic polymorphisms & sedentary life style).

**1.0 to 10.0** mg/L: Moderate increase (in case of systemic inflammation such in body such as RA, lupus or another autoimmune disease, cancer, ischemic heart disease (MI), bronchitis, acute pancreatitis).

**More than 10.0** mg/L: Marked increase (as in acute infection due to bacteria, viral infection, major trauma, systemic vasculitides).

**More than 50.0** mg/L: Severe increase acute infections particularly of bacterial origin. [24]

Increase in CRP values are non-specific and should not be interpreted without a complete clinical history. Taking into account the high variability causality of increased CRP, marginal increase in the CRP can be difficult to evaluate and shouldn't be used as a single test to know the ongoing clinical picture. It is useful in valuable in indicating inflammation versus infection if the levels are highly elevated, but levels in the range of 1mg/L and 10 mg/L can be very difficult to interpret optimally. Chronic conditions, like inflammatory arthritis or systemic lupus erythematosus, can lead to chronically high levels, making it difficult to govern if there is significance to a raised CRP level, when utilizing it as a predictive marker for cardiac disease.

Extremely raised values of CRP, more than 50 mg/L are linked with infections of bacterial origin most of the time (90%). In many studies, CRP was used to know prognosis in acute as well as chronic infections like HCV, dengue fever, and malaria. Mild increase may not be or may be relevant clinically. Clinical correlation is highly advocates during interpretation of CRP levels. [25]

C reactive protein is used widely to in investigation of acute appendicitis with the highly positive likelihood ratio for diagnosing the same, especially when correlated with WBC count. It is considered to be one of the inflammatory markers with highest accuracy for diagnosing acute appendicitis with great NPV. CRP is also a convenient biomarker to assess response to drugs and to look for cases with potential for complications.

Measurement of CRP in suspected appendicitis may improve accuracy of diagnosing acute appendicitis. CRP levels can also help distinguishing pathological types, the degree of inflammation and severity (simple or complicated) which can be used as a tool for reference index for surgery.

Few studies have been done on CRP levels in appendicitis which suggests that CRP aids in the diagnosis of appendicitis.

A study done by Dr. Bhagwan.C. Balagoapl, et al' (over a time of one year i.e from Jan 2013 to Jan 2014) on role serum CRP in diagnosis of acute appendicitis in Kempegowda Medical Institute, Bangalore in which preoperative investigations of TLC and CRP was done and was correlated with the histopathology of the removed appendix which included 100 patients. Eighty five patients (85%) had appendicitis proven hsitologically and 15% underwent negative appendicectomy. CRP levels was raised in 76.55% of histopathologically proven acute appendicitis cases. Of the fifteen patients who had histologically normal (negative) appendix, fourteen (93%) had CRP levels negative.[26]

A study done by Dr.Usharani Rathnam, et al in general surgery dept of ESIC Medical institute, Bengaluru, from Jan 2017 to Dec 2017 to know importance of CRP as a diagnostic tool in acute appendicitis which concluded that an raised serum CRP level aid the diagnosis of surgeon and hence avoid the chances of error in diagnosis, in cases who present atypically. Likewise a normal pre-operative CRP level in patients of suspected appendicitis is mostly associated with normal appendix on histology.[27]

A retrospective study done by Dr. Mazhar H. Raja, et al at department of General Surgery, Milton Keynes university Hospital NHS Foundation trust, United Kingdom in period of 2013-2014, in which 200 patients were included, CRP levels

were checked preoperatively and later based on histology appendicitis was classified in pathological types in which it was concluded that very raised CRP levels are likely to be seen in association with necrotizing appendicitis, CRP of forty or more can be associated with suppurative appendicitis. CRP of more than hundred and less than one fifty may point towards possibility of gangrenous & perforated appendicitis. [28]

A study done by Dr. Bandana Kumari, et al in CRP was evaluated in 200 patients before surgery but wasn't considered in the decision making for appendicectomy. All two hundred appendixes were sent to lab for HPE. The study concluded that specificity, sensitivity, negative predictive value, positive predictive value and diagnostic accuracy of CRP were much greater than leucocyte count.[29]

# MATERIALS AND METHODS

This was a cohort (prospective) study conducted under the department of general surgery in KLES Dr. Prabhakar Kore medical centre and Hospital, Belagavi during the period of Jan 2020 to Dec 2020, in patients who were clinically diagnosed of having appendicitis and posted for appendectomy.

**STUDY DESIGN**:

A one year hospital based prospective study

**METHOD OF COLLECTION OF DATA**:

Preoperatively blood for CRP was withdrawn from patients of appendicitis on admission. All specimens of appendix were subjected to histopathologic examination postoperatively which were taken as final diagnosis, result of CRP were correlated with histology reports to evaluate the role of CRP in diagnosing appendicitis.

**METHOD OF SAMPLING**: Universal sampling method

**INCLUSION CRITERIA**:

All patients of 10 years or elder who had clinical diagnosis of acute appendicitis and underwent appendectomy in KLE Dr. Prabhakar Kore hospital and research centre, Belagavi.

**EXCLUSION CRITERIA** :

1. Patients not giving consent for the study
2. Patients who are being managed conservatively
3. Concomitant diagnosed cases where WBC count/ CRP levels is raised in acute appendicitis, like cases with associated illness like: systemic lupus erythematosus, rheumatoid arthritis, nephritits, inflammatory bowel disease, gouty arthritis.

4. Patients with right lower quadrant pain other than appendicitis like crhon's disease, pancreatitis, urinary tract infection (diagnosed by history of increased frequency or burning micturition & on routine urinalysis) and pelvic illnesses in females (PID diagnosed by history of whitish colored discharge per vaginum and on ultrasonographic evaluation of pelvis)

**Formula** for sample:

The minimum size based on rate of prevalence is

$N = z\ \alpha^2\ P(1-P)/\ d^2$

Where d is the percentage likely difference in prevalence, p is the percentage of prevalance. Z α is linked with the level of significance. For 5% level of the significance Z α = 1.96. Ref: With P = 76.5% and d = 12.5% of P = 9.56%, the sample size is 76

To make the study further confirmative, sample size will be taken to 100.

**STATISTICAL ANALYSIS**:

The analytical plan for this observational study was follows. The CRP and histopathology reports were correlated. True positive, false positive, true negative and false negative samples were taken. True positive were in which CRP levels were raised and features of acute appendicitis were present on histopathological examination. False positive were cases in which CRP levels were not raised but features of acute appendicitis were present on histopathology. True negative were cases in which CRP was not raised and also there were no features of acute appendicitis on histopathology. False negative were cases in which CRP values was

normal but histopathology had features of acute appendicitis. Sensitivity, specificity, negative predictive value and positive predictive value was calculated using graphpad prism software version 9. Also a comparative analysis was done in between suppurative and perforated appendicitis.

**SAMPLING PROCEDURE AND METHOD OF COLLECTION OF DATA**:

Clinical diagnosis of appendicitis was done in surgery department, based on patient's complains of fever, nausea & vomiting, anorexia, pain migration and signs of localized or generalized peritonitis. Patients underwent routine evaluation as per protocol of hospital. A blood sample for CRP was taken from all the patients clinically suspected to have acute appendicitis by registered nursing staff and was sent to the lab in an hour of withdrawing sample. CRP levels were measured by particle enhanced immunoturbidometric assay by an experienced lab technician. Ultrasonography/ CECT of abdomen was done in all cases to confirm the diagnosis and rule out other causes of pain in the abdomen. CRP greater than 10 mg/dl was considered as positive test. Patients with strong suspicion of acute appendicitis were advised appendectomy. After obtaining consent, patient was operated and the appendectomy specimen was sent in a sterile container with 10% formaldehyde for histopathological examination in histopathology department of JN medical college. The histopathological examination report was taken as the final ultimate diagnosis. Acute appendicitis was defined by predominant neutrophilic infiltration beyond muscularis propria layer and associated mucosal ulceration and inflamed swollen appearance on gross examination. Chronic appendicitis was defined as submucosal lymphoid hyperplasia and slender thick cord like structure on gross examination. Breach in serosa was defined as perforated appendicitis.

CRP levels were obtained from automated machine (Cobas c system) operated by a trained lab technician.


**Fig 11: Cobas c system to detect CRP levels**

## RESULTS

This study shows that maximum number of cases were in the age group 20 to 29 years. A major part of the study were males 55%, whereas females accounted for 45%.

While pain abdomen was the presenting symptom in all cases under study it was followed by vomiting (58%), fever (42%) and urinary and bowel complaints in 23 % cases.

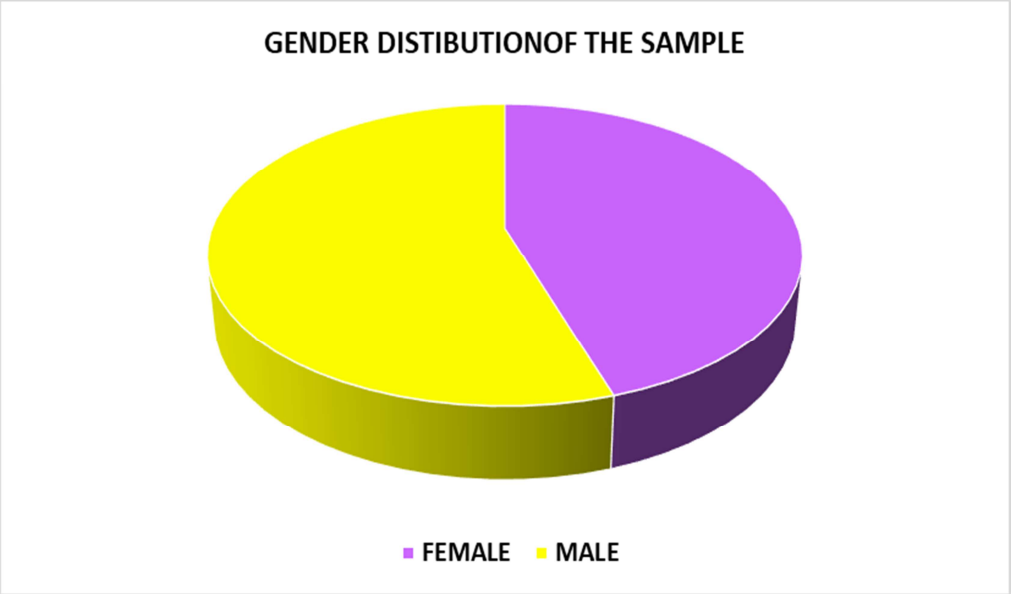
22 % patients had previous abdominal surgery history. 18 % of the female patients also had history of menstrual abnormalities.

In present study majority of cases had right iliac fossa tenderness at initial presentation (95%) along with rebound tenderness (45%), guarding (32%) and per rectal tenderness (18%). Rovsing sing, psoas test and obturator test were present in 15 %, 20 % and 8 % respectively. Liver dullness was obliterated in 8 % patients

USG was done in 72% cases and CT was performed in 28 % cases. TLC > 10000 cells/cmm was seen in 54% patients. Of HPE proved acute appendicitis, raised TLC was present in 60% and raised CRP levels were present in 91% of patients. Conversion to open was done in 16% cases.

**Table no. 1- Total number of patients were 100 out of which female were 45 and male were 55**

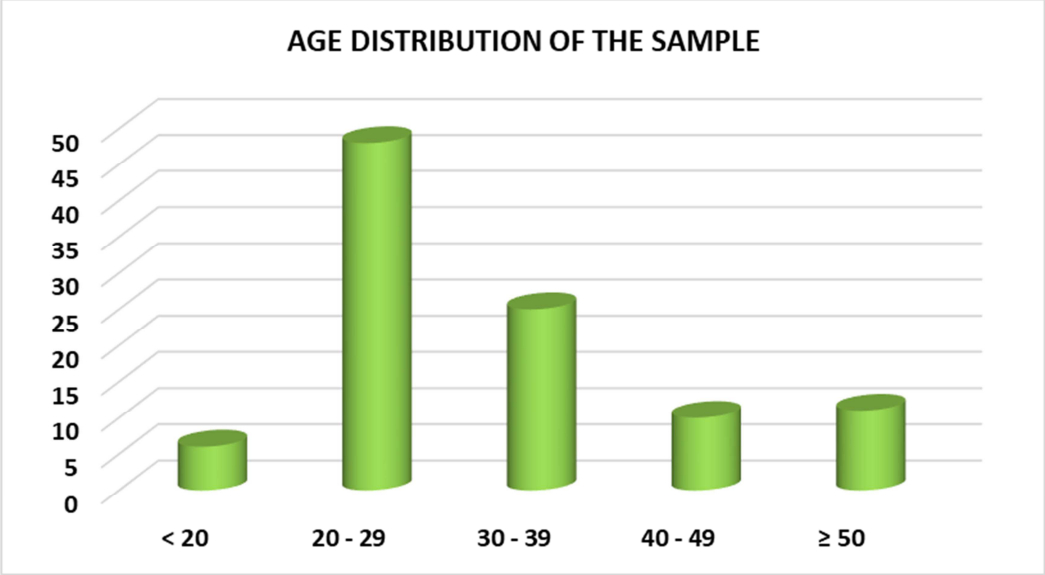
| GENDER | NUMBER |
|---|---|
| **FEMALE** | 45 |
| **MALE** | 55 |
| **TOTAL** | 100 |




**Graph 1- Pie diagram demonstrating gender distribution**

**Table 2- Maximum number of patients (48) in this study were in 20 to 29 years age group and least number of patients (6) were in < 20 year age group.**

| AGE | NUMBER |
|---|---|
| **< 20** | 6 |
| **20 - 29** | 48 |
| **30 - 39** | 25 |
| **40 - 49** | 10 |
| **≥ 50** | 11 |
| **TOTAL** | 100 |




**Graph 2- Graph demonstrating age distribution.**

**Table 3- Correlation in between CRP levels and histopathology report**

| HISTOPATHOLOGY REPORT | | | |
|---|---|---|---|
| **CRP LEVEL** | **ACUTE APPENDICITIS** | **CHRONIC APPENDICITIS** | **TOTAL** |
| **< 10** | 7 | 8 | 87 |
| **≥ 10** | 79 | 6 | 13 |
| **TOTAL** | 86 | 14 | 100 |

Of the 14 patients who had chronic appendicitis on HPE, 42% (6 patients) had positive CRP, 58 % (8 patients) had negative CRP. Of 86 patients who had acute appendicitis on HPE, 91% (79 patients) had positive CRP, 9% (7 patients) had negative CRP.

**Table 4- Percentage distribution suppurative versus perforated appendicitis in acute appendicitis group**

| **Acute appendicitis** | Suppurative | Perforated |
|---|---|---|
| 86 | 73 (84%) | 13 (16%) |

In acute appendicitis group 13 patients (16%) out of 86 patients had perforated appendicitis and 73 (84%) had acute suppurative appendicitis on HPE. In all 13 patients CRP value was more than 50 mg/L.

**Table 5- Sensitivity, specificity, PPV and NPV.**

| | |
|---|---|
| **SENSITIVITY** | 91.86 % |
| **SPECIFICITY** | 42.86 % |
| **POSITIVEPREDICTIVE VALUE** | 90.80 % |
| **NEGATIVE PREDICTIVE VALUE** | 46.15 % |
| **DIAGNOSTIC ACURACY** | 85.00 % |

The **sensitivity** and **specificity** of serum CRP is **91.86 %** and **42.86 %** respectively. The positive predictive value is 90.80% and negative predictive value is 46.15%. The overall diagnostic accuracy is 85 %.

# DISCUSSION

The present study conducted at our institute gives an insight into the utility of CRP as a diagnostic tool in itself and some interesting fact about appendicitis in general.

Diagnosis of acute appendicitis is still challenging even after the advent of computed tomography, ultrasonography and diagnostic laparoscopy. Current study was undertaken to reduce this dilemma. There has always been a discussion on diagnosing acute appendicitis clinically. In difficult situations, surgeons have dilemma to whether manage patient conservatively by intravenous antibiotics or to go ahead with surgical removal of appendix. Many physical symptoms and signs are neither sensitive nor specific. Hence a diagnostic aid which specifically depicts the presence and severity of inflammation or infection is necessary.

Nonsurgical treatment of appendicitis has also been documented with good success. The traditional practice of an interval appendectomy has been called into question by some, indicating that the patients who do not have recurrent episodes of appendicitis within 3 to 6 months mat never require an appendectomy. Hence the clinician often wonders whether a patient with appendicitis needs to receive surgical treatment or to be managed with antibiotics. After a patient is diagnosed with appendicitis, clinician generally want to determine the severity before they can select the optimal treatment. If a clinician could predict the severity of appendicitis, one could determine the therapeutic method and timing of the intervention. A surgical indication marker such as WBC, neutrophil percentage/ CRP would be useful for deciding between treating the patient with surgery or antibiotics. [30]

Also interpreting CRP levels in suspected cases of appendicitis with multiple co-morbidities or any other chronic inflammatory condition is difficult hence such cases were excluded in this study, which remains the drawback.

The results of the present study shows that CRP though not specific (42.86%) but is sensitive (91.86%) with high PPV (90.80%) and less NPV (46.15%) & with overall diagnostic accuracy of 85%.

The case positivity rate is equivalent with previously done studies, 86% patients had acute appendicitis, and 14% patients had chronic appendicitis on histological examination.

The 79 patients who had histologically proven appendicitis also had raised CRP levels, which correlates quite well numerically.

The 9 % patients with histologically proven appendicitis did not have raised CRP levels. It can be due to antibiotic administration before patient presented to our institute. It can also be due to natural course in which infection has settled down on its own. And one of the reason can be minimal local inflammation may not lead to raised serum levels of CRP.

14 % patients had histologically proven chronic appendicitis, out of which majority 58% had low CRP levels and rest 42 % had high CRP levels which can be explained either due to other unknown underlying inflammatory condition or this can be the scenario in cases of acute on chronic appendicitis. CRP levels were below 40 mg/L for all 42% HPE proved chronic appendicitis cases with high CRP. In our study no appendix was histologically reported to be normal.

In our study 13 of 86 patients with histopathologically diagnosed acute appendicitis were also noted to have perforated appendix in biopsy report. And all thirteen patients had preoperative CRP levels of more than 50 mg/L which suggests

that quantifying CRP levels preoperatively not only hints the surgeon towards a complicated appendix but also help in preparation to tackle the enhanced inflammatory state especially in cases of perforated or gangrenous appendicitis. It also suggests that CRP helps in determining the degree of inflammation and also points towards pathological type of appendicitis (suppurative vs perforated). Thus, high CRP levels could possibly predict the diagnosis of complicated appendicitis and facilitate more appropriate surgical care. Yokoyama et al. suggest a siginificance level cut off value for CRP (50mg/L) that predicts the likelihood of complex appendicitis. Mazahar et al in their study concluded that very high CRP maybe related to necrostising appendicitis, while CRP above 40 mg/L may suggest suppurative or inflammatory appendicitis. [30][35]

In our study a 24 year old female was admitted with complains of right iliac fossa pain and vomiting. The computed tomography scan of abdomen revealed query ruptured appendix/ ruptured ectopic. On exploration the appendix was found to be normal, and right sided ruptured tubal ectopic pregnancy was seen which was dealt with salpingectomy. The CRP levels in this case was 4 mg/L, which was mildly raised. In acute bacterial infection setting like acute appendicitis, CRP levels as are usually higher than 10 mg/dl. This above mentioned case is an example why abdomen is called a magic box, even with modern computed tomography scan there can be still a diagnostic dilemma. Hence quantifying CRP levels especially in doubtful cases of right iliac fossa pain can be quite fruitful.

This study conducted in our institute explains the utilization of C-reactive protein as a tool for diagnosing in itself. It revealed that most number of cases were in 20 to 29 year age group accounting for 45%. Male to female ratio - 11:9. Most of the patients presented with RIF pain, fever and vomiting. In this study normal CRP value

excluded the diagnosis of acute appendicitis with a positive predictive value of 90.8%. Involvement of muscularis propria layer with neutrophils was taken into account on histopathological examination for diagnosing acute appendicitis. 86 (86%) case had acute appendicitis proved histologically. Out of which serum CRP was significantly raised in 79 patients. The facts proved in this study are equivalent to results shown in another similar studies.

Anderson in a prospective study on 420 patients found CRP accuracy (89 %) is greater than WBC (81%) and neutrophil count (80%) combination of above three increases accuracy too greater than 90 %.[31] Gurleyik et al noted a CRP sensitivity of 96.6 % in 87 of 90 patients with histopathologically proven disease. [32] similarly, Shakhatreh found a CRP sensitivity of 95.5 % in 85 of 89 patients with histologically proven appendicitis. [33] Asfar et al reported a CRP sensitivity of 93.6 % in 78 patients undergoing appendectomy. [34]

As it is a biochemical investigation, there is no doubt of variability in between operators interoperator and other studies along with the this one proves that this test is reliable.

If clinical history and physical examination findings are apparently typical, clinical evaluation should outweigh the utilisation of investigations. But, when the diagnosis of appendicitis is in doubt or is unlikely, the presence of a normal CRP & TLC can reassure the surgeon and allow the patient to be discharge. If one of the marker or both markers are elevated, it would be advisable give patient admission for further evaluation, observations, investigations, and treatment as needed. In these patients, additional investigation (US/CT/diagnostic laparoscopy) will be dictated by local guidelines.

Hence routine use of CRP level determination should be used in diagnosing acute appendicitis. It decreases the surgeon's dilemma and aids him to conclude on an accurate diagnosis. Thus CRP is an invaluable tool and we insist for the need to incorporate this biochemical investigation in the evaluation for routine diagnosis of acute appendicitis.

# CONCLUSION

Although acute appendicitis is one of the commonest abdominal surgical emergency, its diagnosis is still challenging, CRP levels are useful in evaluation of acute appendicitis, if used wisely they may spare a category of patients not only a nonessential surgical procedure but also unnecessary hospital admission for observation.

CRP more than 50 mg/L is an indicator of perforated appendicitis and when the concerned surgeon is in dilemma whether to manage patient conservatively with antibiotic and clinical observation or go ahead with surgical intervention, CRP levels can be a useful aid in the diagnosis. CRP levels were well correlated with severity of acute appendicitis.

Further studies covering all other confounding factors are needed.

## SUMMARY

- The study was done in tertiary care KLE Dr PK hospital and MRC, Belagavi.
- In a study of 100 patients of suspected cases of acute appendicitis, males comprised 55% and females 45%.
- Maximum patients belong to the age group 20 to 29 years
- Pain in right lower quadrant was the most common symptom followed by anorexia and vomiting.
- CRP levels were measured in all cases and all specimens were subjected to histopathological examination.
- Of the 14 patients who had chronic appendicitis on HPE, 42% (6 patients) had positive CRP, 58 % (8 patients) had negative CRP. Of 86 patients who had acute appendicitis on HPE, 91% (79 patients) had positive CRP , 9% (7 patients) had negative CRP
- The sensitivity and specificity of serum CRP is 91.86 % and 42.86 % respectively.
- The positive predictive value is 90.80% and negative predictive value is 46.15%. The overall diagnostic accuracy is 85 %.
- CRP levels are useful in evaluation of acute appendicitis, if used wisely they may spare a category of patients not only a nonessential surgical procedure but also unnecessary hospital admission for observation.
- CRP more than fifty mg/L is an indicator of perforated appendicitis and when the concerned surgeon is in dilemma whether to manage patient conservatively with antibiotic and clinical observation or go ahead with surgical intervention, CRP levels can be a useful aid in the diagnosis.
- In summary, CRP had a guiding role in the choice of surgical treatment for patients with clinical diagnosis of acute appendicitis.

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# ANNEXURE - I - ETHICAL CLEARANCE

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed – to- be- University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)
**JAWAHARLAL NEHRU MEDICAL COLLEGE,**
**NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)**
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Principal: 2471701
Fax No. +91 (0)831 – 2470759

**Ref: MDC/DOME/** 283 **Date: 24/12/2019**

To,
**REG NO. BH0119003**
PG student in Surgery,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"A PROSPECTIVE STUDY TO EVALUATE DIAGNOSTIC EFFICACY OF SERUM CRP LEVELS IN CLINICALLY DIAGNOSED CASES OF ACUTE APPENDICITIS, CONFIRMED BY HPR",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

**(Dr. Anita Dalal)**
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

**(Dr. Roopa M Bellad)**
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

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## ANEXXURE II- CONSENT FORM

**Title Of Research Study:** entitled **"A PROSPECTIVE STUDY TO EVALUATE DIAGNOSTIC EFFICACY OF SERUM CRP LEVELS IN CLINICALLY DIAGNOSED CASES OF ACUTE APPENDICITIS, CONFIRMED BY HPR"**

Principal Investigator -

**REG NO. BH0119003**

Post Graduate Student,

Department Of General Surgery,

JNMC, Belagavi.

Guide -

Dr. _____

Professor and Unit Head,

Department of General Surgery,

JNMC, Belagavi.

### CONSENT FOR PARTICIPATION IN RESEARCH STUDY

Mr./Mrs._____we are requesting you to enroll yourself in study titled "To evaluate the diagnostic efficacy of serum CRP in clinically suspected cases of acute appendicitis, confirmed by HPR" conducted by **REG NO. BH0119003,** postgraduate in M.S General Surgery under the guidance of DR. _____, Professor in Department of General Surgery, J.N. MEDICAL COLLEGE, Belagavi under KAHER, Belagavi.

Respected Sir/ Madam,

We request you to participate in our study. Your participation in the research is voluntary. Your decision to participate in the study or otherwise will not affect the relationship with KLES Prabhakar Kore hospital. If you decided not to participate, you are free to withdraw at any time.

**Purpose of the study:**

This research is intended to evaluate the diagnostic efficacy (yield) of serum CRP levels in clinically diagnosed cases of acute appendicitis. Thus aiding in diagnosis of the same. The principal investigator of the study is **REG NO. BH0119003,** under the guidance of Dr. _____.

**Procedure involved:**

lf you agree to enroll yourself in this study, your detailed history will be taken and you will be clinically examined in detail. Investigations like Hemoglobin, Total Count, Differential sount, Platelet Count, RBS, Blood Urea, Serum Creatinine, Blood Grouping, Chest X-ray, ECG, USG Abdomen and Pelvis, required for confirmation of your diagnosis and for your pre-operative work up will be done accordingly. The cost of investigation, 'Serum CRP levels in the above mentioned study will be borne by the principal investigator of the research. On the basis of clinical diagnosis of acute appendicitis aided by blood and radiological investigations (USG/CT scan), you will undergo Laparoscopic/ Open

Appendectomy under General/ spinal Anesthesia. The appendix specimen obtained will be subjected for Histopathological examination in the same institute, the results of which will be compared to preoperatively obtained serum CRP levels.

**Risks and Benefits:**

There is no increased risk involved in being a part of this study and the complications are those which are normally anticipatedas follows-

A. Intraoperative-

Haemorrhage, hypotension, hypovolemic shock, need for blood/ blood products transfusion, gas embolism.Need for resection anastomosis, inadvertent injury to bowel, bladder or solid abdominal viscera, conversion to open surgery

B. Post operative-

• Surgical site wound infection, wound dehiscence, delayed wound healing, prolonged hospital stay, prolonged paralytic ileus, peritonitis, sepsis, septic shock, intestinal obstruction, DVT, pulmonary thromboembolism, retained fecolith, stump appendicitis, fecal leak port site herniation, need for revision surgery. The results derived at the end of the study will possibly benefit all similar patients admitted in this hospital and elsewhere.

**Withdrawing/removal from the study:**

The participant has freedom to withdraw from the study whenever he/she wishes and without any prior notice. Even if you decline to participate, there will not be any change in the line of your management or the relationship with your doctor. You will be told about all the information that affects your decision to participate in the study. The investigator may also exclude a participant from the study at any point of time.

**Privacy and Confidentiality:**

The only people to know that you are a research subject are members of the research team.No information about you or information provided by you during the research will be disclosed to other without your written permission except:

1. In emergency to protect your rights and welfare.

2. If required by law.

**Institutional/sponsors policy:**

If any unforeseen complications or injury occurs during the period of study, the participant will be given treatment within the limitations of KLES Prabhakar Kore Hospital.

**Financial Incentives for participation:**

The participant neither gets any financial incentives during the period of study nor will be asked to pay for this study.

**Authorization to Publish Results:**

When the results of the research are published, or discussed in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in this study that can be associated with your identity will remain confidential.

# Consent statement

Mode of communication of consent form: Verbal/ Written

Contents: Selfread / Read by Investigator

Participant's awareness regarding voluntary withdrawal from study : Yes/ No

Investigators decision to remove participants from study: Yes/No

Awareness regarding voluntary participation: Yes/ No

Adequate time given to clarify any doubts about the study or rights to study participant: Yes/ No

In case they have any questions related to the study, in future or in case of study related injury or illness, they can contact **REG NO. BH0119003**, Department of General Surgery, KLES Hospital and MRC, Belagavi, Phone number-_____ or DR. _____., Dept. Of General Surgery, KLES Hospital and MRC, Belagavi Phone number: _____.

If they have any queries about their rights as a study subject, they may call DR. ROOPA BELLADM.D., Chairman, and Ethical Committee for Human Subjects Research. Professor, Department of Paediatrics, J. N. Medical College, Belagavi, Phone number-94481 13403.

**Signature or left thumb print of participant or legally authorized representative_____**Participant's name._____

Participant's signature/thumb print_____

Experimenter's name _____Experimenter's signature

Witness name_____Witness signature

_____Date

# CONSENT STATEMENT

I, Mr/Ms/Mrs._____voluntarily agree for the participation as a subject of study. By signing this consent form, I am not giving up any of my legal rights. I may withdraw from the study anytime. I am signing the consent form after having read or been read for me in my vernacular language, including the risks and the benefits and having all my questions answered.

Subject Name: _____

Signature or Left Thumb Print of Subject: _____

Witness Name: _____

Signature: _____

Investigators Name: _____

Signature: _____

Date: _____

Place: _____

**"A PROSPECTIVE STUDY TO EVALUATE DIAGNOSTIC EFFICACY OF SERUM CRP LEVELSIN CLINICALLY DIAGNOSED CASES OF ACUTE APPENDICITIS, CONFIRMED BY HPR"**

# ANNEXURE III – PROFORMA

The proposed proforma/ questionnaire to be used for data collection for the study titled **"A PROSPECTIVE STUDY TO EVALUATE DIAGNOSTIC EFFICACY OF SERUM CRP LEVELS IN CLINICALLY DIAGNOSED CASES OF ACUTE APPENDCITIS, CONFIRMED BY HPR"** is as :

NAME OF THE PATIENT: _____

AGE/SEX: _____

IP NO.: _____

DATE OF ADMISSION: _____

DATE OF OPERATION: _____

**CHIEF COMPLAINTS:**

i. Pain in abdomen : YES/NO
ii. Vomiting/ nausea: YES/NO
iii. Fever: YES/NO
iv. Other complaints:

**HISTORY OF PRESENT ILLNESS:**

**PAST HISTORY:**

History of similar attacks: YES/NO, if yes, duration and treatment taken.

History of previous abdominal surgeries or past medical history.

History suggestive of hypertension/ diabetes/ tuberculosis/ any chronic inflammatory disorders

**PERSONAL HISTORY:**

Habits: tobacco/alcohol consumption

Sleep and appetite:

Bowel and Bladder habits:

**MENSTRUAL and OBSTETRIC HISTORY:**

Age of menarche, menstrual cycles (regularity/dysmenorrhoea/menorrhagia), LMP,

h/o vaginal discharge and marital status.

**GENERAL PHYSICAL EXAMINATION:**

Severity of dehydration to be accessed

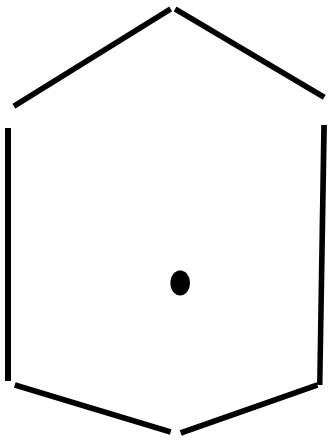
Anema/ jaundice/ clubbing/ cyanosis/ lymphadenopathy/ pedal edema.

BP:__/___ mm Hg. Pulse: _____ bpm

RR: _____ cpm

Temp:_____$^{0}$F

Per Abdomen examination:



Soft : Yes / No

Tenderness (x):_____

Guarding : _____

Rigidity : _____

Bowel sounds : _____

Liver dullness : _____

PER RECTAL EXAMINATION:

INVESTIGATION:

1) CRP LEVEL: ___/ mg/L
2) TLC:
3) DLC:
4) Serum creatinine:
5) USG/ CT scan of Abdomen and Pelvis:

DIAGNOSIS:

**SURGERY PERFORMED:**

Laparoscopic appendectomy/ open appendectomy.

**HISTOPATHOLOGY REPORT:**

**FINAL DIAGNOSIS:**

**POST OPERATIVE PERIOD:**

# Group A

| Serial N0. | IP no. | Age(years) | Sex | CRP levels | Histopathology report |
|---|---|---|---|---|---|
| 1 | 993029 | 29 | M | 22 | Acute appendicitis |
| 2 | 994991 | 29 | M | 18 | Acute appendicitis |
| 3 | 1005288 | 29 | M | 21 | Acute appendicitis |
| 4 | 1009258 | 40 | F | 32 | Acute appendicitis |
| 5 | 1009624 | 37 | F | 557 | Acute appendicitis |
| 6 | 1011261 | 38 | M | 27 | Acute appendicitis |
| 7 | 1013112 | 22 | M | 24 | Acute appendicitis |
| 8 | 1021296 | 25 | M | 35 | Acute appendicitis |
| 9 | 1024597 | 31 | F | 40 | Acute appendicitis |
| 10 | 992877 | 20 | M | 150 | Perforated (acute) appendicitis |
| 11 | 998361 | 22 | F | 16 | Acute appendicitis |
| 12 | 999032 | 19 | M | 15 | Acute appendicitis |
| 13 | 1000252 | 38 | M | 23 | Acute appendicitis |
| 14 | 1005009 | 26 | M | 34 | Chronic appendicitis |
| 15 | 1005429 | 35 | F | 4 | Chronic appendicitis |
| 16 | 1013285 | 50 | M | 60 | Perforated (acute) appendicitis |
| 17 | 1013275 | 39 | M | 65 | Perforated (acute) appendicitis |
| 18 | 1015506 | 30 | M | 27 | Acute appendicitis |
| 19 | 1020515 | 45 | M | 154 | Perforated (acute) appendicitis |
| 20 | 1022664 | 35 | M | 70 | Perforated (acute) appendicitis |
| 21 | 1023477 | 29 | M | 28 | Chronic appendicitis |
| 22 | 1024261 | 29 | F | 26 | Acute appendicitis |
| 23 | 1024864 | 27 | M | 32 | Acute appendicitis |
| 24 | 1005141 | 32 | F | 35 | Acute appendicitis |
| 25 | 994350 | 24 | F | 18 | Acute appendicitis |
| 26 | 994395 | 50 | M | 3 | Chronic appendicitis |
| 27 | 994713 | 31 | F | 28 | Acute appendicitis |
| 28 | 997400 | 36 | M | 28 | Acute appendicitis |
| 29 | 997431 | 28 | F | 6 | Acute appendicitis |
| 30 | 998602 | 45 | M | 24 | Acute appendicitis |
| 31 | 1002498 | 48 | M | 177 | Perforated (acute) appendicitis |
| 32 | 1005525 | 26 | M | 22 | Acute appendicitis |
| 33 | 1006420 | 24 | M | 6 | Chronic appendicitis |
| 34 | 1010832 | 62 | F | 401 | Perforated (acute) appendicitis |
| *35* | 1016460 | 47 | F | 58 | Perforated (acute) appendicitis |
| 36 | 997262 | 30 | F | 26 | Acute appendicitis |
| 37 | 998105 | 26 | M | 32 | Acute appendicitis |
| 38 | 1001515126 | 23 | M | 26 | Chronic appendicitis |
| 39 | 1002737 | 50 | M | 32 | Acute appendicitis |
| 40 | 1004235 | 56 | F | 22 | Acute appendicitis |
| 41 | 1004186 | 57 | F | 16 | Acute appendicitis |
| 42 | 1023689 | 19 | M | 31 | Acute appendicitis |
| 43 | 1025270 | 20 | F | 18 | Chronic  appendicitis |
| 44 | 992949 | 23 | F | 22 | Acute appendicitis |
| 45 | 992771 | 45 | F | 26 | Acute appendicitis |
| 46 | 994104 | 27 | F | 19 | Acute appendicitis |
| 47 | 995933 | 20 | M | 5 | Chronic appendicitis |
| 48 | 996459 | 21 | M | 31 | Acute appendicitis |
| 49 | 998594 | 20 | M | 23 | Acute appendicitis |
| 50 | 1000940 | 27 | M | 24 | Acute appendicitis |
| 51 | 1002044 | 23 | F | 18 | Acute appendicitis |

| | | | | | |
|---|---|---|---|---|---|
| 52 | 1002965 | 59 | F | 21 | Chronic appendicitis |
| 53 | 1033914 | 24 | F | 3 | Acute appendicitis |
| 54 | 1034232 | 28 | F | 24 | Acute appendicitis |
| 55 | 1036591 | 29 | M | 28 | Acute appendicitis |
| 56 | 1038596 | 20 | M | 27 | Acute appendicitis |
| 57 | 1038684 | 25 | M | 25 | Acute appendicitis |
| 58 | 1040060 | 20 | F | 6 | Chronic appendicitis |
| 59 | 1043498 | 38 | F | 36 | Acute appendicitis |
| 60 | 1025953 | 21 | F | 62 | Acute appendicitis |
| 61 | 1031285 | 53 | M | 241 | Perforated (acute) appendicitis |
| 62 | 1032099 | 31 | M | 12 | Acute appendicitis |
| 63 | 1033779 | 25 | M | 6 | Acute appendicitis |
| 64 | 1033417 | 44 | M | 31 | Acute appendicitis |
| 65 | 1048260 | 49 | M | 4 | Acute appendicitis |
| 66 | 1029072 | 46 | M | 182 | Perforated (acute) appendicitis |
| 67 | 1030346 | 24 | M | 34 | Acute appendicitis |
| 68 | 1031032 | 55 | F | 348 | Perforated (acute) appendicitis |
| 69 | 1033202 | 26 | M | 41 | Acute appendicitis |
| 70 | 1035017 | 35 | F | 38 | Acute appendicitis |
| 71 | 1035057 | 44 | F | 36 | Acute appendicitis |
| 72 | 1035899 | 58 | F | 24 | Acute appendicitis |
| 73 | 1035650 | 26 | F | 6 | Chronic appendicitis |
| 74 | 1035665 | 36 | F | 33 | Acute appendicitis |
| 75 | 1035971 | 25 | M | 40 | Acute appendicitis |
| 76 | 1036781 | 35 | M | 62 | Acute appendicitis |
| 77 | 1036777 | 30 | F | 34 | Acute appendicitis |
| 78 | 1042081 | 20 | M | 163 | Perforated (acute) appendicitis |
| 79 | 1003667 | 24 | M | 42 | Acute appendicitis |
| 80 | 1005932 | 19 | M | 42 | Acute appendicitis |
| 81 | 1017462 | 39 | F | 37 | Chronic appendicitis |
| 82 | 1036239 | 32 | F | 34 | Acute appendicitis |
| 83 | 1039545 | 18 | M | 3 | Acute appendicitis |
| 84 | 1039801 | 30 | F | 4 | Acute appendicitis |
| 85 | 1031136 | 21 | F | 26 | Acute appendicitis |
| 86 | 1033656 | 31 | M | 23 | Acute appendicitis |
| 87 | 1034336 | 25 | F | 21 | Chronic appendicitis |
| 88 | 1039407 | 28 | F | 50 | Acute appendicitis |
| 89 | 1040230 | 18 | M | 17 | Acute appendicitis |
| 90 | 1035308 | 27 | F | 33 | Acute appendicitis |
| 91 | 1036383 | 56 | F | 110 | Perforated (acute) appendicitis |
| 92 | 1045919 | 19 | M | 44 | Acute appendicitis |
| 93 | 1045930 | 34 | M | 27 | Acute appendicitis |
| 94 | 1031778 | 32 | F | 52 | Acute appendicitis |
| 95 | 1035551 | 31 | M | 40 | Chronic appendicitis |
| 96 | 1034679 | 22 | M | 26 | Acute appendicitis |
| 97 | 1037184 | 27 | M | 42 | Acute appendicitis |
| 98 | 1040392 | 24 | F | 5 | Acute appendicitis |
| 99 | 930364 | 23 | F | 44 | Acute appendicitis |
| 100 | 1028613 | 22 | F | 36 | Acute appendicitis |