

**STUDY ON EVALUATION OF SERUM
BILIRUBIN IN ACUTE APPENDICITIS AND ITS
CREDIBILITY IN PREDICTING ITS SEVERITY**

Dissertation submitted to

DR.TN.M.G.R.MEDICAL UNIVERSITY

In partial fulfilment of the requirement for the degree of

M.S DEGREE EXAMINATION

BRANCH I-GENERAL SURGERY



THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY

CHENNAI-600032

APRIL 2014

CERTIFICATE

This is to certify that this dissertation in **“STUDY ON EVALUATION OF SERUM BILIRUBIN IN ACUTE APPENDICITIS AND ITS CREDIBILITY IN PREDICTING ITS SEVERITY”** is a bonafide work done by **Dr.P.L.THIRUMANIKANDAN** under my guidance during the period 2011–2014. This has been submitted in partial fulfilment of the award of M.S. Degree in General surgery (Branch–I) by The Tamilnadu Dr.M.G.R. Medical University, Chennai.

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DECLARATION

I, **Dr. THIRUMANIKANDAN. P.L**, solemnly declare that the dissertation titled “**STUDY ON EVALUATION OF SERUM BILIRUBIN LEVEL IN ACUTE APPENDICITIS AND ITS CREDIBILITY IN PREDICTING ITS SEVERITY**” was done by me at the Chengalpattu medical college hospital, during 2011-2014 under the guidance of my unit chief **Prof.V.MOHANRAJ M.S.**

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Last but not least, my sincere thanks to all our patients, without whom this study would not have been possible.

Date :

Place :

(DR.P.L.THIRUMANIKANDAN)

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LIST OF ABBREVIATIONS USED

ALP	-	alkaline phosphatase
CRP	-	c- reactive protein
CT	-	computed tomography
Dl	-	deciliter
DLC	-	differential count
E.Coli	-	Escherichia coli
ELISA	-	enzyme linked immunosorbent assay
Gm	-	gram
HbsAg	-	hepatitis B surface antigen
IL-6	-	interleukin 6
LFT	-	liver function test
Mg	-	milligrams
ml	-	milliliter
Mm	-	millimeter
NPV	-	negative predictive value
OR	-	odds ratio
PPV	-	positive predictive value
SB	-	serum bilirubin
SGOT	-	serum glutamic oxaloacetic transaminase
SGPT	-	serum glutamine pyruvic acid
SMV	-	superior mesenteric vein
Sr	-	serum
TLC	-	total leucocyte count
TNF	-	tumour necrosis factor
USG	-	ultrasonography
WBC	-	white blood cells

Key to master chart

AA	-	Acute appendicitis
ALP	-	Alkaline phosphatase
AP	-	Appendiceal perforation
C	-	Complicated appendicitis
dL	-	Deceliters
DLC	-	Diffenrential count
F	-	Female
I	-	Inflammed appendix
M	-	Male
mg	-	Miligrams
mm	-	Milimeters
N	-	Normal appendix
SGOT	-	Serum glutamic oxaloacetic transaminase
SGPT	-	Serum glutamic pyruvic transaminase
TLC	-	Total leucocyte count

INSTITUTIONAL ETHICS COMMITTEE

CHENGELPETTU MEDICAL COLLEGE & HOSPITAL, CHENGELPETTU

APPROVAL OF ETHICAL COMMITTEE

TO

Dr. P. L. Thirumanikandan

Dear Dr.

The Institutional Ethical committee of Chengalpattu Medical College & Hospital reviewed and discussed your application to conduct the clinical trial /dissertation work entitled

Study on evaluation of serum bilirubin level in Acute Appendicitis

On 14/2/13

The following documents reviewed

- a. Trial protocol, dated-----version no
- b. Patient information sheet and informed consent form in English and/or vernacular language.
- c. Investigators Brochure ,dated-----version
- d. Principal investigators current
- e. Investigators undertaking

The following members of the Ethics committee were present at the meeting held on

Date 14/2/13 time 1.40pm place Chengalpattu Medical college

J. P. S.
14.2.13, -----Chairman Ethics committee

[Signature]
14/2/13 -----member secretary of Ethics committee

Name of each member with designation

Biological scientist



Clinical member

1



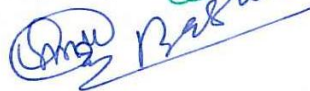
2.



Nonclinical member



Lawyer



Member from nongovernment voluntary



Organisation

Philosopher



Lay person



We approve the clinical trial to be conducted in its presented form

The Institutional Ethics committee expects to be informed about the progress of the study, and any SAE occurring in the course of the study, any changes in protocol and patient information/informed consent and asks to provide copy of final report.

Yours sincerely


14/2/13

Member secretary, Ethics committee

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9 INTRODUCTION

Acute appendicitis is the most common surgical condition presenting at emergency. Appendicitis had been evolved through ages depicting the importance of prompt diagnosis and appropriate treatment.

Even in the era of new diagnostic modalities being available, diagnosis of appendicitis is still more clinical. Even in the hands of experienced surgeon misdiagnosis of appendicitis is 15.3%. According to mangot there are 36

negative appendicectomy done globally to prevent single case of appendicitis

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ABSTRACT

Background and subjectives

Acute appendicitis is the most common surgical emergency in the second and third decades of life. Despite the availability of modern imaging modalities, diagnosis of appendicitis is still more clinical and the dilemma still continues because of the non-availability of imaging techniques at most of our set up during emergency. The present study was done to assess the relationship between hyperbilirubinemia and acute appendicitis and to evaluate its credibility as a diagnostic marker for acute appendicitis and also its predictive potential in diagnosis of appendicular perforation.

Methodology

This one year cross sectional study was conducted in the department of general surgery, Chengalpattu medical college and hospital during the period of December 2012 to November 2013. A total of 100 patients with clinical diagnosis acute appendicitis or appendicular perforation were studied. The serum bilirubin and liver function tests were carried out in all the patients.

Results

In this study, male (62%) outnumbered females (38%) and overall the mean age was 28.96 ± 9.9 . The mean total serum bilirubin of all 100 patients was 1.77 ± 0.94 mg/dl which was above the normal range (>1.0 mg.dl)

considered for the study, hence indicating the presence of hyperbilirubinemia. The mean of direct bilirubin was 1.25 ± 0.88 mg/dl while that of indirect bilirubin was 0.49 ± 0.2 mg/dl.

Among the patients with inflamed appendix, 53 patients (82%) were found to have elevated bilirubin (>1.0 mg/dl). In patients diagnosed with appendicular perforation (n=23), 19 patients (84%) had bilirubin elevated (>1.0 mg/dl), while only 4 patient (16%) had normal level (<1.0 mg/dl). Thus hyperbilirubinemia was seen in 82% of patients with acute appendicitis and 84% of patients with complicated appendicitis.

Sensitivity and specificity of bilirubin in diagnosing acute appendicitis and appendiceal perforation was 81.82% and 83.33% respectively. Similarly positive predictive value and negative predictive value of bilirubin was 97.33% and 38.46%. The Odd's ratio was calculated to be 22.5.

Conclusion and interpretation

Serum bilirubin routinely added to the blood investigation can be useful laboratory investigation for aiding in the diagnosis of acute appendicitis. Can be easily done and cheaply available. Patients with three times the normal bilirubin value and clinical signs of appendicitis and appendicular perforation have higher probability of having complicated appendicitis.

Keywords

Acute appendicitis, appendicular perforation, hyperbilirubinemia, serum bilirubin.

Key to master chart

- AA - Acute appendicitis
- ALP - Alkaline phosphatase
- AP - Appendiceal perforation
- C - Complicated appendicitis
- dL - Deceliters
- DLC - Diffenrential count
- F - Female
- I - Inflammed appendix
- M - Male
- mg - Miligrams
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- SGOT - Serum glutamic oxaloacetic transaminase
- SGPT - Serum glutamic pyruvic transaminase
- TLC - Total leucocyte count

INTRODUCTION

Acute appendicitis is the most common surgical condition presenting at emergency^{1,2}. Appendicitis had been evolved through ages depicting the importance of prompt diagnosis and appropriate treatment.

Even in the era of new diagnostic modalities being available, diagnosis of appendicitis is still more clinical. Even in the hands of experienced surgeon misdiagnosis of appendicitis is 15.3%³. According to maingot there are 36 negative appendicectomy done globally to prevent single case of appendicitis per se.

And again even late diagnosis can be potentially life threatening leading to perforation, abscess, peritonitis and sepsis. Hence diagnosis of appendicitis must be early and at same time to avoid unnecessary surgical morbidity due to negative appendicectomy.

Impact of surgical exploration can lead to anaesthetic complication; abdominal wall muscle weakness leading to future hernia, post-operative adhesion and in pregnancy can cause fetal loss. Lastly an abdominal scar.

Even an experienced surgeon makes his diagnosis based on clinical findings, history and laboratory values which is only 80% positive⁴. Due to non-availability of ultrasonography and CT in the rural setting and with urge to reduce the number of negative appendicectomy and delay in

diagnosis of complicated appendicitis. There arise gap in available diagnostic markers. Though WBC count , CRP ,Alvarado scoring are used. Recent studies on rise in bilirubin value with high specificity and comparable sensitivity than former seems to be easily done laboratory marker.

Appendicitis mostly polymicrobial in nature ,cause bacterial translocation into the gut.They in turn release endotoxin and stimulate the production of pro inflammatory cytokines(TNF , IL1), These molecules reach the liver via portal venous flow causing hepatocyte dysfunction, preventing the release of bilirubin and cholestatic type of jaundice.

Based on these observation ,present study was done to emphathize the predictive value of hyperbilirubinemia in appendicitis and potential to detect appendicular perforation.

AIMS AND OBJECTIVES

The objectives of the present study were:

1. To study the association between hyperbilirubinemia and acute appendicitis and to ascertain its credibility as a laboratory marker aiding in diagnosis of acute appendicitis.
2. To evaluate its positive predictive potential in diagnosis of appendiceal perforation and its severity.

HISTORICAL ASPECTS⁶⁴

The first to describe appendix was physician anatomist DaCarpi in 1521. Drawings of Leonardo da Vinci in 1492 and adreas Vesalius in 1543 “De Human Corporisfabria” depicted appendix⁵. But studies of Morgagni in 1719 was the first to publish gross anatomical details of appendix.

In eighteenth century Egyptians referred it has worms of intestine, only in nineteenth century appendix was identified as an organ capable of causing disease. Various terms typhilitis –perithyphilitis were used for disease of right iliac fossa. In 1886 Dr Reginald F Fitz presented a paper entitled “perforating inflammation of vermiform appendix”. Fitz also urged emergency removal of inflamed appendix⁶. Term appendicitis becomes popular thereafter.

Previously surgery for appendicitis was incision and drainage, until Claudius Amayand first operated a case of scrotal hernia with fecalfistula, found inflamed appendix as content⁵⁵. He then performed first appendectomy of history.⁷

Dr. oschner in 1902, in his handbook of appendicitis suggested a non operative treatment of spreading peritonitis and interval appendectomy.

Contribution of Dr. CharlesMcBurney to appendix is incredible, he changed midline incision to grid iron incision with centered on Mcburney’s point “maximum tenderness, when one examines with the

fingertips is, in adults, one half to two inches inside the right anterior spinous process of the ilium on a line drawn to the umbilicus”⁸.

Dawbarn recommended use of purse string suture of base of appendix in the caecum later abandoned due to post-operative haemorrhage into caecum but it is widely practised nowadays⁹.

Finally with advent of antibiotics and knowledge of fluid resuscitation, mortality and morbidity were greatly reduced.

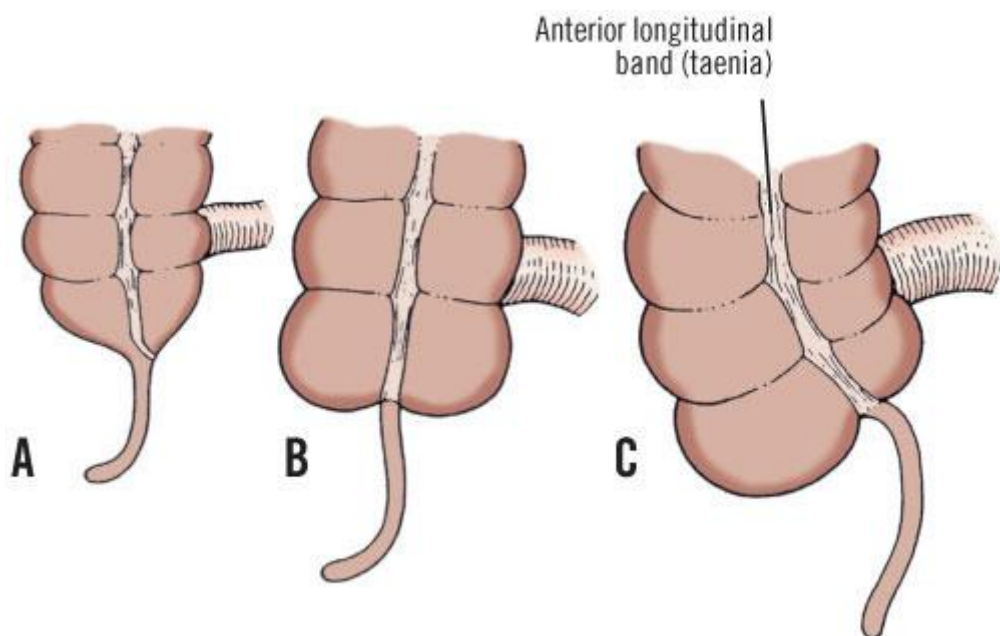
With rising trend of laparoscopy in late nineties, Kurt Semm, German gynaecologist first performed laparoscopic appendicectomy in 1980.

REVIEW OF LITERATURE

EMBRYOGENESIS^{2,10}

Appendix develops at terminal portion of embryological cecum. It is distinguished because of its discrepancy in growth with cecum. Even in postnatal life it continues, with diameter of colon 4.5 times that of appendix at birth and 8.5 times at maturity.

Appendix and caecum are seen as outpouching from the terminal portion of midgut loop at 6th -8th week of gestation. Initially seen at apex of caecum, as caecum grows it shifts to posteromedial wall of caecum, distal to ileocaecal valve. But in 10-15% of individuals it fails to shift. In such cases appendix is funnel shaped.



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VARIATIONS IN POSITION OF APPENDIX:^{15,16}

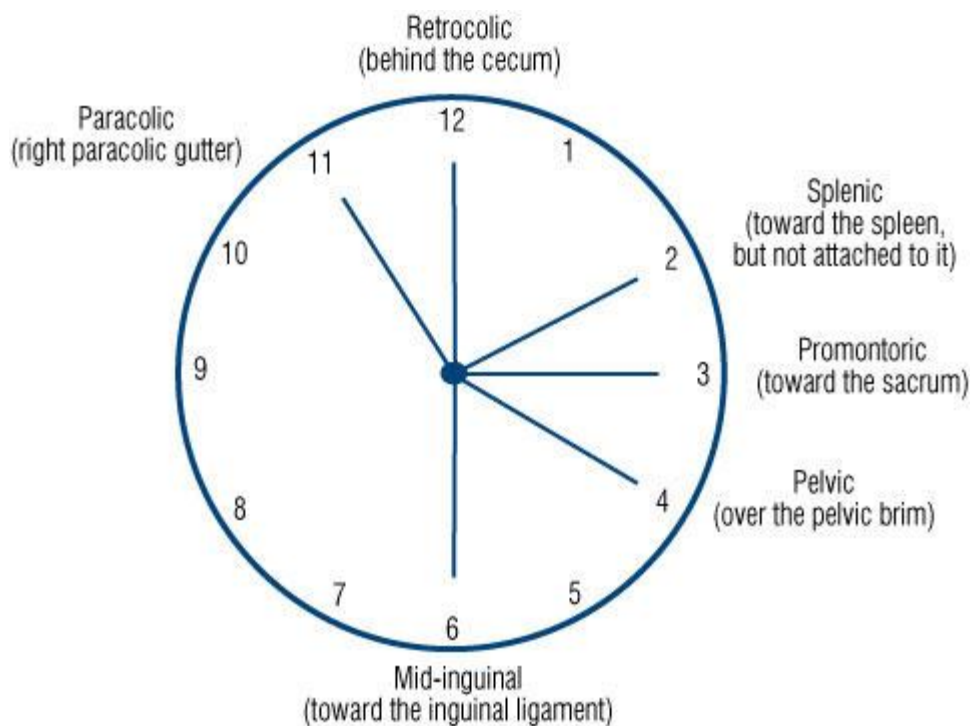
Base of appendix can be found constantly tracing the taenia of colon. Position of tip of appendix varies sometimes a serious challenge for surgeons¹¹.

Sir federick treves explained it on basis of clock position⁶¹.

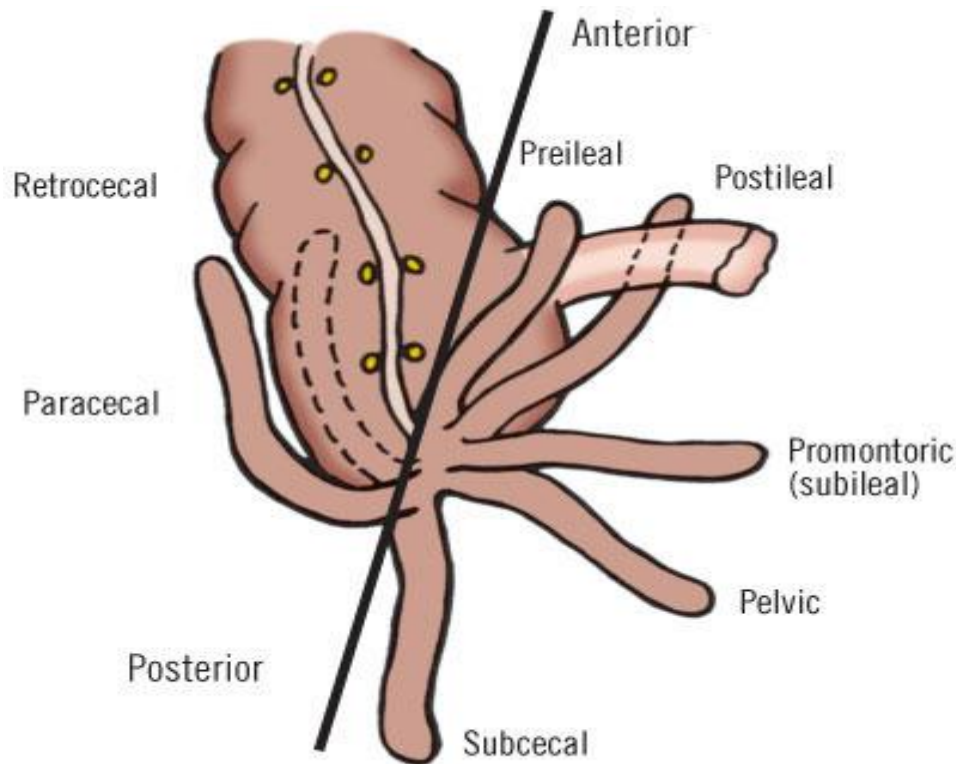
Retrocaecal - 74%, Pelvic - 21%

Paracaecal - 2%, Preileal - 1%

Subcaecal - 0.5%, Postileal - 1%.



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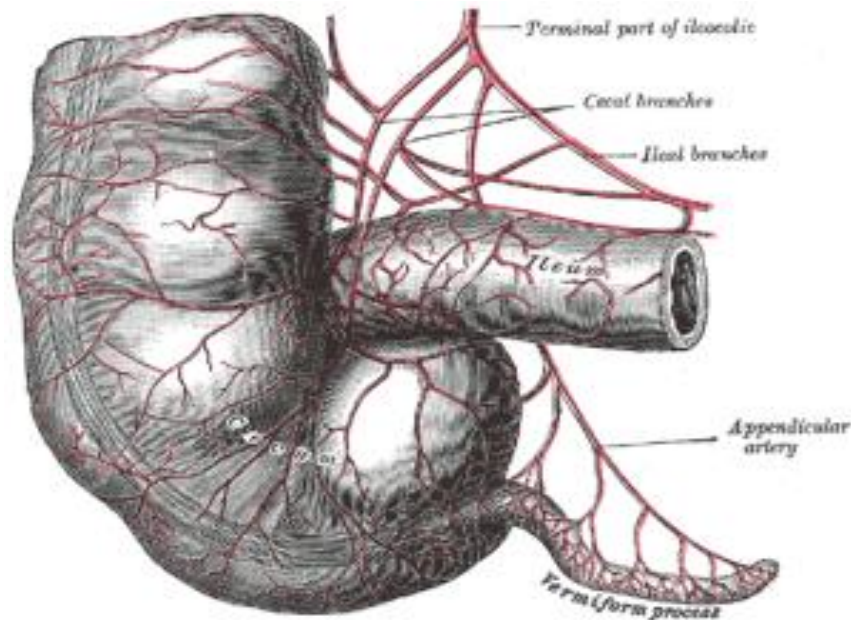
SURGICAL ANATOMY^{1,2,13}

Appendix is blind ending tubular structure found postero medial to ileocaecal junction. Previously known as vestigial organ later referred as lymphoid organ more active in early part of life, which in later part gets fibrosed. Has its own mesentry , blood vessels and lymphatics. Opening of appendix to the caecum is guarded by VALVE OF GERLACH¹².

Blood supply¹²

Appendix is supplied by appendicular artery (appendiceal artery). Appendicular artery is branch of ileocolic artery which in turn arises from the superior mesenteric artery. It descends inferior to terminal part of ileum and runs along the free border of meso appendix. Gives of a

recurrent branch that anastomosis with posterior caecal branch. Venous course follows the artery ends in superior mesenteric vein which drains into portal vein.



Lymphatic drainage^{11,12}

Mesoappendix contain 10 to 12 lymph vessels , that drain into chain of nodes of appendicular, ileocolic, superior mesenteric that eventually drain into caeliac nodes and cisterna chyli.

Innervation^{2,12}

Both sympathetic and parasympathetic nerves travel along the arterial supply to caecum and appendix. It is seen arising from the superior mesenteric plexus. Sympathetic supply is derived from T10 – T11 segment of the cord and parasympathetic is supply from vagus.

MESENTERY AND FOLDS^{2,3,13,17}

Mesoappendix

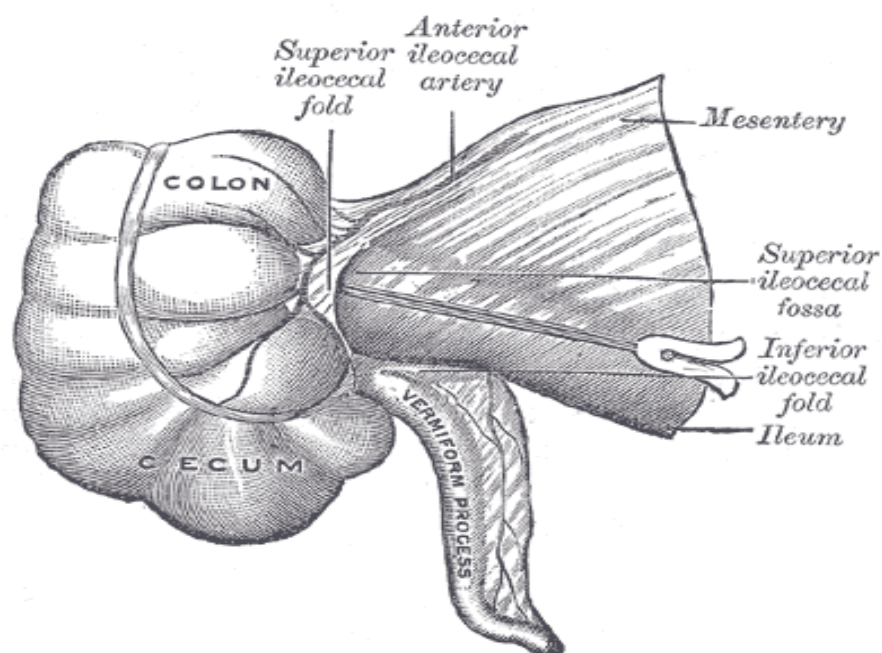
Triangular fold of peritoneum that extends from the ileocolic mesentery posterior to terminal ileum. Extends to tip of appendix and contain appendicular artery and its branches.

Ileocolic or superior ileocaecal fold

It contains anterior caecal artery and forms the anterior wall of superior ileocaecal fossa. Inferior bounded by ileal mesentery forms the superiorileocaecal recess.

Ileocaecal or inferior ileocaecal fold

Extends anterior to mesoappendix forming anterior wall of posterior ileocaecal fossa. Also known as BLOODLESS FOLD OF TREVES.



Congenital abnormalities of appendix^{12,13}

Duplication of appendix

Anomalies of appendix are extremely rare as reviewed by Khanna¹⁴.

Wallbridge classified it into three types¹⁹.

- Type A: single caecum with partially duplicated appendix
- Type B: two appendix on a single caecum
 1. B1: bird like appendix. Two appendix on either side of ileocaecal valve.
 2. B2: two appendix along the line of single taenia coli.
- Type C: duplicated caecum with each having its own appendix.

Left sided appendix

1. Situs inversus
2. Non rotation
3. Wandering caecum with long mesentery.

Heterotropic mucosa

1. Pancreatic mucosa
2. Gastric mucosa
3. Esophageal mucosa

Absence or ectopic appendix.

HISTOLOGY¹⁸

Mucosa

Lined by simple columnar epithelium and thrown into folds. Mucosa also contains crypts of Lieberkühn. They are scarce, sparsely scattered and branched.

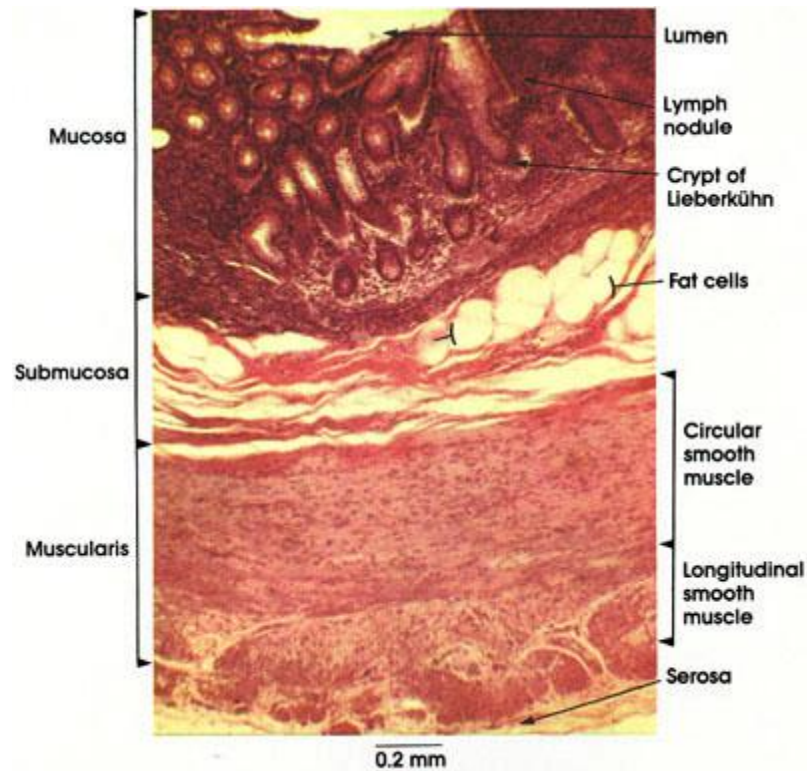
Mucosal epithelium also contains goblet cells, Paneth cells and enteroendocrine cells. Lamina propria contains lymph nodes which penetrate muscularis mucosa to enter submucosa.

Submucosa

Resemble to rest of intestine. Contain neurovascular elements and invaded by lymph node.

Muscularis externa

Contains circular and longitudinal muscles. But there is no taenia. Two muscles converge at the origin of taenia.



PHYSIOLOGY OF APPENDIX^{2,4}

Digestive

In mammals appendix plays an important role in digestion of cellulose by symbiotic bacteria. In humans appendix may retain the bacteria useful in digestion of raw meat.

Endocrine

During the 11th week of development appendix seem contain certain endocrine cells that secrete protein involved in homeostatic mechanism.

Immunological

Act as centre for B cell maturation and secrete Ig A into the gut. Forms a part of GALT gut associated lymphoid tissue. But its removal in early life has no effects on immune defence mechanism.

Reconstructive

Can be used to reconstitute damaged ureter. Create neosphincter in cases where urinary bladder is removed.

INCIDENCE^{19,54}

Appendicitis is most common surgical disease of all ages. With incidence of 11 cases in 10000 populations annually reported as interpreted by Addis and associates.^{1,2,20}

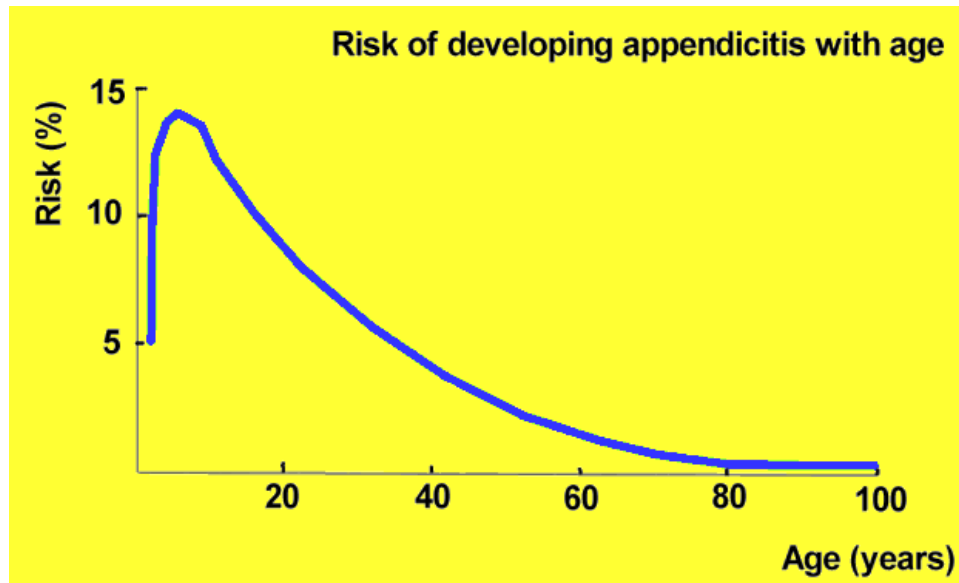
Males have higher propensity to develop appendicitis than females with ratio of 1.4:1. Life table analysis predicts life time risk of 8.6% for males and 6.7% for females.^{1,20}

Appendicitis is most commonly disease of adulthood. With males having highest incidence in 10 -14 years of age and females in 15-19 years of age.^{2,20}

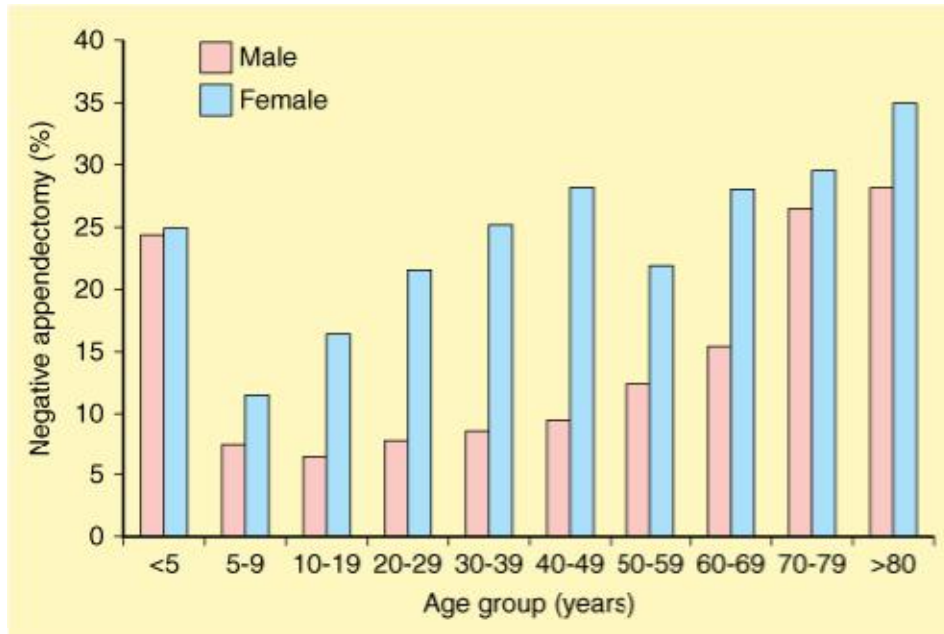
In spite of routine use of ultrasonogram, computerised tomography and laparoscopy percentage of negative appendicectomies seems to constant at 15.3%⁵⁹. Misdiagnosed cases of negative appendicectomy is higher in women than men.(22.3 vs 9.2%). Globally as estimated 36

negative appendicectomies done for single case of appendicitis. With increased incidence in women of extreme age.¹⁹

Geographical, ethnic, seasonal factors influencing the incidence, 11.3% higher in summer compared to winter¹⁹



GRAPH. Depicts the rate of negative appendicectomy according to age



Source: Brunicaudi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Pollock RE: *Schwartz's Principles of Surgery, 9th Edition*: <http://www.accessmedicine.com>
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Above graph shows the incidence of negative appendectomy according to age. Increases with extremities of age.

ACUTE APPENDICITIS^{62,63}

Acute appendicitis is most acute abdominal condition. Studies on aetiology of appendicitis is still controversial.

Etiology

Appendicitis, diverticular disease and carcinoma caecum is more common in developed civilisation. Burkitt attributed this difference to western diet that contains low fiber diet, high refined sugars and animal fat. These diets in turn leads to less bulky bowel contents, prolonged intestinal transit time and increased intra luminal pressure.

Wangensten^{2,12} reimposed the obstructive aetiology of appendicitis. He also said that mucosal folds and sphincter like orientation of muscles making the appendix more prone for obstruction.

Most common causes of luminal obstruction include²²

1. Faecoliths(coproliths)²¹- hardening of feces into stone. Formed by deposit of calcium and fecal debris around nidus of hard faeces. Mostly occurring in chronically constipated patient.
2. Lymphoid obstruction- most commonly due to inflammatory bowel disease and infections (mostly in childhood and adult).
3. Bacteria Yersinia, adenovirus, actinomycosis, cytomegalovirus, Histoplasma.
4. parasite-schistosomes, pinworm, strongyloides.
5. foreign bodies-shotgun pellets, activated charcoal,
6. tuberculosis and tumour.

PATHOGENESIS

1. Obstruction raises intra luminal pressure¹²

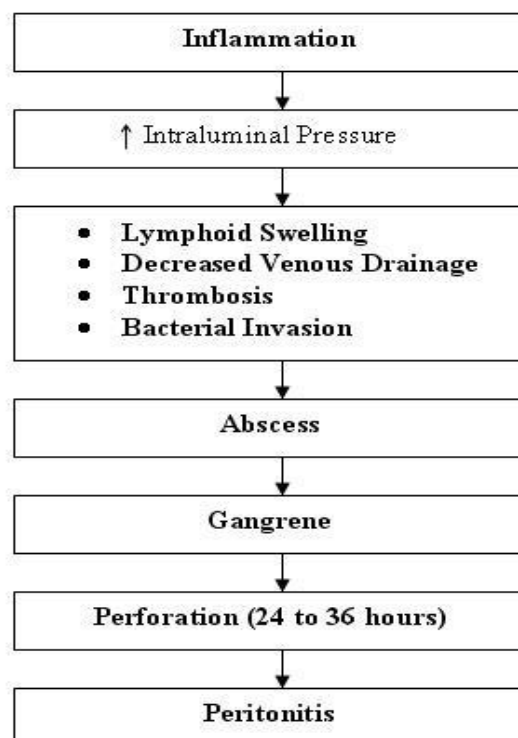
Obstruction causes closed loop obstruction. Luminal capacity of appendix is 0.1ml hence continued mucus secretion of just 0.5 ml can raise the pressure to 60 cm of water. Distention of appendix irritates the visceral afferent sensory nerve endings causing dull aching pain in subumbilical and epigastric region.

2. Mucosal ischemia and ulceration

Progression of distention causes venous pressure is exceeded and capillaries and venules are obstructed but arteriolar inflow continues leading to mucosal edema and congestion. Resulting hypoxia causes micro organismmultiplication and further distention resulting in reflex nausea and vomiting. As disease spreads to serosa parietal peritoneum is also involved which localises the pain to right lower quadrant.

3. Perforation and abscess

Finally arterioles are occluded leading to ellipsoidal necrosis and perforation in antimesenteric border. Superimposed infection can cause purulent peritonitis localised by phlegmon formed by surrounding omentum and intestine.



CLINICOPATHOLOGICAL FORMS²³

1. Acute simple appendicitis

Luminal obstruction followed by distention produces a periumbilical pain which can progress.

2. Acute suppurative appendicitis

Vascular congestion cause transmural spread of bacteria causing infiltration with neutrophils. Serosal inflammation produces fibrinous exudate surrounding the appendix.

3. Gangrenous appendicitis

Intramural venous or arterial thrombosis ensue causing full thickness necrosis of appendiceal wall.

4. Perforated appendicitis

Continuing necrosis erode of the appendiceal wall resulting in peritonitis generalised or localised walled off by the omentum and bowel.

5. Recurrent appendicitis

Patient has mild pain in the right lower quadrant that lasts for few hours and resolves. Eventually may develop severe attack resulting in appendicectomy. Incidence is around 10%.

6. Chronic appendicitis

Incidence is around 1%. Following criteria should be meet.

Symptoms of three weeks duration, symptom relieved by appendicectomy, histopathologically confirmed to contain lymphocytes.

BACTERIOLOGY OF APPENDICITIS²

Aerobic and Facultative

Gram-negative bacilli

Escherichia coli

Pseudomonas aeruginosa

Klebsiella species

Gram-positive cocci

Streptococcus anginosus

Other *Streptococcus* species

Enterococcus species

Anaerobic

Gram-negative bacilli

Bacteroides fragilis

Other *Bacteroides* species

Fusobacterium species

Gram-positive cocci

Peptostreptococcus species

Gram-positive bacilli

Clostridium species

Morphological features²³

Gross finding

Appendix appears congested, swollen, tense and covered with fibrinous exudate. Lumen is filled with seropurulent viscous fluid. A faecolith may be present.

Microscopic features

Cut section shows ulcerated mucosa, crypt abscess, and purulent fluid in the lumen. As infection progresses entire wall upto the

muscularis propria is infiltrated with leucocytes. Close examination of blood vessels show margination of leucocytes and mucosal haemorrhage.(13).

CLINICAL PRESENTATION^{12,23,66}

In cases of appendicitis clinical features present in following sequence

1. Anorexia
2. Periumbilical pain with slight discomfort
3. Nausea followed vomiting
4. Pain localises to right iliac fossa
5. Guarding / rebound tenderness in the appendicular region
6. Muscular rigidity and peritonitis sets in.

Anorexia

Not an essential feature for diagnosis, but its presence adds to clinical suspicion.

Abdominal pain

Luminal obstruction and increase in intraluminal pressure causes pain in umbilical region. With involvement of the serosa parietal peritoneum gets irritated and pain shifts to the right iliac fossa .

Fever²

Usually temperature of 99 or 100F is seen. Fever greater than 101F is often seen in cases of appendicular perforation.

Nausea and vomiting

Luminal increase in pressure causes nausea and vomiting which is further aggravated by the developing ileus.

Urinary symptoms

In retrocaecal and postileal position of appendix , ureter gets irritated causing burning sensation during micturition and very rarely haematuria.

Classical signs of presentation⁴

Tenderness over the McBurneypoint, pyrexia and increase in pulse rate. With involvement of parietal peritoneum localised guarding and rigidity develops in the right iliac fossa.

Blumberg's sign

Deep palpation in area of maximum tenderness followed by sudden release causes sharp pain is known as rebound tenderness.

Rovsing's sign

Palpation in the left iliac fossa may cause pain in right iliac fossa due to displacement of bowel irritating the inflamed peritoneum.

Psoas test

In retrocaecal cases appendix lie on the psoas muscle ,which when put on contraction by extension of the hip patient experiences pain.

Obturator test

In pelvic position of appendix, when patient thigh is passively flexed and internally rotated arises a crampy pain.

Dunphy's sign

Increased pain in RIF when patient coughs caused by irritation of peritonem.

Sherren's triangle of hyperthesia

Bounded by anterior superior iliac spine, pubis and umbilicus, hyperthesia is seen in this triangle in cases of gangrenous appendicitis.

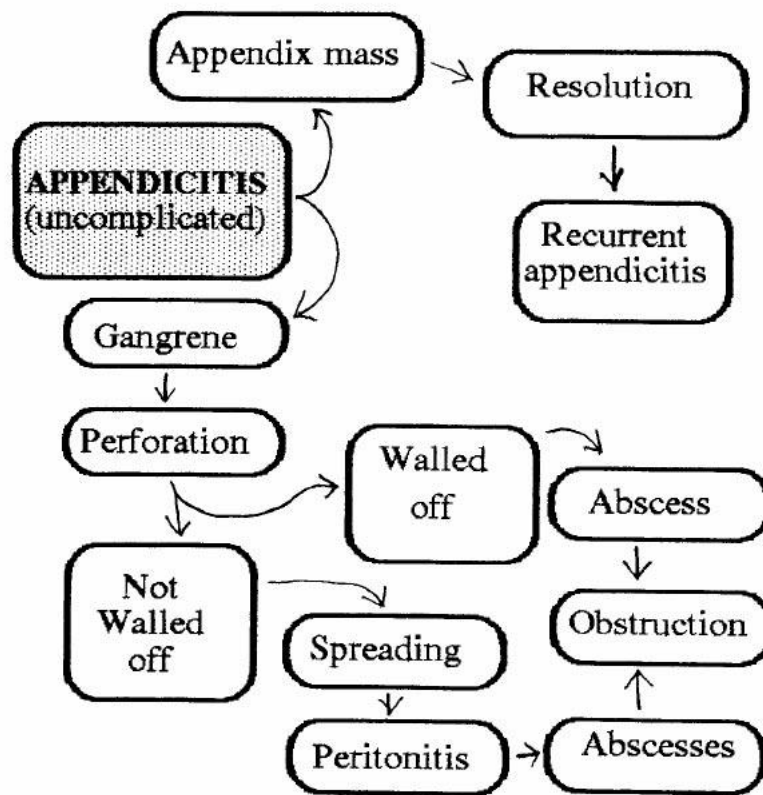
Alders sign

To rule out between appendicitis and gynaecological cause of right lower quadrant pain. Shift in tenderness to centre from Mcburney point when patient rolls to left is suggestive of tubo ovarian disease.

Altered clinical signs in different position of appendix^{2,12}

- Retrocaecal- right flank pain with ureteric irritation
- Pelvis- pelvic pain with urinary disturbance rule out PID in women
- Subhepatic- presents with clinical signs of gallbladder disease
- Post ileal- vague tenderness and irritative diarrhoea.
- Situs inversus- LIF pain and absent routine signs of right sided appendicitis

Clinical outcome of acute appendicitis



The possible course of appendicitis

LABORATORY INVESTIGATIONS^{12,24}

WBC COUNT⁵³

Leucocytosis is present in most of the cases of appendicitis having sensitivity of 70% and specificity of 40%²⁵. WBC count of 10000-18000 cells /cu mm is highly suggestive of appendicitis more than that is often present in cases of appendicular perforation and abscess. Rise in polymorphs neutrophils greater than 70% occur in 80% of cases.²⁶

URINE ANALYSIS¹²

- a) Urinalysis to be done to rule out urinary cause of pain.
- b) Urine culture and microscopy to rule out ureteric pathology and cystitis.
- c) Urine HCG test is done in women of reproductive age to rule out ectopic ruptured pregnancy.

CRP – C REACTIVE PROTEIN

CRP is acute phase protein secreted by hepatocytes in response to acute stress such as inflammation. Detected as early of about 6 to 12 hrs of onset. Diagnostic efficacy is higher than ESR and WBC in detecting inflammatory and infectious disease²⁷.

Sensitivity and specificity of CRP in diagnosing acute appendicitis is 85 to 90% and 70 to 75%. But there is no cut of value in predicting severity of appendicitis. Less specific as it is elevated in all bacterial and viral infections, myocardial infarction, malignancy and rheumatic disease.²⁸

LIVER FUNCTION TEST

Jaundice in patients with appendicitis is unknowingly present for years. Many surgeons alter the diagnosis attributing jaundice to the cause of abdominal pain. After analysing the cause of rise in bilirubin in serum it was found that there is isolated hyperbilirubinemia with normal liver

function. Value of hyperbilirubinemia is now currently being used to diagnose severity of abdominal sepsis resulting from appendicitis.

It is also hypothesed that serum bilirubin can be used as laboratory marker to diagnose appendicitis and predicts its severity.

BILIRUBIN¹⁶

Also known as hematoidin. Formed by four pyrole rings is degradation of haem metabolism. Serum level in bilirubin is indicator of balance between production and excretion from the body. Detected by the van den berg reaction it exists in two forms

1. indirect (unconjugated)
2. direct(conjugated)

Since bilirubin is potentially toxic it is essential to excrete it from the body. Liver is concerned with excretion of this through bile ducts. Series of process involved in liver such as

1. Hepatocellular uptake
2. Intracellular binding
3. Conjugation
4. Canalicular uptake
5. Excretion.

Disruption of either of these steps can result in jaundice. Based on this it is classified as prehepatic, hepatic and cholestatic jaundice.

Jaundice in sepsis is well established for years. Due to fact after conjugation of bilirubin to mono or di glucuronides it is excreted from the liver through canalicular transport system.

Canalicular transport through hepatocyte is ATP dependent pathway mediated by canalicular protein (multi drug resistance protein - 2). This pathway is more sensitive for injury. Bacteremia during sepsis release endotoxin and liposacchrides that cause canalicular disruption resulting in cholestatic type of jaundice. Endotoxin can also aggravate hemolysis at a rate greater than capacity to conjugate resulting in unconjugated hyperbilirubinemia.

ACUTE APPENDICITIS AND BILIRUBIN²⁸

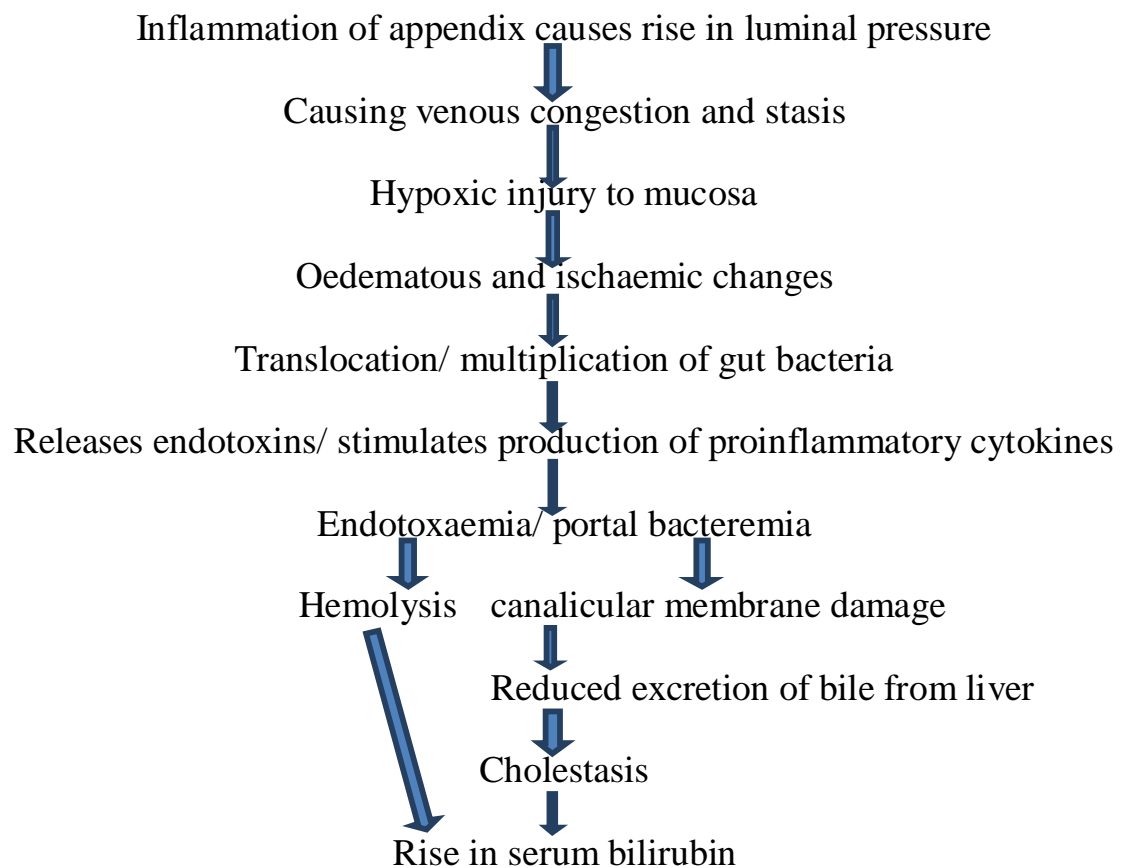
Hyperbilirubinemia is recently postulated as laboratory marker for diagnosing acute appendicitis and determining its severity. Studies have shown that bacterial infection causes disruption in production and excretion of bile.

Normally in portal circulation bacteria is carried by portal blood to liver. It is eliminated by the detoxification or immunological action of reticuloendothelial cells of liver²⁹. In patients with abdominal infections bacterial load in portal blood increases beyond the capacity of kuffer cell function. Additional it may cause damage to hepatocyte which is reflected by the rise in serum bilirubin.

Most common organism found in appendicitis is escheria coli. E coli is lipopolysaccharide that can mediate release of pro inflammatory cytokines (IL-6,TNF)²⁹. These cytokines in turn causes canalicular damage resulting in reduction of bilirubin excretion from hepatocyte. Many studies also highlighted that decreased output of bilirubin is not due to defective conjugation but due to defective excretion³¹.

E coli toxin resulting in endotoxaemia aggravates hemolysis causing unconjugated hyperbilirubinemia causing rise in serum alkaline phosphatase. Transaminase level is normal excluding other possible liver diseases.^{50,51}

Pathophysiology of hyperbilirubinemia in appendicitis³⁰



REVIEW OF THE CURRENT STUDY

Khan .S. reported a prospective study of 45 cases of appendicitis at NGMC hospital, Nepal. He interpreted as hyperbilirubinemia was found in 86.6% of the patients of acute appendicitis. Hyperbilirubinemia was cholestatic type due to excretion abnormality from liver.³²

Retro spective study of pre-operativemarkers of appendicular perforation conducted at azmiraturk research institute, Turkey reported wbc count and total bilirubin as useful parameters in early diagnosis of perforation. Bilirubin is effective in diagnosis of appendicular perforation versus suppurative appendicitis.³³

Sand M. Bechara FG of Germany published in American journal of surgery that patients with appendicular perforation had a higher bilirubin level compared to non perforated appendicitis. Concluded in their study that specificity of hyperbilirubinemia for perforation was 86% compared to 55% forWBC and 33% for C-reactive protein.³⁴

Estarada JJ and Petresyan M found that on logistic regression analysis patient with appendicular perforation had higher bilirubin value with significant relationship ($p=0.031$,95% confidence interval 1.11-7.60). Odds of cases with appendicular perforation have three times higher odds .(Odds ratio 2.96%).³⁵

Pgimerchandigarhstudies revealed that in their study hyperbilirubinemia was found in all patients with appendicular

perforation. It was mixed in type with normal enzymes. For complicated appendicitis the P-value of SB was <0.001 . It also emphasised that other than Trans locating bacteria there are cytokines involved in hyperbilirubinemia.³⁶

Korean surgical society in their journal published diagnostic value of pre-operative bilirubin value in complicated appendicitis. Recommending their inclusion in scoring system used to diagnose appendicitis. Bilirubin value has higher specificity with two times increased chance for complicated appendicitis.²⁸

Giordano et al in their diagnostic meta-analysis published in international journal of surgery, that patients with clinical diagnosis of appendicitis and hyperbilirubinemia should be taken up for surgery. Results of the study were sensitivity of 49% and specificity of 82% .Odds ratio of 4.42.³⁸

IMAGING MODALITIES¹⁴

PLAIN X RAY ABDOMEN

Not useful in diagnosing appendicitis but can be beneficial in ruling out other pathology. Certain features can raise the suspicion of acute appendicitis

1. Altered bowel gas pattern
2. Presence of faecolith
3. Obliteration of psoas shadow
4. Blurring of preperitoneal fat line.

Limitation cannot be done in children and pregnant women.



Barium enema

Smith and associates described signs of appendicitis after enema but it's routinely done owing to the non-specificity of the signs

1. Appendix persistently non visualised
2. Appendix partially visualised.
3. Filling defect on caecum
4. Irritability of the inflamed surrounding bowel.

ULTRASONOGRAPHY⁵²

Graded compression sonography can be done rapidly, does not requires contrast medium and useful in pregnant patients.

Positive finding⁴⁰

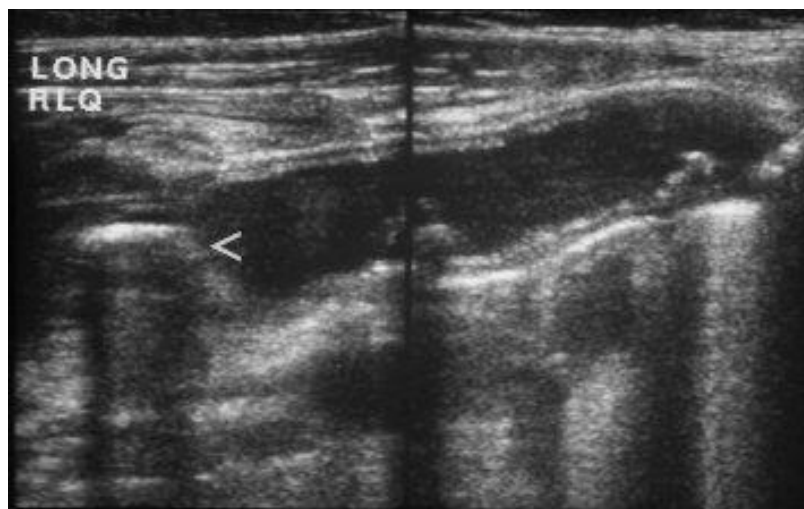
1. Blind ending non peristaltic loop.
2. AP diameter of >6 mm non compressible.
3. Presence of appendicolith
4. Thickening of appendix wall and presence of periappendiceal fluid.

Sonography has sensitivity ranging from 55 to 96% and specificity ranging from 60 to 85% in diagnosing appendicitis³⁹.

False positive results are given when dilated fallopian tube is misdiagnosed as appendicitis. Or periappendicitis which occur due to surrounding inflammation.

False negative results are given when appendicitis is confined to tip, retrocaecal, large appendix can be mistaken for small bowel.

Large limiting factor in using sonography is its intraobserver variability¹².



COMPUTERISED TOMOGRAPHY⁶⁰

HRCT can also be used to appendicitis. On CT scan inflamed appendix has diameter >5 cm and increased wall thickness. Other signs of inflammation are presence of dirty fat, thickened mesoappendix and presence of phlegmon. Occasionally faecolith can also be found⁴¹.

Most important diagnostic sign is arrow head sign- on contrast examination there is tapering of barium towards the appendix base.

Following advent focused /non focused, enhanced /non enhanced sensitivity and specificity has improved to 92-97% and 85-94%^{2,12,42}.

Many trials emphasise on routine CT scanning claiming reduction in rate of negative appendectomy from 22 to 7%. Rational approach is selective use of CT scanning based clinical and laboratory suspicion as to confirm diagnosis and most importantly to rule out other pathologies.

Radioactive isotope imaging⁴³

Technetium-99m and indium-3 have been used as radioactive isotope in tagging the white blood cells. On reinjection, these leucocytes can be detected in inflamed appendix on scanning. Sensitivity is 83 to 89 %and specificity is 92 to 100 percent. The method is not helpful in diagnosing appendicitis in women. Hence it is necessary to do ultrasonology to rule out gynaecological disease.⁴⁴

SCORING SYSTEM

Alvarado and modified Alvarado are being globally used.⁴⁵

	Manifestations	Value
Symptoms	Migration of pain	1
	Anorexia	1
	Nausea and/or vomiting	1
Signs	Right lower quadrant tenderness	2
	Rebound	1
	Elevated temperature	1
Laboratory values	Leukocytosis	2
	Left shift in leukocyte count	1
		Total points 10

- Score <5 - appendicitis unlikely
- 5 to 6 - appendicitis possible
- 7 to 8 - appendicitis likely
- >9 - highly suggestive of appendicitis.

Remembered as mnemonic

MANTRELLS

DIFFERENTIAL DIAGNOSIS OF APPENDICITIS^{2,12}

Gastrointestinal Causes

- Cecal diverticulitis
- Sigmoid diverticulitis
- Meckel's diverticulitis
- Epiploica appendicitis

Mesenteric adenitis
Omental torsion
Crohn's disease
Cecal carcinoma
Appendiceal neoplasm
Lymphoma
Typhlitis
Small bowel obstruction
Perforated duodenal ulcer
Intussusception
Acute cholecystitis
Hepatitis
Pancreatitis

Infectious Causes

Infectious terminal ileitis (Yersinia, tuberculosis or cytomegalovirus)

Gastroenteritis

Cytomegalovirus colitis

Genitourinary Causes

Pyelonephritis or perinephric abscess

Nephrolithiasis

Hydronephrosis

Urinary tract infection

Nonabdominal Causes

Streptococcal pharyngitis

Lower lobe pneumonia

Rectus muscle hematoma

In Women

Ovarian cyst (ruptured or not ruptured)

Corpus luteal cyst (ruptured or not ruptured)

Ovarian torsion

Endometriosis

Pelvic inflammatory disease

Tubo-ovarian abscess

In Pregnancy

Ectopic pregnancy

Round ligament pain

Chorioamnionitis

Placental abruption

Preterm labor

APPENDICITIS IN SPECIAL CIRCUMSTANCES

Appendicitis in early¹²

There is always a delay of diagnosis in the young attributed to reasons as inability to give history, frequency of GIT symptoms, delay in recognition by parents.

Rates of morbidity associated with appendicitis and advanced presentation as perforation is more likely as omentum is underdeveloped and reduced resistance to bacteremia.

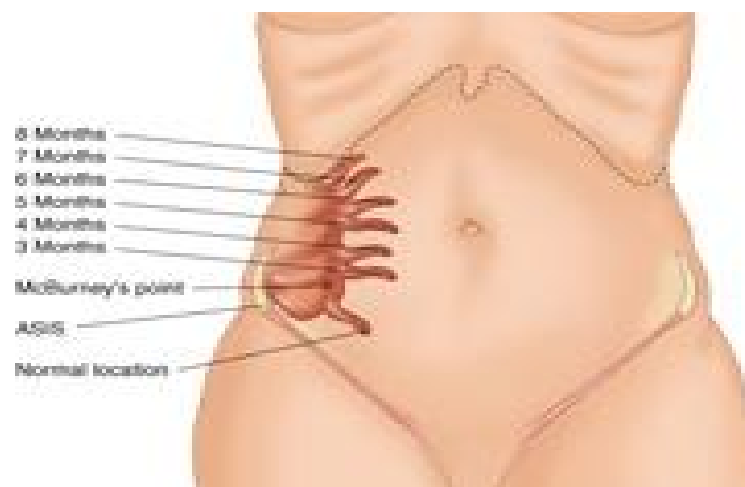
Management is similar to adults expect difficulty excluding differential diagnosis and laparoscopic surgery is more beneficial.

Appendicitis in elderly

Extreme of age is more prone for perforation with rates of 50 to 70% in elderly compared to 20 to 30% in others. Also there is an atypical presentation, operative findings not correlating with clinical findings. Associated other co morbid conditions increasing morbidity further.

Appendicitis in pregnancy^{46,57,69}

Most common surgical emergency during pregnancy. Difficulty in diagnosis is because of anatomic changes in the position of appendix during pregnancy and increased abdominal laxity.



There is no association between appendix and subsequent fertility. Appendicectomy both second or third trimester results in fetal loss in 4% of cases and early delivery in 10%. Maternal mortality is rare (0.03%).

Appendicitis in immunocompromised¹²

Presentation and morbidity is similar to other cases of appendicitis. Because of reduced WBC count there is no absolute leucocytosis but there is relative leucocytosis.

Low CD4 count is associated with increase incidence of appendicular perforation. With studies reporting patients with non ruptured appendix having higher CD4 count than ruptured appendix.

There is also difficulty in diagnosis because of so many opportunistic infection causing spontaneous peritonitis like CMV, Mycobacterium avium intracellulare, tuberculosis, cryptococcus neoformans, strongyloides and non Hodgkin lymphoma.

Management and surgical intervention are similar, with no studies on laparoscopic appendicectomy.

TREATMENT OF APPENDICITIS¹²

Despite the available diagnostic modalities, early operative intervention is still recommended. Adequate hydration, electrolyte abnormalities corrected and other cardiac, renal, pulmonary conditions to be taken care off.

Surgical society recommends antibiotics of 24 hrs duration for acute simple appendicitis, and till fever comes down or WBC level normalises in patients with abscess and perforation. Routinely cephalosporin, monobactam or aminoglycoside and anaerobic cover with metronidazole are used. Recommendations are similar in children.

Modalities of treatment:

- ❖ Open appendicectomy
- ❖ Laparoscopic appendicectomy
- ❖ Conservative management
- ❖ Management of complication

OPEN APPENDICECTOMY²⁴

Routinely used incision are grid iron(McBurney)⁸ and rocky davis(transverse) muscle splitting incision.

On opening the abdomen caecum is visualised and taenia are traced to base of appendix. By sweeping lateral to medial appendix is delivered out of the wound.

Mesoappendix is identified and appendicular artery and its branches ligated. Base is ligated and appendix is removed. Routine inversion of base by purse string or Z stitch is not done. Cavity irrigated with saline and layers closed.

If normal appendix is encountered small bowel and pelvis(in women) examination are done.if any other lower abdomen pathology is encountered fowler weir medial extension can be done.

Complication of open appendicectomy

Intra-abdominal abscess⁵⁸

Perforated appendicitis occurs in 23-30% of all appendicitis. Perforation is followed by poly microbial infection resulting in peritonitis and abscess formation in nearly 50 % of cases. Hence wound infection, fecal fistula and portal pyaemia are common.

Intestinal obstruction

Due to postoperative adhesion patient experiences adhesive colic and intestinal obstruction.

Tubal infertility

Appendicitis is common acute abdominal condition during pregnancy with incidence on 1 in 1500 deliveries, resulting in foetal loss and early delivery.

Right inguinal hernia

During open appendicectomy muscles of lower abdomen and possibly the nerves are damaged increasing the chance of patient developing future hernia.

LAPAROSCOPIC APPENDICECTOMY⁴⁷

Kurt semm in 1980, performed laparoscopic appendicectomy even before advent of cholecystectomy⁵⁶. But appendectomy became popular only after cholecystectomy was routinely done in all centres. Due to the fact that appendicectomy was already done in mini lap incisions, laparoscopic appendicectomy was less popularised.

Three ports one ten mm umbilical port and two 5 mm port in suprapubic, left iliac fossa. Surgeon standing on left, camera being operated by assistant, appendix first visualised and mesoappendix clips applied and base tied in roeders extracorporeal or intracorporeal knots applied, appendicectomy is done. Then the specimen is delivered through separate bags and irrigation of peritoneal cavity with saline done. Fascial defects are closed.

Recently techniques like SILS (single incision laparoscopic surgery) and NOTES (natural orifice transluminal endoscopic surgery) are being developed. Effects of laparoscopy and pneumoperitoneum in pregnancy is not known as no detailed studies are available. Laparoscopic surgeries are first trimester.

Advent of laparoscopy has created new dimension in diagnosing and treating acute abdominal conditions. Diagnostic laparoscopy can be aided in diagnosing obscure causes of abdominal pain and further avoiding negative laparotomies.

Laparoscopic access can be used definitive treatment method for acute appendicitis, torsion of ovarian cyst and endometriosis. Its diagnostic utility is of immense value in obese and patients with abnormal anatomy.

Conservative management of appendicular mass⁶⁸

Oschner-Sherren regimen is being practised for cases of appendicular mass. Going and opening case of appendicular mass is dangerous as it end up in fecal fistula. It is worthwhile to treat and observe.

1. Charts : half hourly temperature and pulse chart, intake output chart.
2. Nothing by mouth initially followed by oral fluids.
3. Intravenous fluid resuscitation
4. Generally analgesics are not given.
5. Antibiotic therapy: third generation cephalosporins, aminoglycoside and metronidazole.
6. Prophylaxis against DVT and physiotherapy to avoid pulmonary complications.
7. Measuring the mass and daily assessment for regressing in size.

Criteria to convert into surgical management

- Increase in pulse rate.
- Prolonged paralytic ileus.
- Increase in size of abscess.
- Spreading abdominal pain.

MATERIALS AND METHODS

The current study was performed in the department of general surgery at Chengalpattu medical college hospital during the period of December 2012 to November 2013.

Study design:

A one year cross sectional study

Place of study:

The present study was conducted in the department of surgery, Chengalpattu medical college hospital.

Study period:

One year from December 2012 to November 2013.

Source of data;

Patients admitted with clinical diagnosis and planned for emergency surgery under the department of general surgery, Chengalpattu medical college during the study period.

Sample size:

A total of 100 patients with pre-operative clinical diagnosis of appendicular pathology were included.

Sampling method

The sample size was calculated based on the following formula

$$n = Z^2 * p * q / d^2$$

Where,

n = Sample size

Z = 1.96 \approx 2 (considering confidence as 95%)

p = prevalence (considered as 50% as exact prevalence not known)

q = 100 – p that is, 50%

d = Absolute error which was 10%.

Selection criteria

Inclusion criteria

All patients clinically diagnosed as acute appendicitis and gangrenous appendicitis which were taken up for emergency surgery in surgical department.

In both the group histopathological report were considered.

Exclusion criteria

- Prior history of jaundice
- Prior history of liver disease
- Prior history of pancreatitis
- Chronic alcoholism
- Patients with hepatitis B, A and C
- Taking drugs increasing liver parameters like rifampicin

Procedure:

The study was conducted after obtaining ethical committee clearance of Chengalpattu medical college. Based on the criteria patient admitted and underwent emergency appendicectomy for acute and gangrenous appendicitis in Chengalpattu medical college hospital were included.

All eligible patients were informed about the purpose and usefulness of study. Then after obtaining informed consent as per consent form submitted in annexure.

All relevant clinical finding and history recorded in predesigned patientproforma submitted in annexure. All patients clinically diagnosed as acute and gangrenous appendicitis were submitted to battery of blood investigation, then emergency appendicectomy and histopathological report attached.

Routine laboratory investigation done

- Urine –albumin, sugar and deposits
- Renal function test- urea and creatinine
- Total count and differential count
- Serum total bilirubin
 - Indirect and direct bilirubin
- Liver function test
 - ❖ SGOT
 - ❖ SGPT

❖ ALP

- Seropositivity for HbsAg

Serum bilirubin and liver function test were done using auto analyser machine available in our hospital.

Reference value of serum bilirubin and liver function test

TEST	NORMAL RANGE
Serum bilirubin	
Total	0.3-1.0 mg/dl
Direct	0.1-0.3 mg/dl
Liver function test	
SGOT	0-35 U/L
SGPT	0-35 U/L
ALP	60-160 U/L

Statistical analysis:

The data obtained were recorded in Microsoft excel spreadsheet and tabulated using SPSS and Epi info and results were depicted in charts.

- Patient with diagnosis of acute appendicitis having increased serum bilirubin were expressed in percentage

$$= \frac{\text{patients with diagnosis of inflammed appendicitis with hyperbilirubinemia}}{\text{all patients with diagnosis of inflammed appendicitis}}$$

➤ Mean and standard deviation of the serum bilirubin for patients with inflamed appendicitis.

➤ Patient with diagnosis of complicated appendicitis having increased serum bilirubin were expressed in percentage

$$= \frac{\text{patients with diagnosis of complicated appendicitis with hyperbilirubinemia}}{\text{all patients with diagnosis of complicated appendicitis}}$$

➤ Mean and standard deviation of the bilirubin values in patients with complicated appendicitis.

➤ Similarly percentage of increased total count in cases of appendicitis were calculated and compared with hyperbilirubinemia.

➤ Hypothesis was tested based on the increase in serum bilirubin in patients with inflamed and complicated appendicitis.

➤ Using 2*2 table sensitivity, specificity, positive predictive value, negative predictive value and odds ratio were calculated.

Sr.bilirubin	Normal appendix	inflamed appendicitis
Raised	A	b
Normal	C	c

Sr.bilirubin	Normal appendix	Complicated appendicitis
Raised	A	b
Normal	C	c

Results were calculated using the formula:

$$\text{Sensitivity} = \frac{a}{a+c} * 100$$

$$\text{Specificity} = \frac{d}{b+d} * 100$$

$$\text{Positive predictive value} = \frac{a}{a+b} * 100$$

$$\text{Negative predictive value} = \frac{d}{c+d} * 100$$

$$\text{Odds ratio} = \frac{ad}{bc}$$

RESULTS AND ANALYSIS

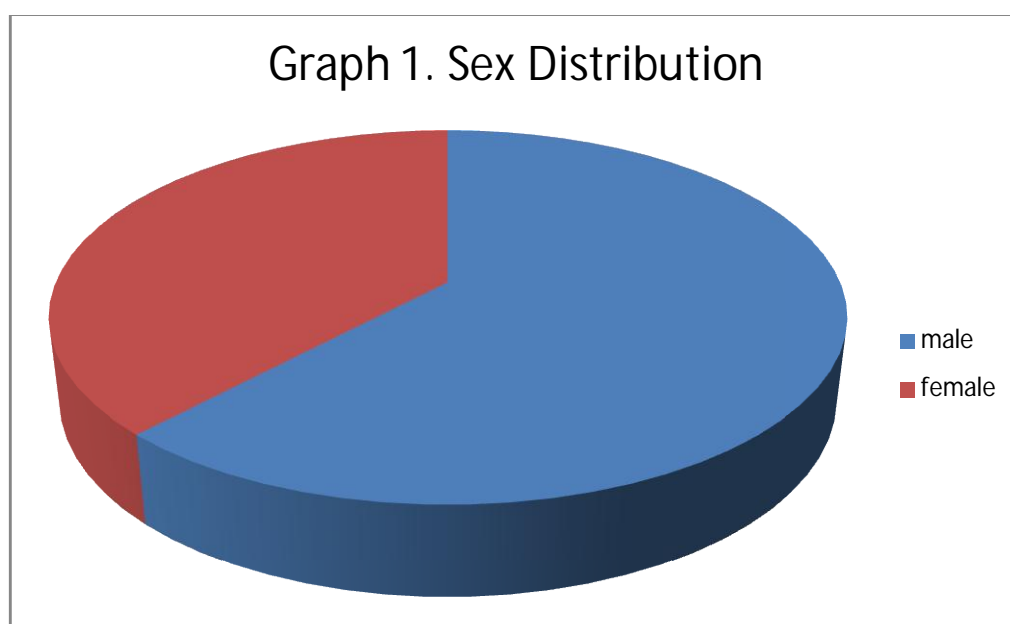
The present one year cross sectional study was conducted in the department of surgery, Chengalpattu medical college hospital during the period of December 2012 to November 2013.

A total of 100 patients with clinical diagnosis of acute appendicitis were included in the study.

The data was tabulated on Microsoft excel sheet and analysed as below.

Table 1. Sex distribution

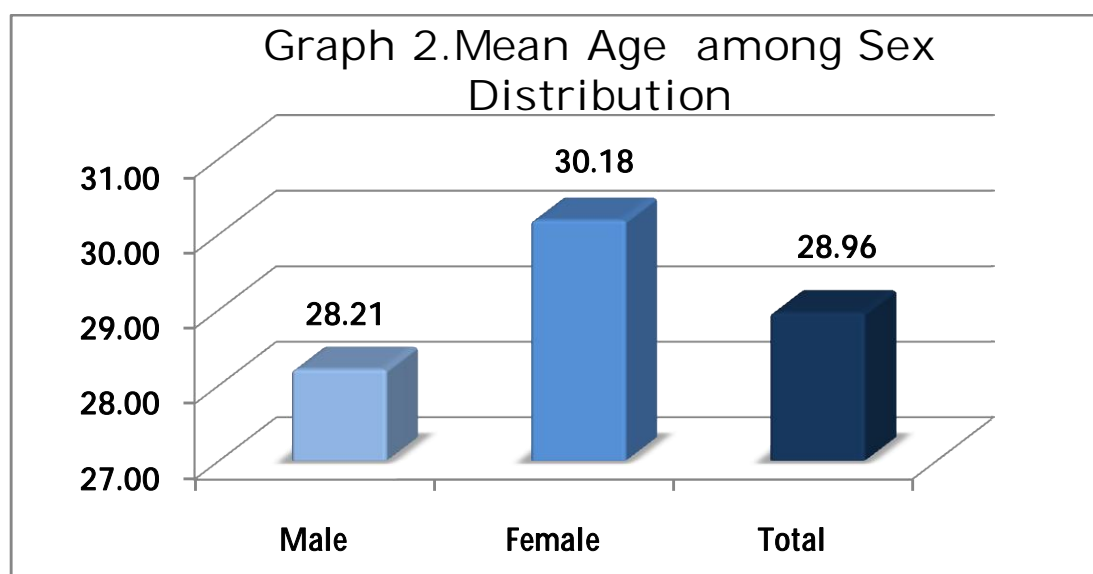
	No. of Patients	Percentage
Male	62	62.0
Female	38	38.0
Total	100	100.0



Of the 100 patients enlisted for the study, 62 patients (62%) were males while the remaining 38 patients (38%) were females.

Table 2. Age distribution

	Mean	Std. Deviation
Male	28.21	10.777
Female	30.18	8.459
Total	28.96	9.961



The overall mean age of all 100 patients was 28.96 ± 9.97 years. The average age in females and males was 30.18 ± 8.45 years and 28.21 ± 10.77 years.

Table 3. Age wise distribution of both sex

	Sex		Total
	Male	Female	
11-20	16	6	22
21-30	26	16	42
31-40	14	11	25
41-50	3	5	8
51-60	2	0	2
>60	1	0	1
Total	62	38	100

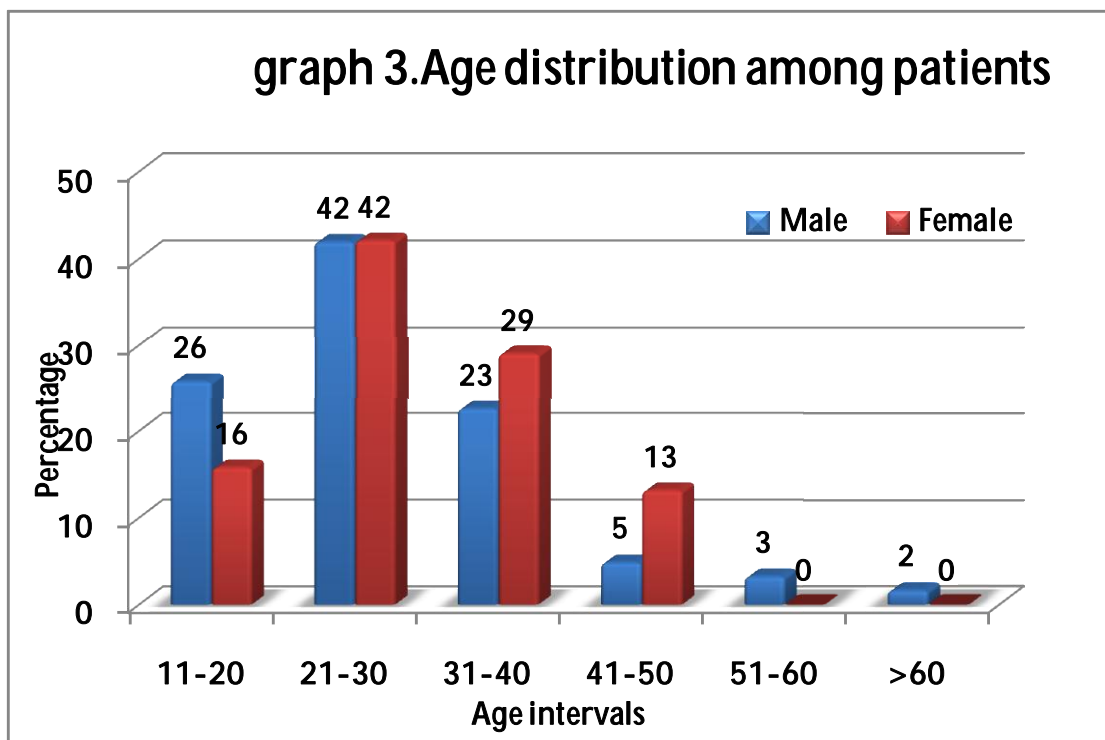
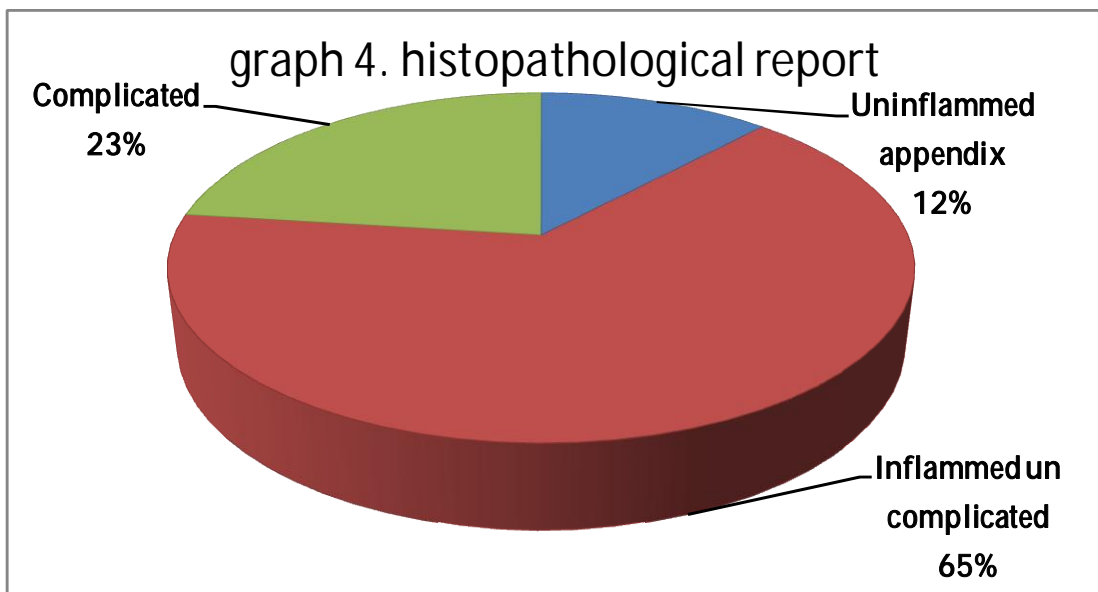


Table 4.Histopathological reports

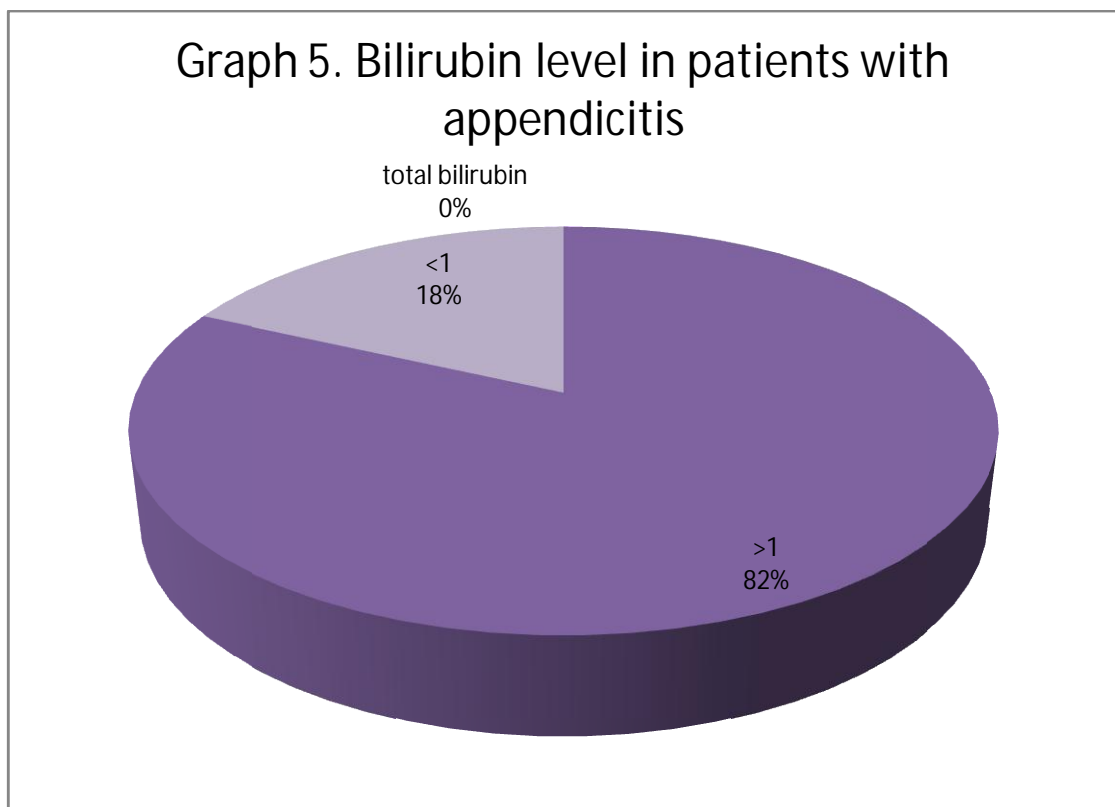
	No. of Patients	Percentage
Uninflammed appendix	12	12.0
Inflammed uncomplicated	65	65.0
Complicated	23	23.0
Total	100	100.0



Of the 100 patients undergone appendicectomy 65 (65%) patients had inflamed uncomplicated appendicitis, 23(23%) patients had complicated appendicitis and 12(12%) had normal appendix on histopathology.

Table 5. Bilirubin level in patients with appendicitis

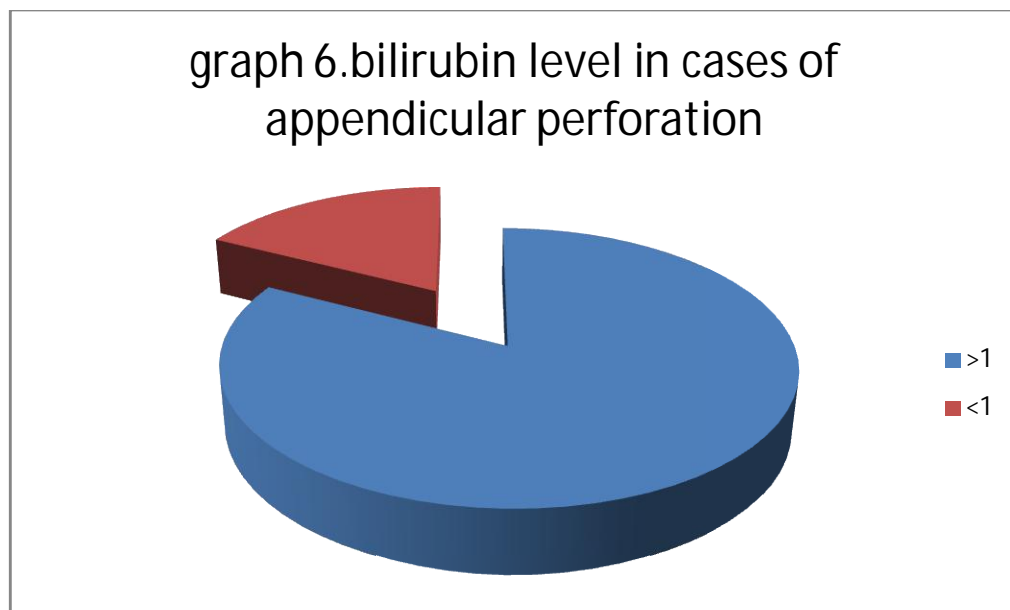
Total bilirubin	Cases of appendicitis	Percentage
>1mg/dl	72	82%
<1mg/dl	16	18%



Of the 88 patients diagnosed as acute appendicitis, 72 patients(82%) had raised bilirubin levels (>1.0 mg/dl), while the remaining 16 patients (18%) had normal levels (<1.0 mg/dl).

Table 6. Bilirubin level in cases of appendicular perforation

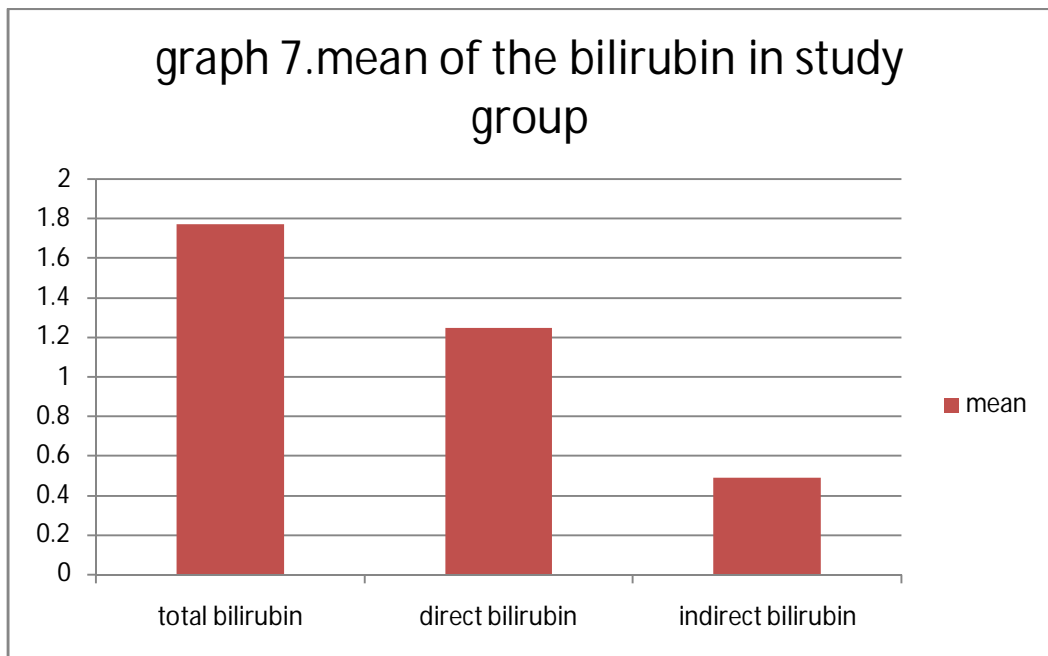
Total bilirubin	Distribution in cases of appendicular perforation	
	Number	Percentage
>1mg/dl	19	84
<1mg/dl	4	16

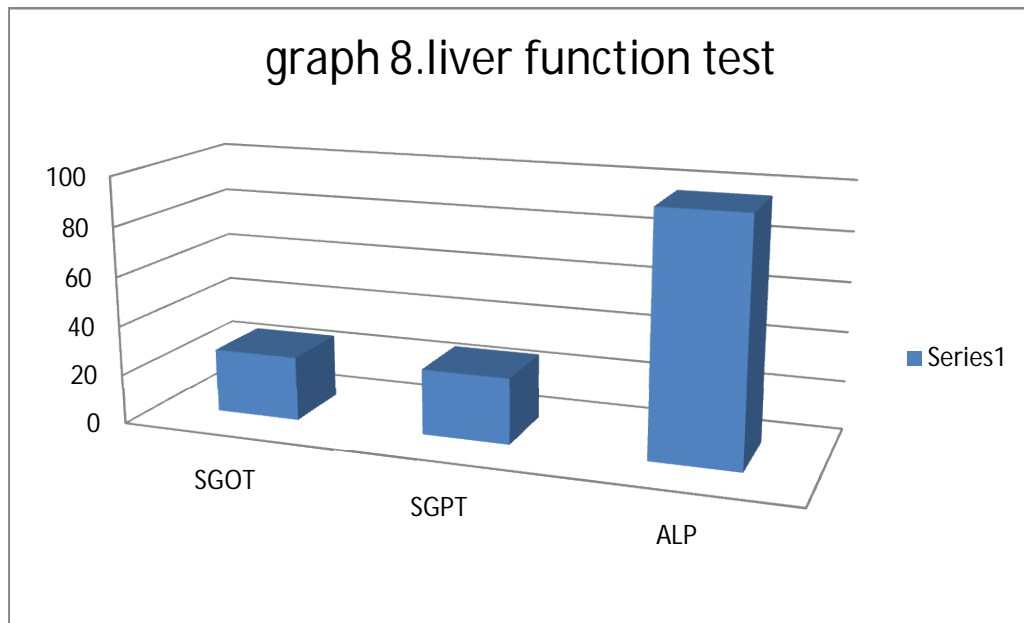


In patients diagnosed with appendicular perforation (n=23), 19 patients (84%) had bilirubin elevated (>1.0mg/dl), while only 4 patient (16%) had normal level (<1.0 mg/dl).

Table 7. Liver function test

LIVER FUNCTION TEST		
	MEAN	S.D
TOTAL BILIRUBIN	1.77	0.94
DIRECT	1.25	0.88
INDIRECT	0.49	0.2
SGOT	26.13	12.92
SGPT	26.87	9.49
ALP	96.88	39.68

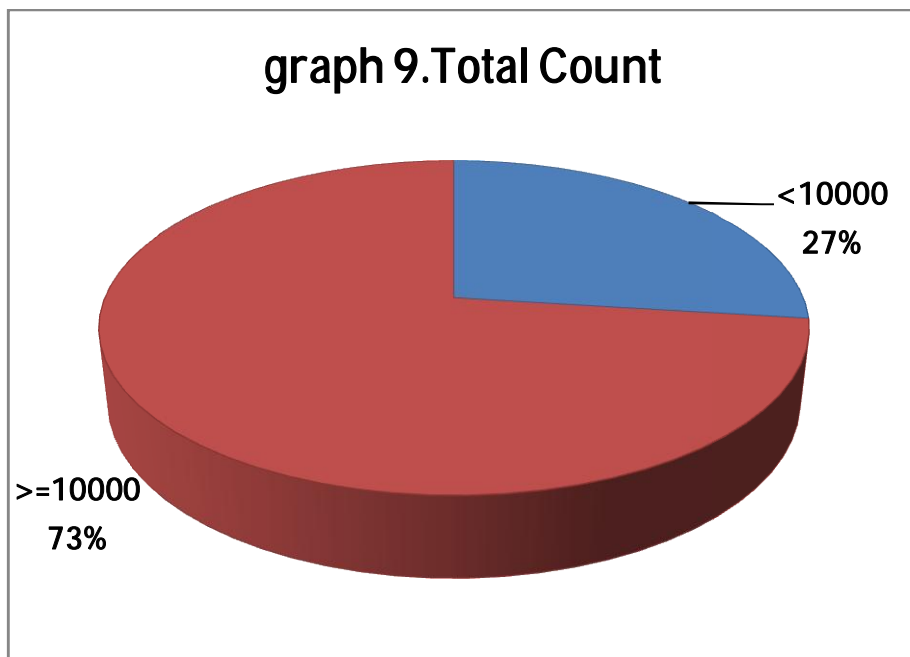




The mean total serum bilirubin of all 100 patients was 1.77 ± 0.94 mg/dl which was above the normal range (>1.0 mg.dl) considered for the study, hence indicating the presence of hyperbilirubinemia. The mean of direct bilirubin was 1.25 ± 0.88 mg/dl while that of indirect bilirubin was 0.49 ± 0.2 mg/dl. All patients were found to have SGOT and SGPT within normal limit. The mean SGOT and SGPT were 26.13 ± 12.92 U/L and 26.87 ± 9.49 U/L. The mean ALP values were 96.88 ± 39.68 U/L.

Table 8. Total leucocyte count

Total Count	No. of Patients	Percentage
<10,000	27	27.0
>=10,000	73	73.0
Total	100	100.0



73 patients (73%) had total leucocyte count more than >10,000/ cu mm while 27(27%) patients counts less than 10,000/ cu mm.

Table 9. Neutrophilia in patients with appendicitis

Neutrophils	No. of Patients	Percentage
<70	35	35.0
>=70	65	65.0
Total	100	100.0

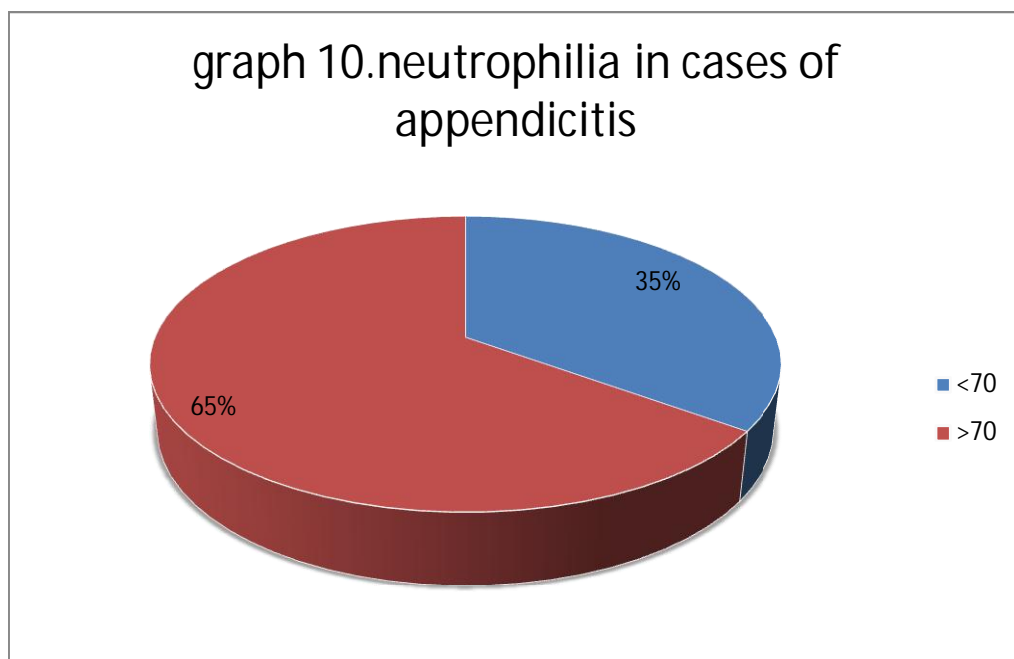
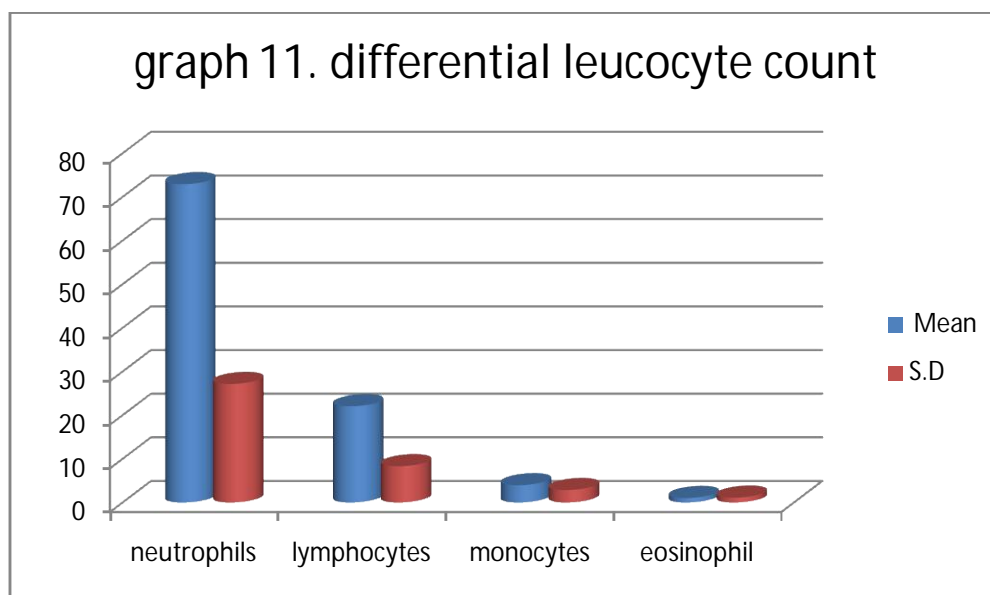


Table 10. Differential leucocyte count

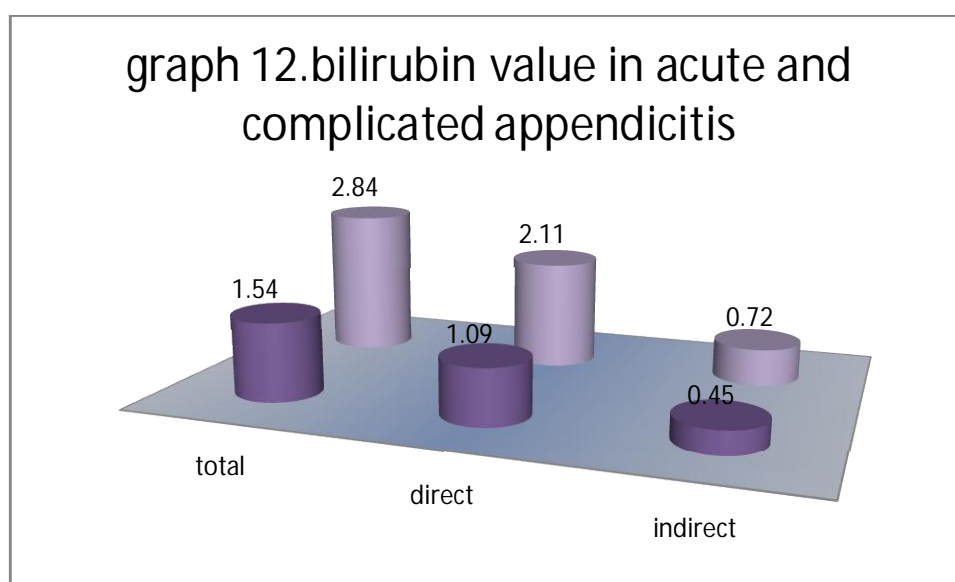
		MEAN	S.D.
T.C.in mm ³		11,829	5758.90
D.C	neutrophils	72.97	27.20
	lymphocytes	22.08	8.35
	monocytes	3.99	2.89
	eosinophil	1.06	1.14



The mean of total leucocyte count in all patients was $11,829 \pm 5758.9/\text{cu.mm}$, in which the highest percentage constituted by neutrophils with 72.97% followed by 22.08% by lymphocytes.

Table 11.comparison of mean serum bilirubin level in patients with acute appendicitis and appendicular perforation

BILIRUBIN LEVEL (mg/dl)	DIAGNOSIS			
	Acute appendicitis		Appendicular perforation	
	mean	S.D	mean	S.D
Total	1.54	0.53	2.84	1.18
Direct	1.09	0.39	2.11	0.91
Indirect	0.45	0.28	0.72	0.29



The mean bilirubin levels in patients with acute appendicitis was 1.54 ± 0.53 mg/dl, while in patients diagnosed with appendiceal perforation was 2.84 ± 1.18 mg/dl. The direct and indirect bilirubin in patients diagnosed with acute appendicitis was 1.09 ± 0.39 mg/dl and 0.45 ± 0.20 mg/dl respectively. Similarly direct and indirect bilirubin in patients diagnosed with appendiceal perforation was 2.11 ± 0.91 mg/dl and 0.72 ± 0.29 mg/dl respectively.

Table 12. Correlation of acute inflamed appendicitis and complicated appendicitis with total bilirubin levels

Total bilirubin	Inflamed uncomplicated		Complicated	
	No	%	No	%
>1mg/dl	53	82%	19	84%
<1mg/dl	12	18%	4	16%

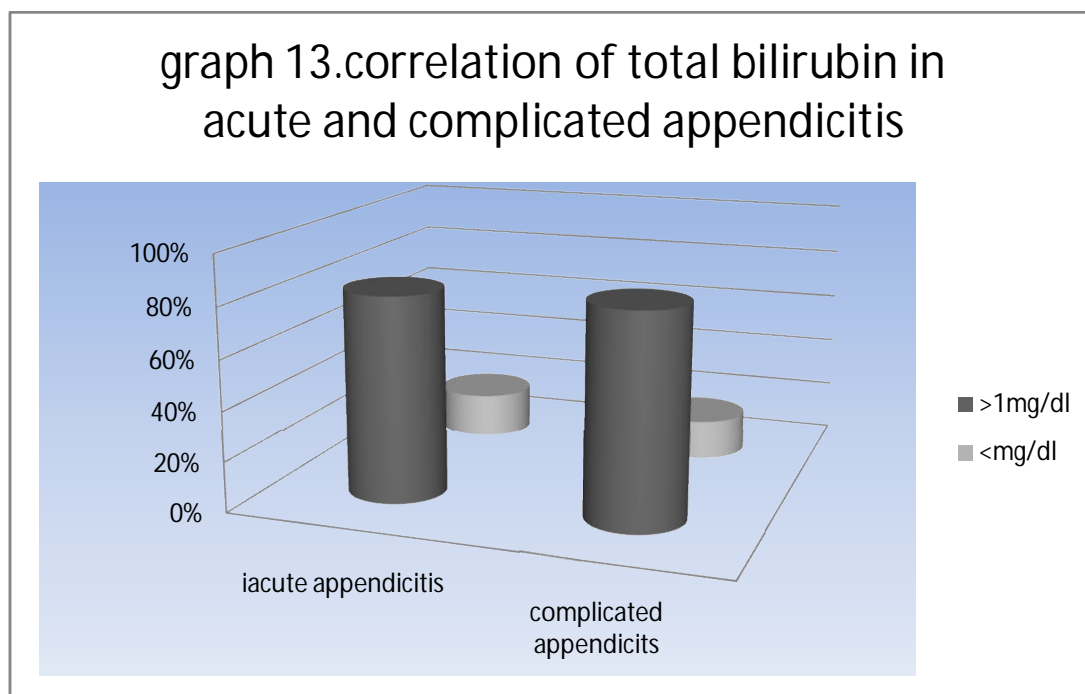


Table 13. 2*2 table of patients with increased WBC count and appendicitis

Total count	Inflamed & complicated appendix	Normal appendix
>10000 cells/cu mm	64	9
<10000 cells/cu mm	24	3

Parameter	Estimate	Lower - Upper 95% CIs
Sensitivity	72.73%	(62.62, 80.93 ¹)
Specificity	25%	(8.894, 53.23 ¹)
Positive Predictive Value	87.67%	(78.2, 93.38 ¹)
Negative Predictive Value	11.11%	(3.852, 28.06 ¹)
Diagnostic Accuracy	67%	(57.31, 75.44 ¹)
Likelihood ratio of a Positive Test	0.9697	(0.771 - 1.22)
Likelihood ratio of a Negative Test	1.091	(0.1416 - 8.404)
Diagnostic Odds	0.8889	(0.2218 - 3.563)

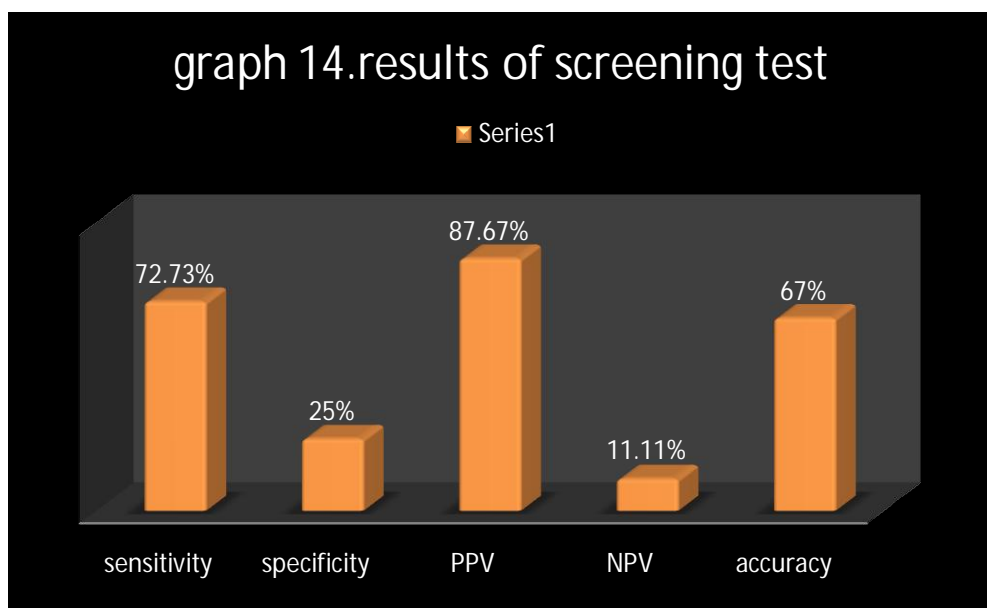
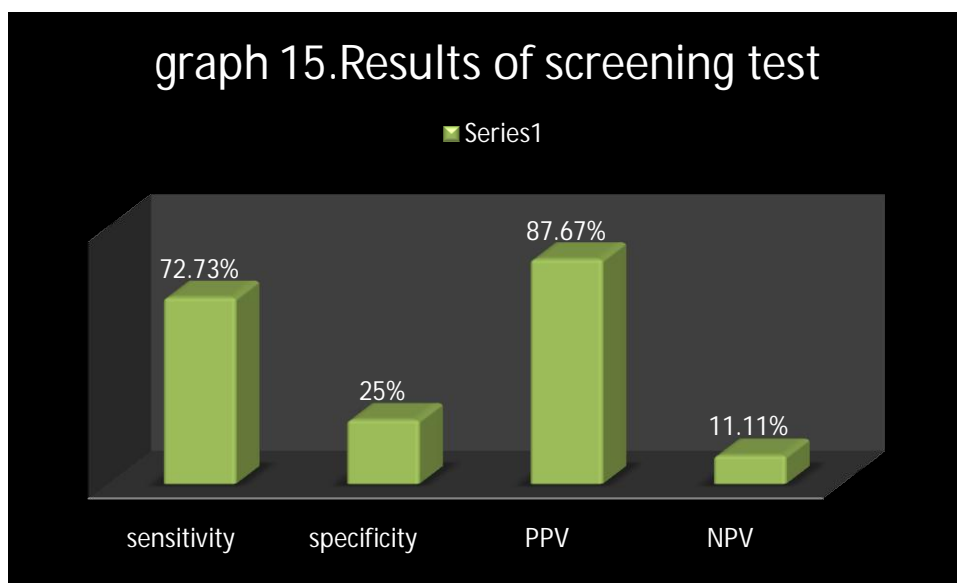


Table 14. 2*2 table of patients with increased bilirubin and appendicitis

Serum bilirubin	Inflamed & complicated appendix	Normal appendix
>1mg/dl	72	2
<1mg/dl	16	10

Sensitivity	81.82%	(72.49, 88.49 ¹)
Specificity	83.33%	(55.2, 95.3 ¹)
Positive Predictive Value	97.3%	(90.67, 99.26 ¹)
Negative Predictive Value	38.46%	(22.43, 57.47 ¹)
Diagnostic Accuracy	82%	(73.33, 88.3 ¹)
Likelihood ratio of a Positive Test	4.909	(1.831 - 13.16)
Likelihood ratio of a Negative Test	0.2182	(0.1856 - 0.2565)
Diagnostic Odds	22.5	(4.489 - 112.8)



From this table, following values were calculated as

Sensitivity

$$= \frac{a}{a+c} = \frac{72}{72+16} = 81.82\%$$

Therefore, sensitivity of bilirubin in predicting acute appendicitis and its severity was

Specificity

$$= \frac{d}{b+d} = \frac{10}{2+10} = 83.33\%$$

Therefore, specificity of bilirubin in predicting acute appendicitis and its severity was

Positive predictive value

$$= \frac{a}{a+b} = \frac{2}{17+2} = 97.3\%$$

Therefore, positive predictive value of bilirubin in diagnosing acute appendicitis and its severity was

Negative predictive value

$$= \frac{c}{c+d} = \frac{16}{16+10} = 38.46\%$$

Therefore, negative predictive value of bilirubin in diagnosing acute appendicitis and its severity was

Odds ratio

$$= \frac{ad}{bc} = \frac{72 \cdot 10}{16 \cdot 2} = 22.5$$

Therefore odds ratio is 22.5

Two-Sample Independent *t* Test

Input Data

Two-sided confidence interval		95%		
	Sample size	Mean	Std. Dev.	Std. Error
Group-1	65	1.54	0.53	
Group-2	23	2.84	1.18	

Result	<i>t</i> statistics	<i>df</i>	p-value¹	Mean Difference	Lower Limit	Upper Limit
Equal variance	-7.12701	86	<0.0000001	-1.3	1.662610	0.937393
Unequal variance	-5.10449	25	0.00002845	-1.3	1.824520	0.775478

	<i>F</i> statistics	<i>df</i>(numerator,denominator)	p-value¹
Test for equality of variance²	4.95692	22,64	0.000000527

¹p-value (two-tailed)

²Hartley's *f* test for equality of variance

DISCUSSION

Acute appendicitis is the most common acute abdominal condition with 8% of population in western countries experiences it in their life time. Appendicectomy is the dictum of olden days “*to do when suspected than to delay*” .

Highest incidence is seen in twenties and thirties. Appendicitis occurs in equal incidence in both sexes with male to female ratio of 1.4:1. Life table suggest risk of 12% for men and 25% for women¹².

Major factor responsible for acute appendicitis is obstruction of lumen²². Faecolith is found in most of cases²¹. Other less common causes are also identified. Vast variety of aerobic and anaerobic organism is involved. However principal organisms are *Escherchia coli* and *Bacteroidsfragilis*.

Through ages diagnosis of appendicitis is essentially clinical. Recent advantages in imaging have made diagnosis comparatively easy. In most of the clinical setting, owing to the presentation of the patient during emergencies when imaging facilities are not available. Hence it is mandatory to operate a patient based on clinical suspicion is the rule of the day. Because of it is globally estimated that 15 to 30% cases are negative appendicectomy.

There arises a need for necessary routinely available laboratory marker to confirm diagnosis.

It is recently postulated that hyperbilirubinemia is seen in cases of appendicitis and it can be used as predictive factor for diagnosis of appendicitis and its increased potential to foresee complication of appendicitis.

With limited data available in the literature. It is hypothesized that hyperbilirubinemia is seen in cases of acute appendicitis.

The present study was done to ascertain the association of hyperbilirubinemia and appendicitis, then to evaluate predictive potential and its credibility in diagnosis of complications such as perforation, gangrene and abscess.

The study was conducted in the department of general surgery, Chengalpattu medical college over a period of December 2012 to November 2013 on 100 patients who have undergone appendicectomy.

In the present study of 100 patients, 62 patients (62%) were males while the remaining 38 patients (38%) were females. The mean age in our study group was 28.96 ± 9.9 . This is in par with age incidence given in most of literature that appendicitis is more common in second decade of life. The average age in males 28.21 ± 10.77 was slightly lower than the females 30.18 ± 8.45 .

Hyperbilirubinemia (>1 mg/dl) in our study was found in 74 (74%) patients of all the hundred patients ($n=100$), while 26 (26%) had normal bilirubin value (<1 mg/dl).

The mean total serum bilirubin of all 100 patients was 1.77 ± 0.94 mg/dl which was above the normal range (>1.0 mg/dl) considered for the study, hence indicating the presence of hyperbilirubinemia. The mean of direct bilirubin was 1.25 ± 0.88 mg/dl while that of indirect bilirubin was 0.49 ± 0.2 mg/dl. Our findings were on par with the Nepalgunj study by Khan.S. where the average level of serum bilirubin was 2.38 mg/dl.

All patients were found to have SGOT and SGPT within normal limits, thus fulfilling our exclusion criteria. The mean SGOT and SGPT were 26.13 ± 12.92 U/L and 26.87 ± 9.49 U/L. The mean ALP values were 96.88 ± 39.68 U/L.

In our study 65 patients were found to have inflamed appendix, 23 patients had complicated appendicitis, 12 patients had normal appendix. Diagnosis was confirmed postoperatively by histopathological report.

Among the patients with inflamed appendix, 53 patients (82%) were found to have elevated bilirubin (>1.0 mg/dl). In patients diagnosed with appendicular perforation ($n=23$), 19 patients (84%) had bilirubin elevated (>1.0 mg/dl), while only 4 patients (16%) had normal level (<1.0 mg/dl). Thus hyperbilirubinemia was seen in 82% of patients with acute appendicitis and 84% of patients with complicated appendicitis.

The total leucocyte count was found to be elevated in 73(73%) patients that is >10000 cells/ cu mm. The mean of total leucocyte count in all patients was $11,829\pm 5758.90$ in which the highest percentage

constituted by neutrophil with 72.97% followed by lymphocytes with 22.08%.

The mean bilirubin levels in patients with acute appendicitis were 1.54 ± 0.53 mg/dl. While in patients diagnosed with appendicular perforation was 2.84 ± 1.18 mg/dl which was three times the normal value. Sand et al, Estrada et al and Khan.S in their study postulated that bilirubin value in patients with appendicular perforation was three times the normal value making it more sensitive and specific.

The direct and indirect bilirubin in patients diagnosed with acute appendicitis was 1.09 ± 0.39 and 0.45 ± 0.20 mg/dl respectively. Similarly direct and indirect bilirubin in patients diagnosed with appendiceal perforation was 2.11 ± 0.91 mg/dl and 0.72 ± 0.29 mg/dl respectively.

The sensitivity, specificity, positive predictive value, negative predictive value and Odds ratio was calculated from 2x2 table. Sensitivity and specificity of bilirubin in diagnosing acute appendicitis and appendiceal perforation was 81.82% and 83.33% respectively. Similarly positive predictive value and negative predictive value of bilirubin was 97.33% and 38.46%. The Odd's ratio was calculated to be 22.5.

Sensitivity and specificity of WBC was 72.73% and 25%, PPV and NPV was 87.67% and 11.11%. Accuracy calculated to be 67%.

Study group	Sample size	sensitivity	specificity	PPV	NPV	accuracy
Sand et al	538	70%	86%			
Annals of surgery	472	57%	88%	91%		
Data base study	189 ABSTRACTS	77%	87%	61%	21%	
Giordano et all	4974	54%	82%	89%	32%	80%
Present study	100	81.82%	83.33%	97.3%	38.46%	82%

Results of our study were comparable to the journal of Korean society, international journal of biological research by Nitin Wasnik, Vijay P Agarwal, Sand et all results and Estrada et all results were compared^{34,35,36,37}.

CONCLUSION

- Acute appendicitis is the most common acute abdominal pain and appendicectomy is the most commonly performed emergency surgery in our population.
- Higher prevalence of the disease in the males compared to females with ratio of 1.4:1.
- Increased incidence in second and third decades of life.
- Serum bilirubin estimation has an overall sensitivity of 81.82%, specificity of 83.33% and diagnostic accuracy of 82%.
- Jaundice is known in sepsis hence other causes of liver disease must be excluded.
- False positive rate of 16% is seen in our study is because other infectious cause of abdominal pain can cause rise in serum bilirubin.
- Leucocytosis and differential count cannot be solely relayed upon. But when combined with bilirubin values, there is higher probability of diagnostic accuracy.
- Serum bilirubin can be added with routine Alvarado scoring for increased diagnostic accuracy.

- Serum bilirubin is easily done and anytime available laboratory marker in rural and semi urban hospitals.
- Serum bilirubin is more specific than CRP which is more sensitive , because CRP is elevated in many of the inflammatory condition.
- Rate of negative appendicectomies is at rate of 15 to 30%.
- Patients with normal bilirubin and normal leucocyte count can be deffered from surgery reducing the rate of negative appendicectomy.
- Ultrasonography is more useful in ruling out other pathologies and it is largely dependent on sonologist experience and interpretation.
- Though diagnosis of appendicitis is more clinical, serum bilirubin can be used as an additive tool in aiding the diagnosis and predicting its complication.

SUMMARY

Acute appendicitis is the most common surgical emergency from olden days till now. In spite of advances in imaging ,dsiagnosis of appendicitis is still more clinical and great dilemma with vast variety of differential diagnosis. Studies being routinely done for search of laboratory marker for acute appendicitis. Association of hyperbilirubinemia in acute appendicitis and its severity has been recently postulated.

The present study was undertaken to evaluate the correlation of elevated serum bilirubin in acute appendicitis and its credibility in predicting the diagnosis of appendicular perforation.

The present one year study cross sectional study was conducted in the department of general surgery, Chengalpattu medical college hospital during the period of December 2012 to November 2013. A total of 100 patients with clinical diagnosis of appendicitis and appendicular perforation were studied. The serum bilirubin and LFT were carried out in all patients.

In this study, male (62%) outnumbered females (38%) and overall the mean age was 28.96 ± 9.9 . The mean total serum bilirubin of all 100 patients was 1.77 ± 0.94 mg/dl which was above the normal range (>1.0 mg.dl) considered for the study, hence indicating the presence of

hyperbilirubinemia. The mean of direct bilirubin was 1.25 ± 0.88 mg/dl while that of indirect bilirubin was 0.49 ± 0.2 mg/dl.

Among the patients with inflamed appendix, 53 patients (82%) were found to have elevated bilirubin (>1.0 mg/dl). In patients diagnosed with appendicular perforation ($n=23$), 19 patients (84%) had bilirubin elevated (>1.0 mg/dl), while only 4 patient (16%) had normal level (<1.0 mg/dl). Thus hyperbilirubinemia was seen in 82% of patients with acute appendicitis and 84% of patients with complicated appendicitis.

Sensitivity and specificity of bilirubin in diagnosing acute appendicitis and appendiceal perforation was 81.82% and 83.33% respectively. Similarly positive predictive value and negative predictive value of bilirubin was 97.33% and 38.46%. The Odd's ratio was calculated to be 22.5.

Serum bilirubin routinely added to the blood investigation can be useful laboratory investigation for aiding in the diagnosis of acute appendicitis. Can be easily done and cheaply available. Patients with three times the normal bilirubin value and clinical signs of appendicitis and appendicular perforation have higher probability of having complicated appendicitis.

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ANNEXURE - 1

INFORMATION SHEET

- We are conducting a study on elevated serum bilirubin acute appendicitis in Chengalpattu Medical College Hospital, Chengalpattu, for that your participation may be valuable to us.
- The purpose of this study is to evaluate the association between serum bilirubin and acute appendicitis.
- We are selecting certain patients and if you are found eligible you will be included in the study.
- The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.
- Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time ; your decision will not result in any loss of benefits to which you are otherwise entitled.
- The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator

Signature of Participant

Date :

INFORMATION TO PARTICIPANTS

Principal Investigator

Dr. P.L.THIRUMANIKANDAN

2 nd year M.S.General surgery Post Graduate

Chengalpattu Medical College and Hospital

Chengalpattu.

Name of the participant:

Title:

Study on elevated serum bilirubin in acute appendicitis,its role and predictive value in diagnosis and severity.

You are invited to take part in this study. The information in this document is meant to help you decide whether or not to take part. Please feel free to ask if you have any queries or concerns.

You are being asked to participate in this study being conducted in The Department of General surgery, Chengalpattu Medical College.

Purpose of the Research:

Acute appendicitis is one of the most common intra-abdominal infection seen in surgical department which can be treated easily if accurate diagnosis is made in time.

Otherwise delay in diagnosis and treatment can lead to gangrene perforation and diffuse peritonitis.

We have obtained permission from the Institutional Ethics Committee.

Study Design :

Prospective study

Study procedures:

The study involves laboratory estimation of serum bilirubin level additional to routine investigation in patients clinically diagnosed as acute appendicitis.

Then postoperatively patient will be asked to review with histopathological report.

At each visit, the study surgeon will examine you.

You may have to come to the hospital for examination and investigations apart from your scheduled visits, if required.

You must not participate if you are pregnant, breast feeding a child.

Benefits of this study:

The results of the research may provide benefits to the society in terms of advancement of medical knowledge and/or diagnostic benefits of future patients.

INFORMED CONSENT FORM

(This is only a guideline – Relevant changes to be made as per the study requirements)

Title of the Study :

“ _____ ”.

Name of the Participant :

_____.

Name of the Principal (Co-Investigator):_____.

Name of the Institution:_____.

Name and address of the sponsor / agency (ies) (If any) :

_____.

Documentation of the informed consent

I _____ have read the information in this form (or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, hereby give my consent to be included as a participant in “ _____ ” (title of the study).

1. I have read and understood this consent form and the information provided to me.
2. I have had the consent document explained to me.
3. I have been explained about the nature of the study.
4. I have been explained about my rights and responsibilities by the investigator.
5. I have been informed the investigator of all the treatments I am taking or have taken in the past _____ months including any native (alternative) treatment.
6. I have been advised about the risks associated with my participation in this study.*
7. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms.*
8. I have not participated in any research study within the past _____month(s).*
9. I have not donated blood within the past _____ months----add if the study involves extensive blood sampling.*
- 10.I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital.*

11.I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent.

12.I hereby give permission to the investigators to release the information obtained from me as result of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.

13.I have understand that my identity will be kept confidential if my data are publicly presented .

14.I have had my questions answered to my satisfaction.

15.I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document.

ANNEXURE -2

PROFORMA

Name:

Hospital No :

Age :

Case No :

Sex :

Presenting Complaints :

H/o present illness:

Any previous treatment :

- **H/O Gall Stones:**
- **H/O Pancreatitis:**
- **H/O Previous blood transfusions:**
- **H/O Jaundice:**
- **H/O Drug Intake:**
- **H/O Diabetes:**
- **H/O Hypertension:**

Personal H/O:

- **H/O Alcohol Consumption:**
- **H/O Smoking:**

General examination

CVS :

RS :

Abdomen :

Investigations

S.Electrolytes:

Liver function test

Blood Sugar:

SGOT -

B. Urea -

SGPT-

S. Creatinine -

ALP -

Na+ - Cl -

ALBUMIN -

K+ - HCO₃ -

GLOBULIN-

Serum bilirubin:

X-ray

Chest:	Erect abdomen:
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Total count

Differential count

Operative procedure

Histopathological report

ANNEXURE – 3

Photo 1. Acute suppurative appendicitis



Photo 2. Perforated appendicitis at the base

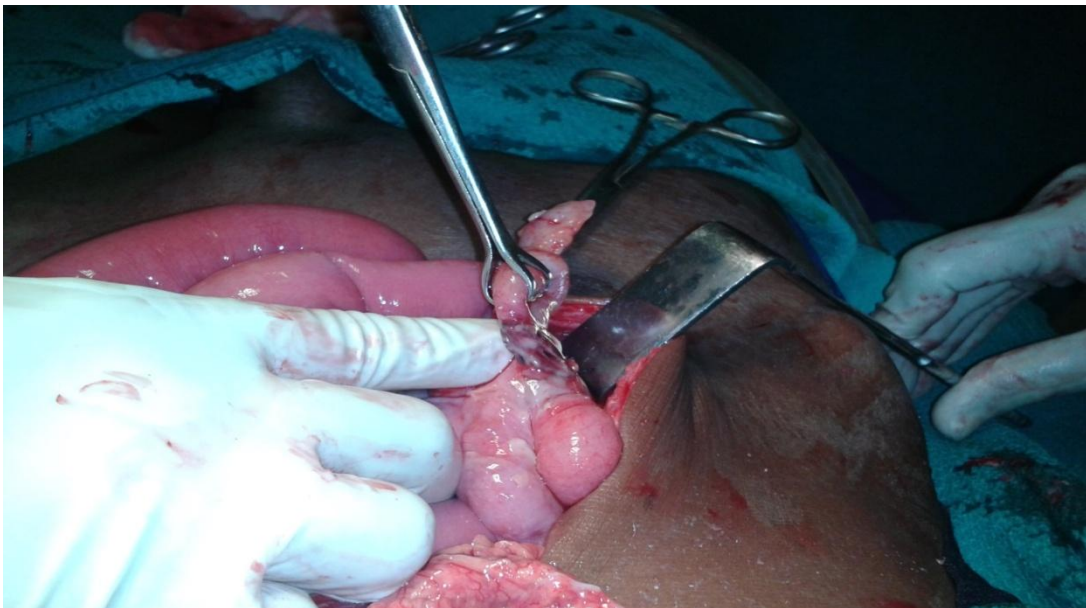


Photo 3. Perforated appendicitis

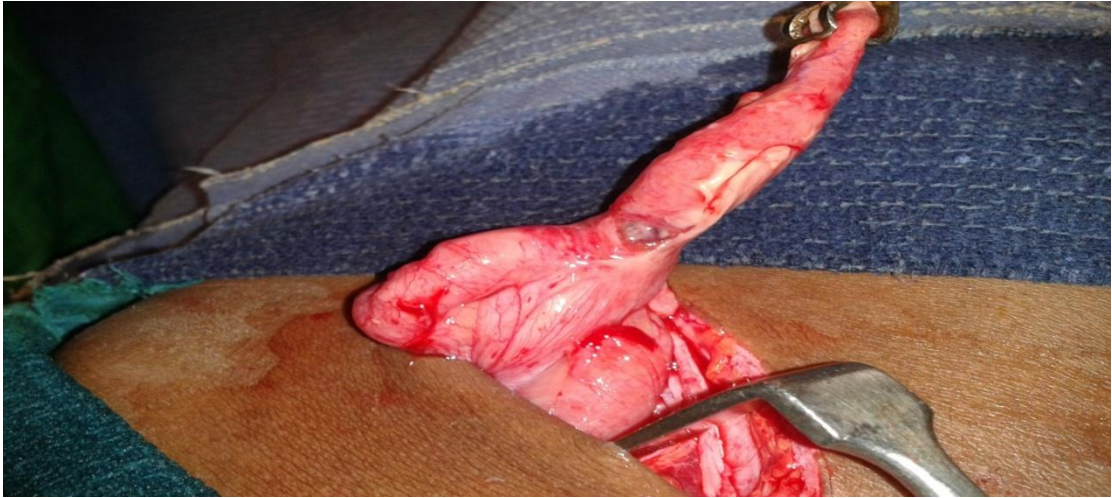


Photo 4. Acute appendicitis operative picture

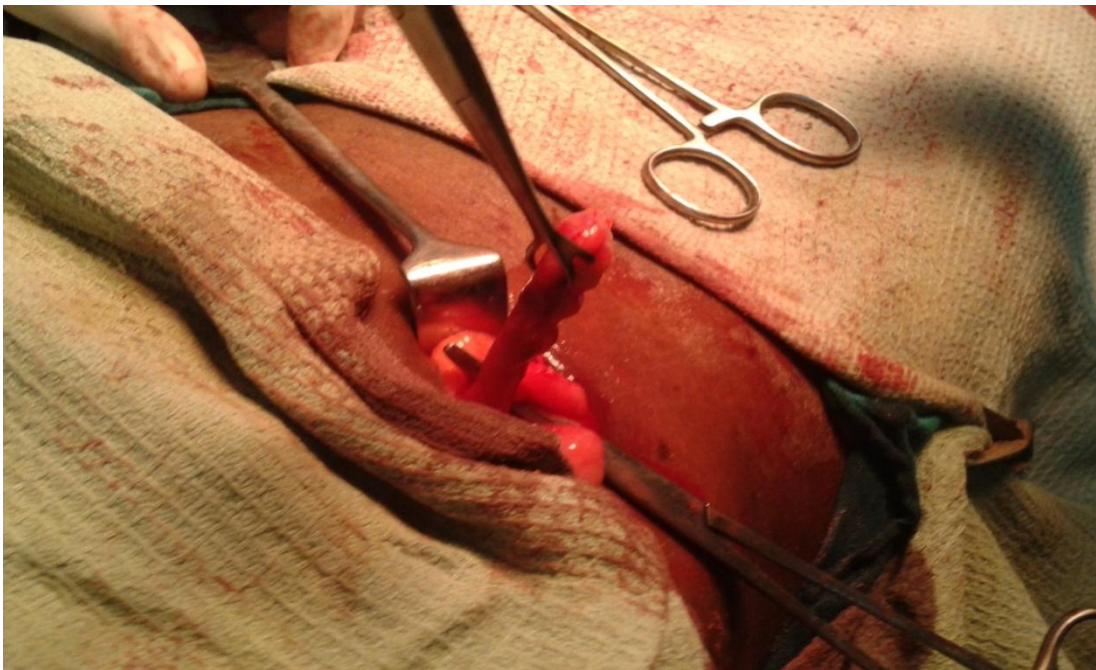


Photo 5. Retrocaecal appendicitis

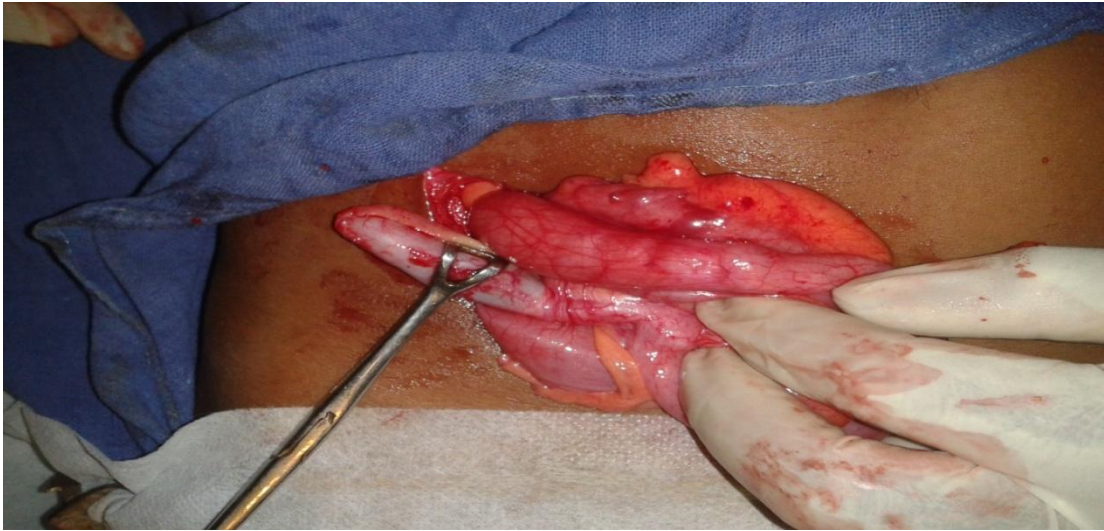


Photo 6. Bulky appendix with about to rupture

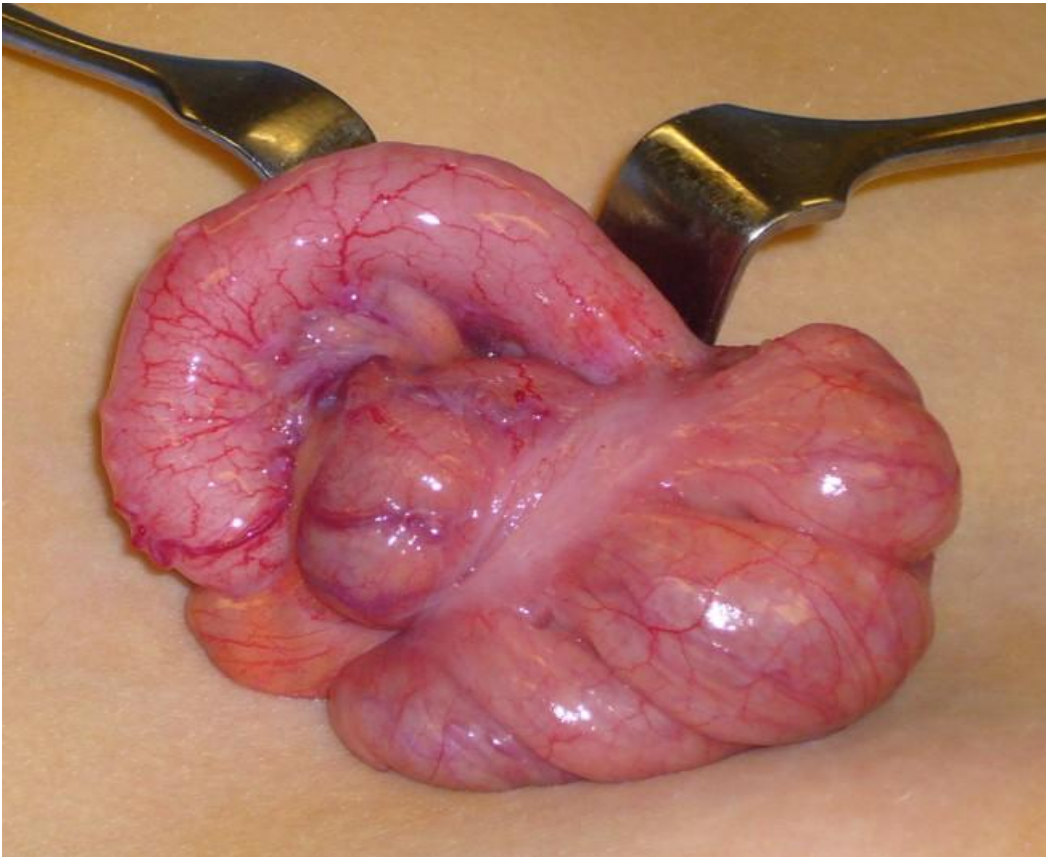
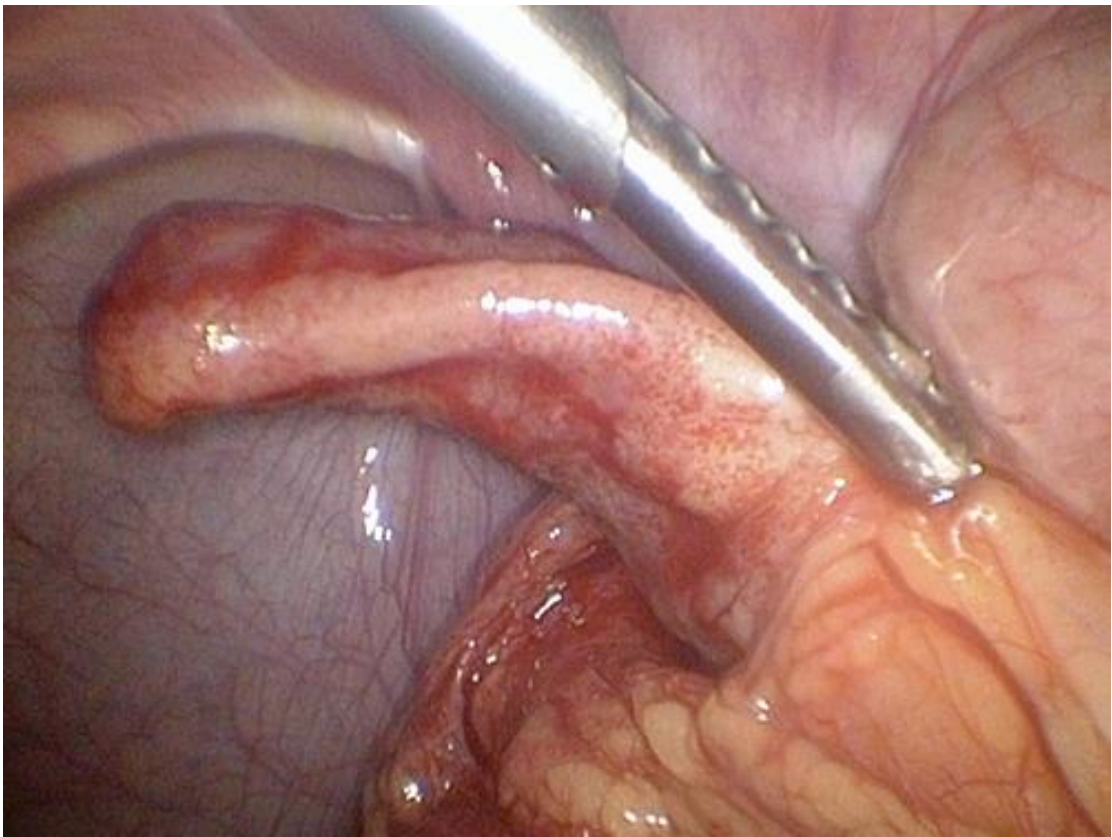


Photo 7. Laparoscopic appendicectomy



ANNEXURE - 4

NAME	In patient no	sex	age	TOTAL BILIR	DIRECT	INDIRECT	SGOT	SGPT	ALP	TOTAL COU	neutrophils	lymphocyte:	monocytes	eosinophil	PRE OP DIA	uninflame	inflamed	complicated
grace mary	43586	f	21	1.2	1	0.2	12	21	112	10,200	78	19	3	0 AA		I		
aruna	13527	f	30	0.7	0.5	0.2	45	32	56	14,300	86	11	2	1 AA				C
ashok	42573	m	18	1.7	1	0.7	33	45	84	8100	71	19	5	4 AA		I		
lakshmi	42362	f	29	0.9	0.7	0.2	27	11	73	10800	66	25	5	4 AA	N			
glory	42050	f	40	1.4	1	0.4	36	19	125	11400	72	26	2	0 AA		I		
rahul	41290	m	19	3.2	2.4	0.8	42	16	115	15500	74	17	5	0 AP				C
venkatesar	41804	m	20	2.2	1.7	0.5	9	27	99	12500	65	22	7	4 AA		I		
sudha	41378	f	35	2.1	1.4	0.7	21	33	83	7400	87	9	4	0 AP				C
bhavani	41126	f	21	2.4	1.9	0.5	34	19	76	8700	58	26	10	4 AA		I		
gnanavel	40420	m	25	0.8	0.6	0.2	40	14	64	10900	81	14	5	0 AA	N			
gokul	40990	m	16	1.9	1.4	0.5	18	26	58	12600	73	16	4	1 AA		I		
latha	53542	f	38	4.2	3.1	1.1	23	21	121	12400	81	17	2	0 AA				C
loganathan	40948	m	48	1.2	0.8	0.4	39	35	110	9100	67	21	8	2 AA		I		
ellapan	40456	m	23	2.9	2	0.9	11	24	76	17400	90	9	1	0 AA				C
saraswathi	40656	f	35	1.8	1.2	0.6	25	18	84	8800	80	19	1	0 AA		I		
saranya	40523	f	24	0.7	0.4	0.3	29	16	88	11900	79	19	2	0 AA	N			
mani	40297	m	58	0.9	0.6	0.3	34	28	113	8200	52	44	2	2 AA		I		
sugumar	40162	m	38	1.9	1.5	0.4	39	46	141	9900	71	26	3	0 AA		I		
devi	39583	f	19	0.8	0.5	0.3	52	34	131	12600	66	30	3	1 AA	N			
selvarani	39538	f	20	3.7	2.6	1.1	24	28	95	13300	86	13	1	0 AP				C
balaji	39563	m	17	1.2	0.9	0.3	16	15	82	10300	76	23	1	0 AA		I		
suresh	39032	m	28	0.7	0.5	0.2	13	28	91	8500	54	44	1	1 AA		I		
neelavathi	38824	f	17	2.4	1.6	0.8	37	39	63	14300	88	12	0	0 AP				C
murugan	40556	m	38	3.2	2.8	0.4	16	42	33	14000	72	24	3	1 AA				C
ramesh	38941	m	40	1.1	0.8	0.3	13	16	126	13300	66	32	2	0 AA		I		
sudhakar	38510	m	28	0.6	0.4	0.2	22	31	138	12200	76	21	4	1 AA		I		
purushothr	37886	m	22	1.6	1.1	0.5	41	41	95	10300	72	24	4	0 AA		I		
koteswarar	37694	m	31	2.1	1.4	0.7	27	33	87	8300	68	28	3	1 AA	N			
rajini	36990	m	23	0.8	0.4	0.3	19	21	126	9900	55	39	4	2 AA		I		
prasanth	37481	m	21	1.4	0.9	0.5	23	12	138	7500	64	31	5	0 AA		I		
kalaivani	37261	f	18	1.8	1.4	0.4	14	21	69	11400	74	16	8	2 AA		I		
gunasekara	43202	m	34	0.8	0.6	0.2	18	14	76	18400	88	10	2	0 AP				C
rajesh kanr	36520	m	22	2	1.3	0.7	38	30	84	12900	72	22	4	2 AA		I		
murugesan	36478	m	35	0.9	0.6	0.3	31	20	114	11200	63	27	7	3 AA	N			

mythili	38204 f	28	2.6	1.8	0.8	21	18	127	14700	85	13	1	1 AP		C
amul	36395 f	26	3.3	2.3	1	34	25	94	15500	79	20	1	0 AA		C
muniyamm	35632 f	35	1.4	1.1	0.3	25	38	83	13200	74	24	1	1 AA	I	
prabhu	33618 m	30	0.6	0.4	0.2	21	31	82	11800	75	20	3	2 AA	I	
thirumalai	35590 m	24	1.3	0.8	0.5	42	29	135	7900	66	29	5	0 AA	I	
venkatesar	35603 m	28	1.6	0.9	0.7	44	39	94	9400	72	26	1	1 AA	I	
elumalai	35720 m	64	2.1	1.4	0.7	15	19	76	9600	79	18	3	0 AA	I	
magesh	35704 m	23	2.3	1.3	1	25	47	92	14200	86	9	4	1 AA	I	
sundar	40911 m	33	4.1	3.2	0.9	34	21	88	16300	90	9	1	0 AA		C
navaneetha	35250 f	32	0.8	0.7	0.1	19	34	119	12200	72	24	3	1 AA	I	
ranjitham	34965 f	50	0.6	0.4	0.2	27	26	98	13400	71	25	3	1 AA	N	
mahalakhn	34930 f	33	2.1	1.3	0.8	34	21	124	9800	63	35	2	0 AA	I	
manivanna	34761 m	17	1.8	1.3	0.5	18	13	112	11700	70	28	1	1 AA	I	
vinoth	34609 m	26	1.9	1.4	0.5	22	18	94	6800	54	35	11	0 AA	I	
vadivel	34276 m	23	0.6	0.4	0.2	29	16	86	10400	68	22	10	0 AA	I	
udhayakun	34041 m	33	2.2	1.8	0.4	34	28	93	10700	78	20	1	1 AA	I	
sagayamar	33940 f	44	0.8	0.7	0.1	16	33	116	6200	69	24	7	0 AA	N	
anandan	33850 m	18	1.8	1.1	0.7	35	44	93	13200	80	19	1	0 AA	I	
yuvaraj	22990 m	23	2.6	1.6	1	16	15	127	12900	86	13	1	0 AP		C
nishar ahm	33895 m	20	3.4	2.8	0.6	17	37	74	16600	76	22	1	1 AA		C
manikanda	33752 m	25	2.3	1.5	0.8	46	18	68	12100	64	32	2	2 AA	I	
ravisankar	33120 m	18	0.8	0.6	0.2	33	26	56	11500	71	22	6	1 AA	I	
sekar	32095 m	46	1.7	1.2	0.5	27	34	94	8900	71	20	9	0 AA	I	
manjula	32778 f	26	3.9	3	0.9	29	19	112	15800	74	18	8	2 AA		C
jayasurya	31727 m	18	1.9	1.4	0.5	18	26	134	12600	71	28	1	0 AA	I	
kaniyappar	30466 m	60	1.5	0.9	0.6	16	31	110	13800	78	16	5	1 AA	I	
renuka dev	31489 f	38	2.8	1.8	1	10	20	84	14400	89	9	1	1 AP		C
saranraj	31172 m	23	1.8	1.4	0.5	28	34	92	11200	76	15	8	1 AA	I	
dinesh	31098 m	24	2.1	1.2	0.9	32	18	113	11100	62	28	10	0 AA	I	
jeyalakshm	31068 f	19	1.4	0.9	0.5	38	24	125	14700	73	20	7	0 AA	I	
sakunthala	30372 f	30	3.7	2.9	0.8	24	31	86	18700	79	16	3	2 AA		C
lokesh	30531 m	18	1.2	0.8	0.4	14	26	72	10400	68	20	8	4 AA	I	
rajasekar	29666 m	23	0.6	0.5	0.1	19	37	118	9400	76	18	6	2 AA	I	
sangeetha	29625 f	25	1.8	1.1	0.7	16	44	62	8300	54	35	10	1 AA	I	
kumar	29543 m	19	4.4	3.6	0.8	14	28	58	16800	86	9	4	1 AP		C
mariyamm	26981 m	35	2.8	2	0.8	28	16	134	13300	88	10	2	0 AA		C
ravi	28758 m	39	0.7	0.5	0.2	38	25	126	14200	74	22	3	1 AA	N	

mala	25004 f	21	2.1	1.6	0.5	26	20	94	11600	68	24	8	0 AA		I
rajesh	26637 m	26	0.7	0.4	0.3	18	28	86	12800	76	20	3	1 AA		I
ahilesh	26257 m	18	1.8	1.2	0.6	34	35	96	7700	54	36	10	0 AA		I
anandan	26239 m	37	1.1	0.9	0.2	17	14	116	6600	62	32	5	1 AA		I
mohan	25933 m	19	1.6	1.1	0.5	29	17	92	11900	70	18	7	5 AA	N	I
nandhini	25246 f	20	2.6	1.8	0.8	40	26	64	12100	71	23	4	2 AA		I
doss	26226 m	38	0.8	0.7	0.1	30	32	110	9800	64	32	3	1 AA		I
kaniammal	18850 f	35	1.3	0.9	0.4	26	28	124	13800	73	20	5	3 AA		I
prabhu	25091 m	21	1.7	1.4	0.3	24	14	114	10300	70	24	3	3 AA		I
mariyam.	24951 f	33	0.9	0.6	0.3	16	23	96	14700	82	16	1	1 AP		C
thiyagaraja	24971 m	21	2.4	1.7	0.7	31	38	84	11900	66	28	4	2 AA		I
anthony sar	23802 m	42	0.9	0.8	0.1	20	41	64	15600	91	8	1	0 AA		C
porkodi	19598 f	30	1.6	1.2	0.4	24	28	77	11400	70	18	10	2 AA		I
srinivasan	19475 m	30	2.1	1.5	0.6	31	34	82	9400	58	42	8	2 AA		I
anandhi	18413 f	28	1.1	0.7	0.4	15	18	64	9400	74	22	3	1 AA		I
jebarani	21355 f	28	2.9	2.1	0.8	45	35	125	16800	85	13	1	1 AA		C
selvaraj	21159 m	36	2.1	1.5	0.6	33	16	134	13500	72	19	7	2 AA		I
nithyanand	15235 m	20	1.7	1.2	0.5	24	22	85	11900	76	20	3	1 AA		I
datchyani	13676 f	26	0.9	0.5	0.4	19	28	81	8800	56	39	4	1 AA	N	
chinnaponr	16378 f	45	1.9	1.4	0.5	17	35	96	12700	71	28	1	0 AA		I
malliga	12513 f	43	1.7	1.3	0.4	28	12	112	11800	74	22	11	3 AA		I
ragavan	15912 m	25	1.6	1.1	0.5	35	36	135	9100	76	22	1	1 AA		I
arunpandiz	17667 m	20	0.6	0.4	0.2	41	45	68	10200	70	24	4	2 AA		I
ezhilarasan	44033 m	24	3.9	3.2	0.7	11	34	74	15500	88	10	1	1 AP		C
moorthy	44246 m	23	1.4	1.2	0.2	18	18	118	13400	77	16	6	1 AA		I
mary	43308 f	34	2.1	1.7	0.4	25	36	126	12300	68	28	3	1 AA		I
amudha	40818 f	43	1.3	0.9	0.4	21	25	114	11600	71	26	2	1 AA		I
loganathan	40956 m	35	0.7	0.4	0.3	29	31	94	10800	66	32	2	0 AA	N	
ramya	40705 f	28	1.3	1.1	0.2	32	33	86	13300	80	18	1	1 AA		I