

A DISSERTATION ON

**“ COMPARING THE DIAGNOSTIC ACCURACY OF CT AND
USG IN THE DIAGNOSIS OF ACUTE APPENDICITIS ”**

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BONAFIDE CERTIFICATE

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DECLARATION

I, certainly declare that this dissertation titled, “**COMPARING THE DIAGNOSTIC ACCURACY OF CT AND USG IN THE DIAGNOSIS OF ACUTE APPENDICITIS**”, represent a genuine work of mine. The contribution of any supervisors to the research are consistent with normal supervisory practice, and are acknowledged.

I, also affirm that this bonafide work or part of this work was not submitted by me or any others for any award, degree or diploma to any other university board, neither in India or abroad. This is submitted to The Tamil Nadu Dr.MGR Medical University, Chennai in partial fulfilment of the rules and regulation for the award of Master of Radiodiagnosis Branch VIII

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LIST OF ABBREVIATION

- CRP - C reactive protein
- WBC - White blood count
- PPV - Positive Predictive value
- NPV - Negative Predictive value
- PR - Perforation Rate
- NAR - Negative Appendectomy Rate
- ED - Emergency department
- HPE - Histopathology
- CT - Computed Tomography
- USG - Ultra sonogram
- No - Number
- n - Number of case
- β -HCG - Human Chorionic Gonadotropins

ABSTRACT

AIM OF THE STUDY:

- The Aim of the study was to evaluate the accuracy of CT and USG in the diagnosis of acute appendicitis in patients who are taken for appendectomy on clinical basis
- To calculate the sensitivity ,specificity positive predictive and negative predictive value of CT and USG

METHODOLOGY

Patients who were admitted in the surgical emergency ward with clinical findings and symptoms suspected of appendicitis .A total study sample of 100 was selected

USG PROTOCOL

A routine USG was done in SONOSCAPE machine for the upper abdomen and pelvis using a 3-5-MHz convex transducer to rule out alternative abnormalities related to solid organs and to rule out free fluid.Then graded compression and colour Doppler sonography of the right lower quadrant giving attention to the site of maximal tenderness was performed using a linear transducer.

CT PROTOCOL

Examinations were performed on a MDCT performed using a 4-slice C scanner (TOSHIBA) at 120 kVp and 100 mAs; a pitch of 1 was used. CT of the lower abdomen and pelvis, from the xiphoid to the pubic symphysis, was performed with 80 mL of non-ionic contrast material Iohexol 350 (Omnipaque 350) was injected through a 18-gauge cannula placed in the volar aspect in the cubital vein at a flow rate of 4 ml/s and delay of 50 sec.

Axial reconstructions from the raw data were done at 3 mm thick, at 1.5-mm increments were obtained. The second data set was reformatted coronal at a thickness of 3 mm with 3-mm increments .No oral contrast was used.

RESULT

From the study it is concluded that CT is more sensitive ,specificity ,PPV,NPV. Hence the CT investigation is more accuracy than USG in diagnosing cases of appendicitis.

CONCLUSION

Evaluating a case of appendicitis is mainly clinical ,depending on the clinical scores and signs. But there is increase in the negative appendectomy rate on depending only on clinical findings .

Usually USG is the first primary techniques ,considering its easy availability, low cost and reproducible with no radiation But it has its own pitfalls ,being operator dependent .

CT on the other hand is more specific than USG and hence could rule out appendicitis .

Most of the studies including our study has shown that CT has more sensitivity, specificity ,Negative predictive value and Positive predictive value in diagnosing appendicitis.

Weighing the cost versus the radiation and the real need to rule out appendicitis ,and the dire need in search of alternate diagnosis should be considered before deciding over which imaging modality to choose.

But CT without doubt has definitely more diagnostic performance than USG in acute appendicitis and our study also proves the same.

INTRODUCTION



Vague abdomen pain is the most commonly encountered symptom in the emergency department at any hospital. It may be associated with vomiting, fever and diarrhoea but the most distressing symptom is the pain. As the pain threshold varies from person to person the severity of the disease could not be evaluated taking, only this symptom into account.

The various cause of the abdomen pain may vary from benign to life threatening disease. Diagnosing and treating the condition in time is in the hands of the surgeons or the physician who handle them. Time is a very important factor as any delay may lead to grievous consequences like perforation , and may lead to morbidity and in some case also mortality. Hence timely diagnosis is crucial and remains a challenge to the people in medical field.

Appendicitis is the most common cause of abdomen pain in patients admitted at the emergency department. Diagnosing this in young male patient is mostly straight forward, but the same becomes a problem in premenopausal women with similar clinical history and symptoms.

This is mainly due to the reason that number of gynaecological problems in women can present with abdominal pain mimicking appendicitis. So it becomes a real challenge to exclude the diagnosis in women more than diagnosing a positive case of appendicitis.

Problems also arise in extremes of age because of the delay in seeking medical care, or difficulty in obtaining history and it also becomes a mountain moving task in performing an accurate physical examination in these patients.

The timely diagnosis and intervention of acute appendicitis is important due to the fact of its grave complication like perforation. As the increase rate of perforation also increase the morbidity and mortality rates, the first few hours of timely intervention is very crucial.

Some surgeons are in favour of early laparotomy, even if there is no definite diagnosis of appendicitis, taking into account only the clinical findings. This is done mainly to minimize the risk of appendiceal perforation.

REVIEW OF LITERATURE

HISTORY OF APPENDICITIS¹

Appendicitis is a common and frequently made diagnosis . History of appendicitis was made and written in the past two generations.

Hippocrates has given description of a picture similar to that matched, like present appendix of appendicitis with perforation , in his writing title “The Epidemics”:

“The woman who lodged at the house of Tisamenas has a troublesome attack of iliac passion , acute abdominal pain and distension ,much vomiting ;could not keep her drink; pain about the hypochondria, and pain also in the lower part of belly ;not thirsty ;became hot; extremities cold throughout with nausea and insomnolency; urine scanty. Nothing could do her any good. She died”

The appendix was first depicted in western medicine by Leonardo Da Vinci in his drawings. Vesalius in 1541 depicted appendix and listed the central cause of appendicitis as due to a fecolith or a inspissated ball of stool that obstructs the appendiceal lumen.

The function of the appendix was not entirely made out in the fifteenth century. It was recognised as an organ attached to the gut with no role to play in digestion. The lack of obvious function and the

variability of presentation led the Natural Philosophers like Darwin to classify the appendix as vestigial, and harmless organ that could be safely ignored.

Berengaria Carpi, surgeon gave the first description of this structure. He quoted that the organ was empty inside ,measuring 3 inches, present at the end of caecum .He made his findings in the early fifteenth century in 1522.

Twenty-one years later, the findings of Berengaria was augmented by the writings and description by Versalis, who gave several illustrations about the structure of appendix. Much confusion existed between the caecum and the appendix.Versalis insisted to call it vermiformis a “ blind ending pouch”. Fallopius in 1561, compared appendix to a worm like structure.

Anders Celsius in year 1744 quoted in his writings :

"Distemper seated in the large intestine, particularly affecting that part, where I mentioned the caecum to be, accompanied by violent inflammation and vehement pains, particularly in the right side" .He described something similar to appendix.

Jacopo Berengaria Carpi was the first who found that the pain in right lower quadrant was due to appendix.

The three coats of appendix along with the mucous glands, the meso-appendix the peritoneum fold adjacent to the appendix, in this region was described at the start of nineteenth century.

The mucous membrane of appendix was found by Gerlach in 1847. He also found that these mucous membrane, function as a valve to occlude the appendiceal lumen.

In 1711 Lorenz Heister described the blackened stump of an acute gangrenous appendix in his dissection. The appendix was first removed in a planned operation by Dr. Lawson Tait in the year 1880.

In 1886, Reginald H. Fitz of Boston gave a clear picture that the, inflammation of the right iliac fossa, the “fons et origomali” was the vermiform process of the caecum. He was the first to use the term “appendicitis” in his article. Now the word appendix is universally used.

The three classical sign of pain in the right lower quadrant with fever and chills, and peritonitis was contributed by McBurney in 1889. He also described, what is now the Mc Burney’s point, the point of

maximum tenderness at the junction of a line drawn from umbilicus to anterior superior iliac spine.

Dr. Deaver says, "So many times does it appear that acute observers stumbled on the very threshold of the discovery that the original lesion in these conditions was in the vermiform appendix, that it seems scarcely credible that for less than forty five years have we had any adequate knowledge of appendicitis."

Perforated appendix was closed by suture in the year 1887 by Sand and revised later in 1888 by Treves. Since 1890, the history of appendicitis has been one of refinement in the technique and the diagnosis. Today we have a multiplicity of signs and symptoms, that aids to the diagnosis of appendicitis.

ANATOMY OF APPENDIX

The vermiform appendix is a tubular structure from the postero medial portion of caecum. It is a blind ending tubular structure. It is situated inferior to the ileo caecal junction. The length varies from 7.5 to 10mm.

The base of the appendix lies in a constant position. The base is formed by the confluence of the taenia coli. Base of the appendix is roughly deep to the McBurneys point. Localised pain and guarding at this point is the most important physical examination finding for the diagnosis of appendicitis

While the base of the appendix is essentially constant the free end of the appendix or the tip of the appendix is found in various position. And this different location of the appendix sometimes lead to false negative diagnosis at USG imaging .The position also influence the clinical finding².

The position may be retrocaecal ,post and pre ileal ,pelvic, midinguinal and subcaecal or paracolic.

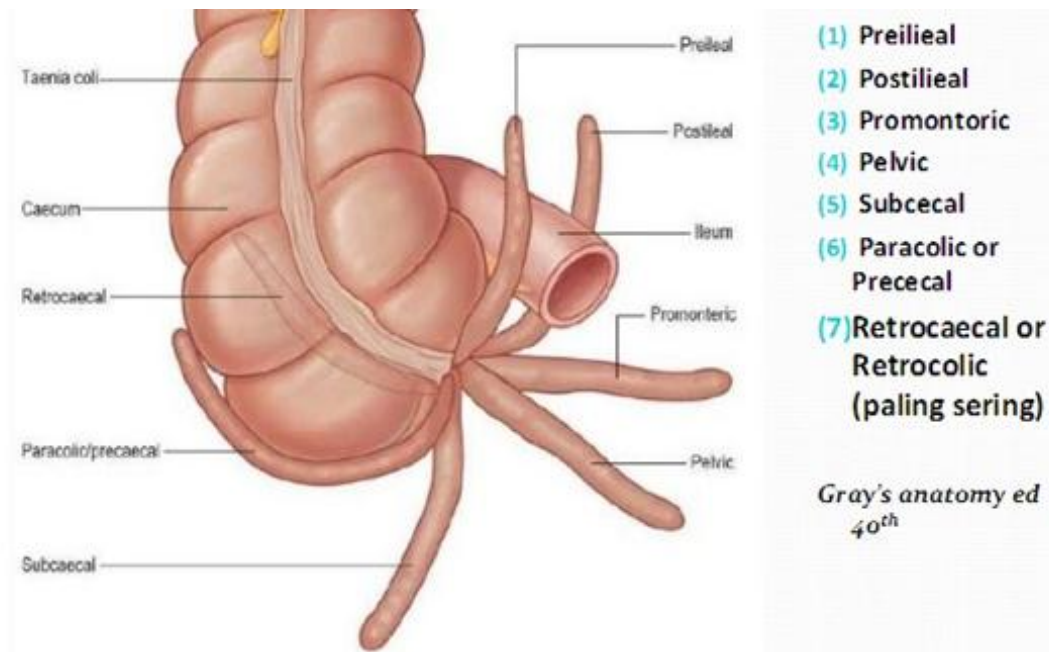


Fig: 1 Various position of appendix

The appendix is suspended by a fold of peritoneum which is a part of the mesentery of the terminal ileum and gets attached to the caecum and proximal part of the appendix. This is called the mesoappendix and contains the appendicular artery, a branch of ileocolic artery. The ileocolic and the right colic drains the appendix to the portal system³.

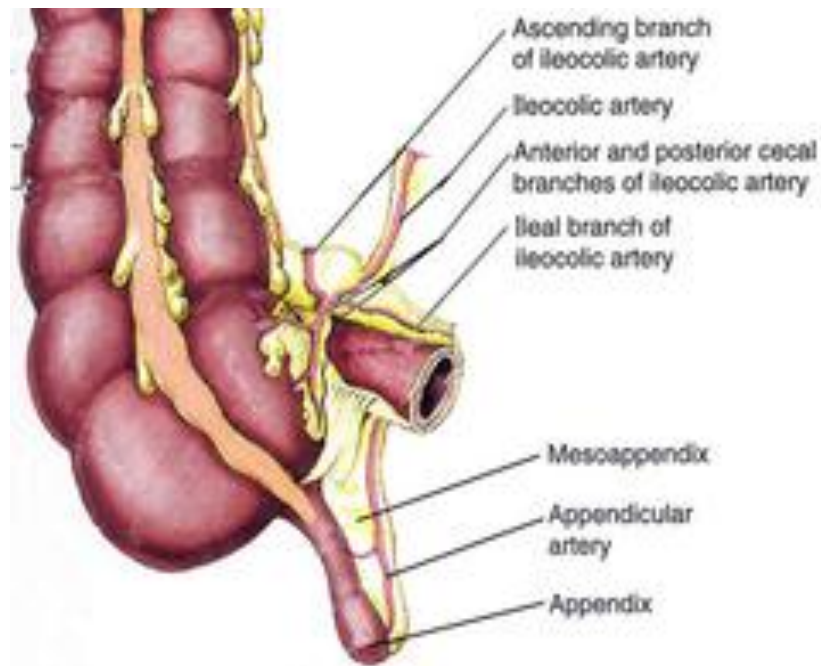


Fig:2 Arterial Supply of appendix

The lymphatic drainage is via the ileocolic node along the superior mesenteric to celiac and end in cisterna chyli. Nerve supply is through T10 spinal segment which also explains the pain that is sometimes referred to the periumbilical region.

HISTOLOGY OF APPENDIX

There are 5 layers from inner to outer.They are

- The mucosa,
- Lamina propria,
- Sub mucosa,
- Muscularis, and
- Adventitia.

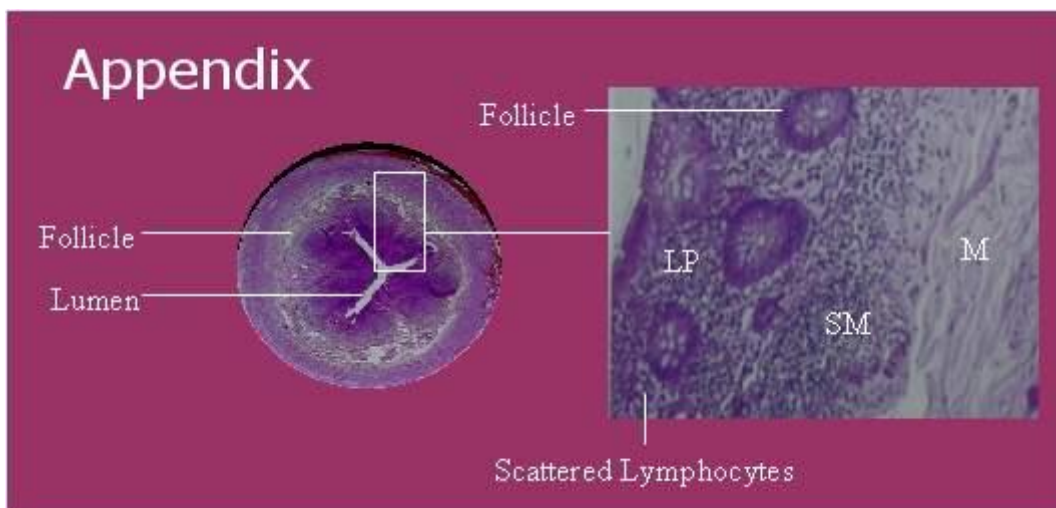


FIG:3 HISTOLOGY PICTURE OF APPENDIX

Lamina propria(LP),Submucosa(SM) and muscularis layer

It has no digestive glands or secretory ducts, which confirms the vestigial nature of the organ with no digestive function. It has a role in immunity, which is suggested by the presence of lymphoid aggregations in the submucosal layer. The aggregates are responsible for the immense inflammatory response in case of acute appendicitis. However, loss of this organ does not endanger the immune system of an individual.

PATHOPHYSIOLOGY OF APPENDIX

Appendicitis is mainly due to obstruction of the appendicular lumen. The obstruction may be due to foreign body, Crohn's disease, parasite infection, gastroenteritis, upper respiratory tract infection, fecolith and lymphoid hyperplasia.

Within the obstructed lumen, there is an increase in mucous secretion and hence, there is an increase in intraluminal pressure causing distension of the appendix.

Mucosal edema and ulceration occur with overgrowth of bacteria. With an increase in luminal pressure, there is venous obstruction and vascular congestion of the appendix extending up to the serosal surface.

The increase in pressure also stretch and stimulate the nerve endings of the visceral efferent which is perceived by the patient as periumbilical or epigastric pain.

When the inflammation spread to the peritoneum the pain shifts to the right lower quadrant. Venous congestion and stasis may cause thrombosis which results in gangrene of the appendix.

At the end stage due to tissue ischemia the appendix get infarcted and perforated.

Rupture of appendicitis may cause the inflammatory process to spread, with inflammatory thickening of the adjacent bowel loop, or abscess and collection at the ruptured site.

These features leads to generalised peritonitis. Sometimes the collection gets walled off by the greater omentum and bowel loops causing a phlegmatous mass.

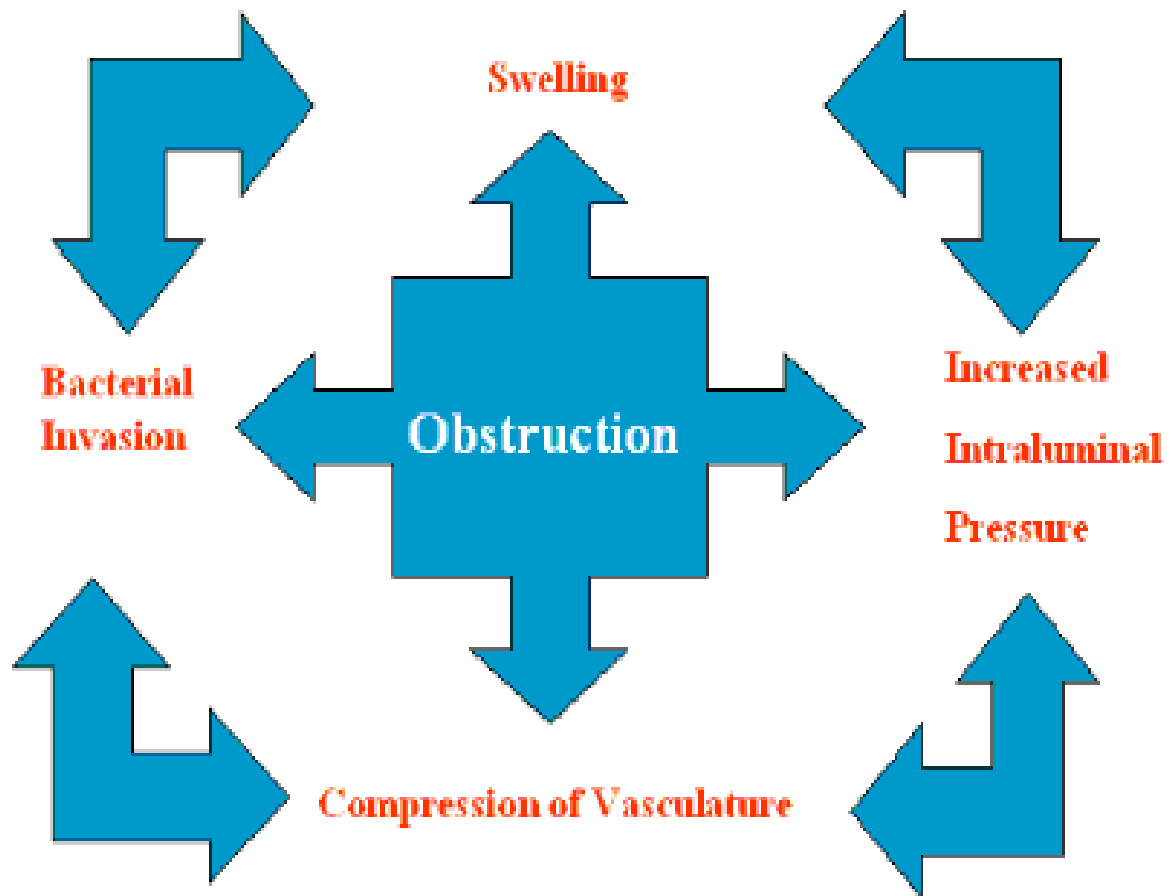
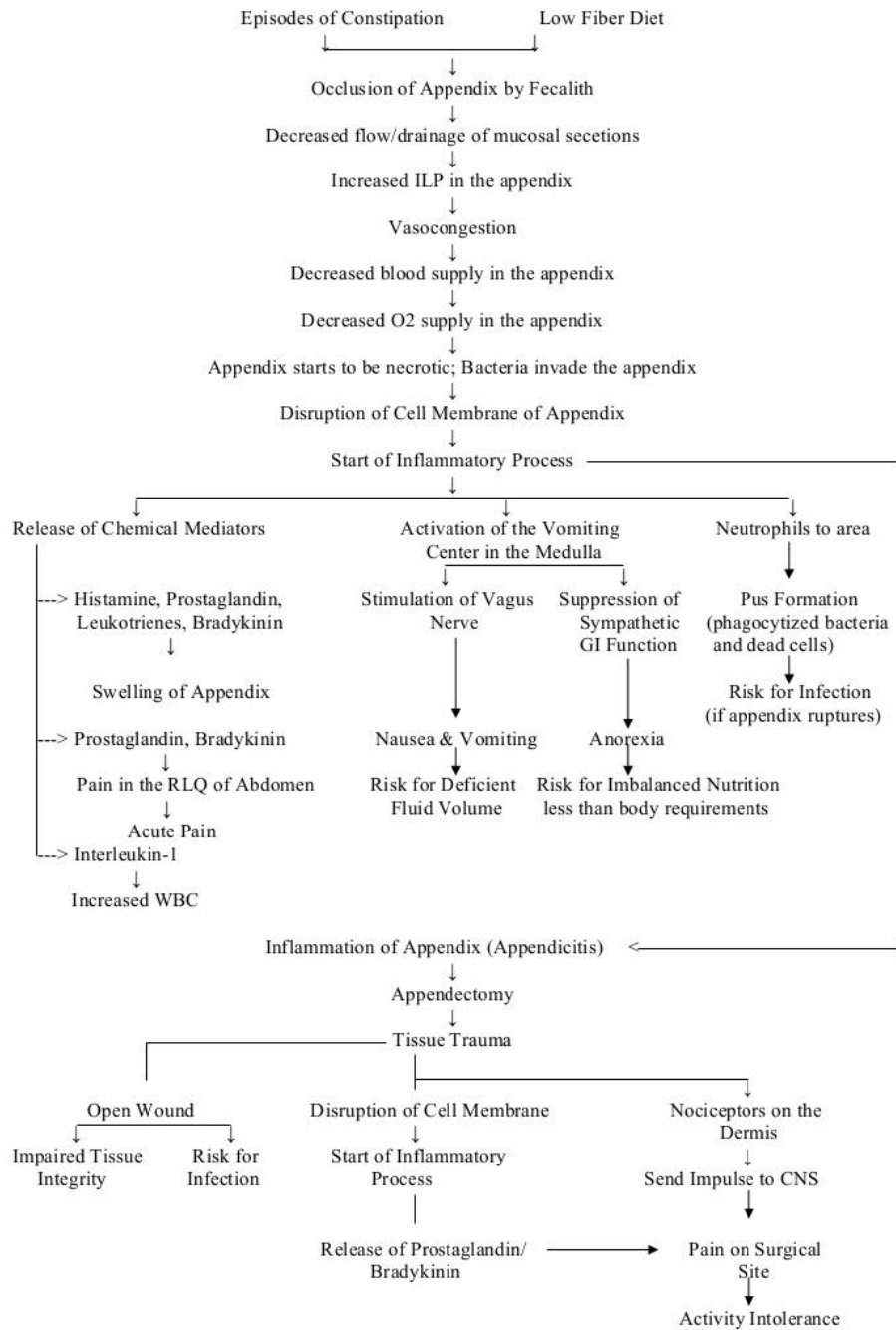


FIG:4 CYCLIC CHANGES IN APPENDICITIS

Fig:5 Representative algorithm of pathophysiology of Appendicitis



History and physical examination

The diagnostic cornerstone in the evaluation of acute abdomen pain is history taking and physical examination. Combination of various signs and symptoms may support the diagnosis.

Three signs most predictive of acute appendicitis^{4,8}

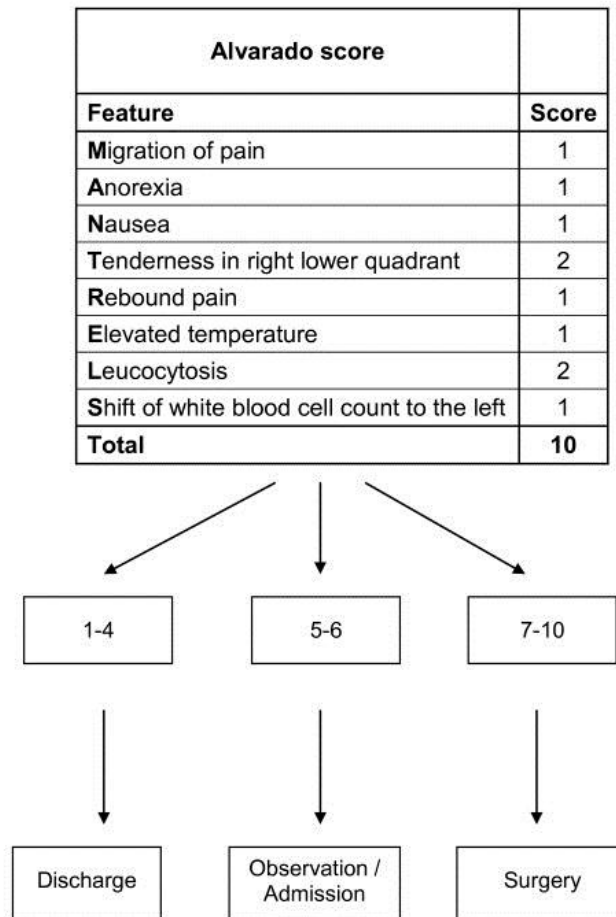
- The right lower quadrant pain
- Abdominal rigidity
- Migration of pain from the periumbilical region to the right lower quadrant
- The duration of pain contribute to an important predictor^{5,8} .

Misdiagnosis is most common, among women due to gynaecological problems like pelvic inflammatory disease, ruptured ovarian follicle, and ectopic pregnancy^{6,8} and mimics like gastroenteritis, urinary tract infection.

Predictors of pelvic inflammatory disease^{7,8}

1. history of vaginal discharge,
2. urinary symptoms,
3. tenderness outside the right lower quadrant
4. cervical-motion tenderness

Acute appendicitis is a clinical diagnosis. Most of the surgeons and physician depends on various clinical scoring system for the accurate diagnosis of appendicitis. Among the various scoring system ALVARADO scoring is commonly used in practice.



Predicted number of patients with appendicitis:

- Alvarado score 1-4 - 30%
- Alvarado score 5-6 - 66%
- Alvarado score 7-10 - 93%

FIG:6 ALVARADO SCORE (ref:Alvarado et al ⁹⁴)

The ALVARADO Score (MANTRELS)

Alvarado published clinical score for appendicitis in the year 1986. He compared suspected patients with common clinical and laboratory findings with the pathologically proven acute appendicitis.

Eight criteria were chosen to be included in the diagnostic score. Most predictive and prevalent was the right lower quadrant pain and a left Shift of WBC count .

Each criteria was given 1 point .Right lower quadrant pain and leucocytosis was given 2 points each reaching a total of 10.The score was applied to adults and children , with an age ranging from 4 to 80 years.

An Alvarado Score of ≥ 7 was considered high risk for appendicitis with sensitivity of 81% and a specificity of 74%^{94,95}.

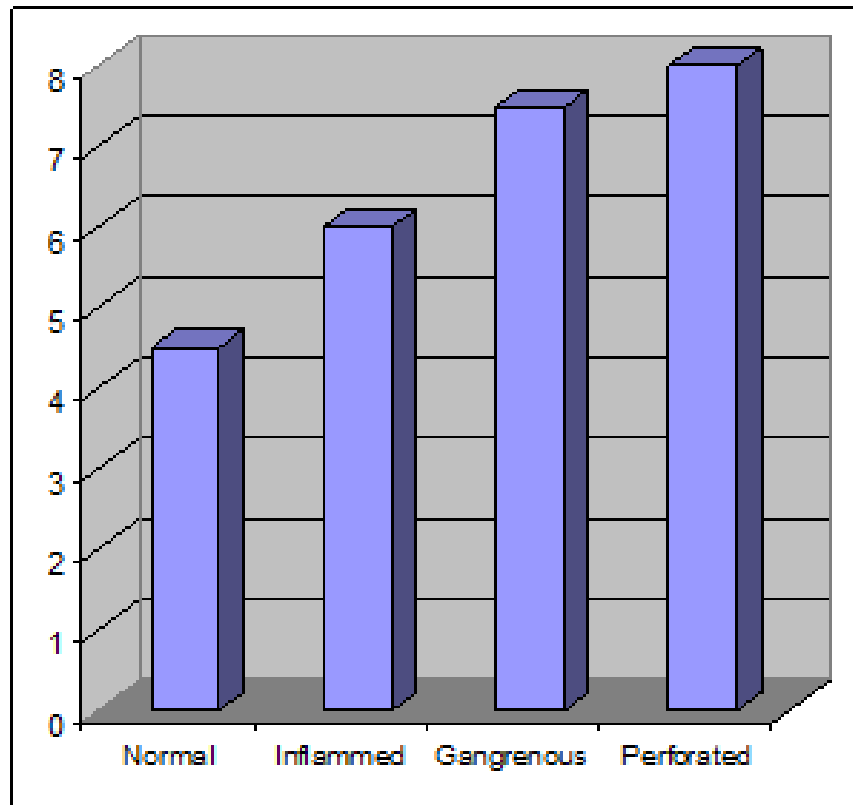
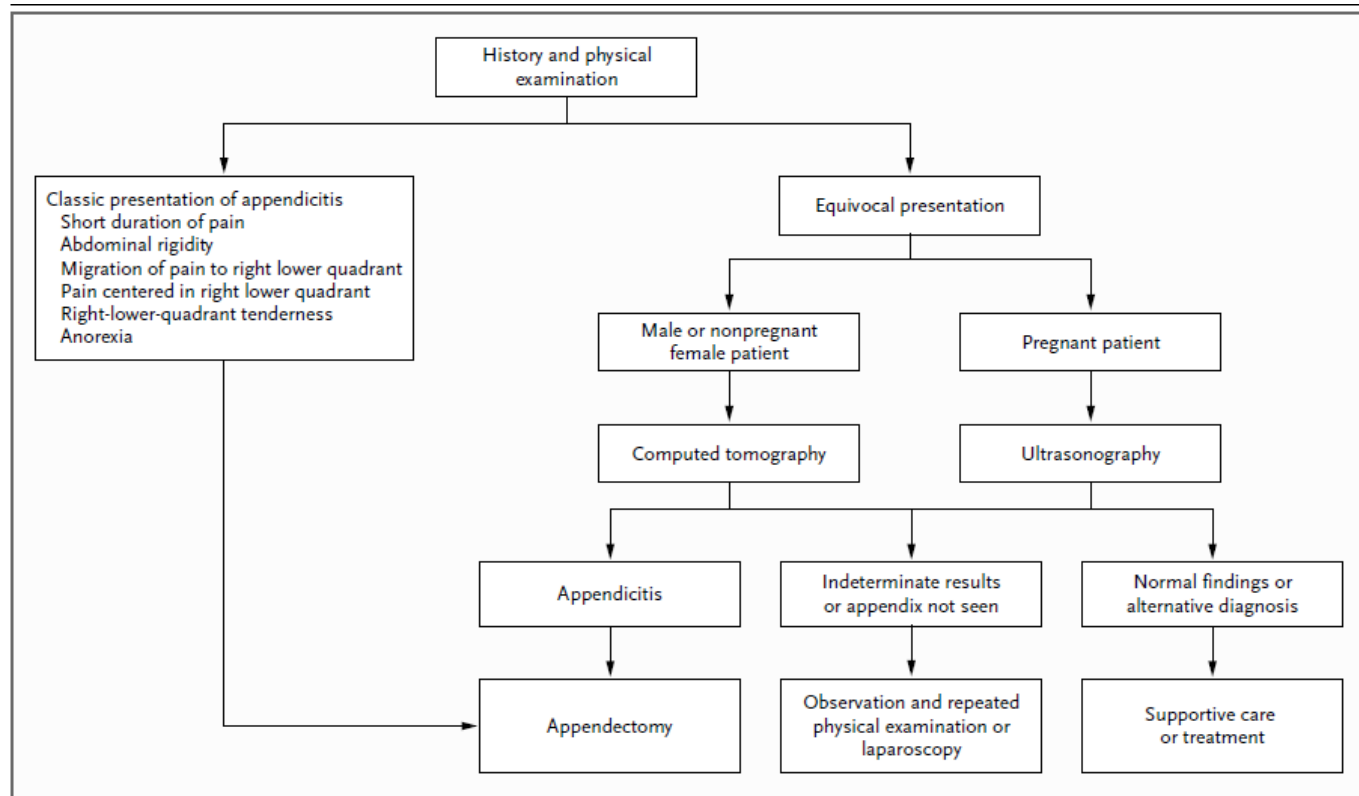


FIG: 7 The mean ALVARADO score of different categories of inflamed appendix are compared with each other and the p value was found to be .001 ($p < 0.05$), which is statistically significant.

Fig:8 Algorithm for suspected case of appendicitis



Laboratory testing

Routine investigation of the patients admitted with right quadrant pain includes the laboratory investigations like complete blood count , c-reactive protein , the urine routine and urine culture examination .

The investigation of female patient under the age group of 25-45 years or the reproductive age group includes the β -HCG (Human Chorionic gonadotropins) level in order to exclude ectopic pregnancy.

The inflammation of appendix may cause hematuria, pyuria which may be similar to the presentation, in patients with urinary tract infection .Studies have shown such patients to be about 10%⁹.Hence routine urine examination is important to rule out UTI.

Nearly 70-90% of patients of acute appendicitis have an elevated neutrophil count .It has poor specificity for diagnosing acute appendicitis¹⁰⁻¹⁴.

WBC has been found to be elevated in acute appendicitis which may be due to the mural inflammation of the appendix. Studies have also shown that the WBC count correlates with the severity of appendicitis.

CRP is an acute phase reactant that has similar role as that of WBC in appendicitis ¹⁵. There has been a reported sensitivity of 40-90% and specificity of 27-90% ¹⁶ in the diagnosis of appendicitis.

Another study shows that WBC was found to differentiate normal appendix from the early inflamed appendix, than the CRP level .

Amallesh et al¹⁷ quoted “ The accuracy of CRP for diagnosing acute appendicitis is low and that CRP levels are not useful when deciding on surgery”.

Ortega-Deballon et al¹⁸ concluded “That CRP level is the most useful laboratory parameter in terms of diagnosing acute appendicitis and that CRP levels strongly correlates with inflammation severity of the inflamed appendix ”.

CRP levels were found to be more accurate when there is more severe , an increase in inflammation like that of gangrenous or perforated appendix .Studies have shown , the correlation of CRP level with CT findings and also could predict the probability of the patient going for perforation.

OBSERVATION AND LAPAROSCOPY

Diagnostic laparoscopy has mainly found its advantage in cases that shows equivocal findings ,where the surgeons are in dilemma of relying on the imaging techniques or the diagnostic laparoscopy. The end point is to reduce the unnecessary appendectomy¹⁹.

It is of major use in female patient where many gynaecological problems may mimic appendicitis in 10-20%^{20,21}. These patients warrant some active measures to rule out appendicitis or to favour an alternate diagnosis.

Diagnostic laparoscopy comes into issue, when the surgeons are not in favour of surgery and also reluctant to keep the patients in observation. Both the decision is a double edged sword, where the risk of perforation is more in positive cases and increase, in the rate of unnecessary appendectomy¹⁸ in false negative case.

The practice of observation has reduced the negative appendectomy without increasing the perforation rate²²⁻²⁴. Any diagnostic method delays the time for final diagnosis^{25,26}

Diagnostic laparoscopy has the advantage of²⁷

- Rapid and accurate diagnosis
- Reduce the rate of unnecessary laparotomy²⁸
- Additional caecal and colonic lesion are identified

Disadvantage of diagnostic laparoscopy²⁷

- Invasive Procedure
- Increased expenditure and cost

Hof et al²⁹ quoted “Laparoscopy is the gold standard for diagnosis of patients with suspected acute appendicitis ”. Acute appendicitis can be diagnosed by laparoscopy in early stages .It also lowers the threshold for appendectomy³⁰.

Garbarino and Shimi et al³¹ “Routine use of Diagnostic laparoscope in women significantly reduced the negative appendectomy rate to 5%”

Lim et al.³² “Use of Diagnostic laparoscope changed the therapeutic course of the disease in 31%”

Limitation of Diagnostic laparoscopy is that it could not be compared with the gold standard , no tissue excision is done as it is a diagnostic procedure and hence no specificity or sensitivity calculated.

Diagnostic laparoscopy has the high specificity of 95% as compared to CT and ultrasound of 72 and 63% respectively and PPV of 85%-100%.Women has specificity of 95% in laparoscope compared to 72% in CT and 63% in USG²⁷.

With the improved diagnostic accuracy of (CT) computed tomography, early use of CT has reduced the overall cost and use of hospital resources³³than the observation strategy.

Being a invasive procedure diagnostic laparoscopy also have the added disadvantage with approximately, a 5 percent rate of complications, which in most cases are associated with the use of a general anesthetic²⁰.

DIAGNOSTIC IMAGING IN ACUTE APPENDICITIS

Acute abdomen pain is the most common symptom we encounter in most of the emergency department. The abdominal pain is attributed to many cause, of which the appendicitis occupies within the first few of the cause. Evaluating a case of appendicitis is mainly clinical ,depending on the clinical scores and signs.

But there is increase in the negative appendectomy rate, depending only on clinical findings . And also in patients with atypical and equivocal clinical findings surgeons are in favour of imaging modalities for arriving at a diagnostic conclusion ,rather than to keep the patient in observation.

As the later practice of observation has lead to increase in the percentage of perforation rate, here comes the major role of the imaging techniques like CT and USG.

Considering the imaging technique, there comes a question which is the best or which is the first modality to be considered. Usually USG is the first primary technique recommended considering it's easy availability, low cost and reproducible with no radiation .

But it has its own pitfalls, being operator dependent, highly depending on the skill and experience of the radiologist who does the scan. And also other factors like the built of the patient, and the various position of the appendix , makes it difficult for the scanning radiologist to visualise the appendix .

Sometimes USG also gives a equivocal findings were in we are forced to switch over to CT or other modalities. CT on the other hand is more specific than USG and hence could rule out appendicitis .Both the imaging technique could give an alternate diagnosis if appendicitis is ruled out.

Literature shows many studies that have debated over the best modality for diagnosing acute appendicitis. Most of them come up with more or less the same results. Both the technique have definitely reduced the rate of negative appendectomy in recent years.

Weighing the cost versus the radiation and the real need to rule out appendicitis ,and the dire need in search of alternate diagnosis should be considered before deciding over which imaging modality to choose.

ROLE OF XRAY IN THE DIAGNOSIS OF APPENDICITES

With the advent of newer techniques like CT and USG X ray has outdated, in the diagnosis of appendicitis ,but it confirms the presence of appendicolith in 80-100% which is indicative of an appendicitis, mostly perforated one.

X ray is also of use in the differential diagnosis of renal stone, crohn's disease, ileocaecal tuberculosis, intussusceptions , and malrotation of the gut³⁴. Four out of five patients with false-positive radiographs for acute appendicitis have other conditions like ,ruptured ovarian cyst, leaking carcinoma of the caecum, or a low-lying inflamed gallbladder.

This emphasis the fact that radiology reflects all diseases affecting the right lower quadrant, the commonest being acute appendicitis. Abdominal X-ray is neither sensitive nor specific for appendicitis but can provide clues to an alternate diagnosis or clue in favour of appendicitis.

Ellis³⁴ recommends plain x-ray films of the abdomen in all cases acute abdomen. Brooks and Killen have listed these radiological signs for acute appendicitis:

RADIOLOGICAL FEATURES IN ABDOMINAL X-RAY

- i) Air-fluid levels localised to the caecum and/or terminal small bowel are indicative of localised inflammation in the right lower quadrant of the abdomen.
- ii) Localised adynamic ileus ,gas in the caecum, ascending colon and terminal ileum.
- iii) Increased soft-tissue density in the right lower quadrant.
- iv) Blurring of the right flank stripe.
- v) Appendicolith, the calcified concretions in the appendix with typical laminated densities in the right lower quadrant
- vi) Alteration of the psoas outline and blurring of its distal third.
- vii) Gas-filled appendix, a rare but valuable sign.
- viii) Extra luminal gas or free gas in the peritoneal or retroperitoneal space.
- ix) Deformity of the caecum.
- x) Blurring of the psoas shadow on the right side.

ULTRASOUND IN THE DIAGNOSIS OF APPENDIX

USG is a simple procedure that can be done. It is a non-invasive technique and it is also cost effective and easily available even at primary centres.

It was introduced by Puylaert in the year 1986 which was nearly ten decades after Fitz published his paper on acute appendicitis.

Ultrasound is used as the first diagnostic modality, followed by CT scan of the abdomen, if only the ultrasound is negative or equivocal.³⁵⁻³⁸ It also avoids excessive radiation.

The common technique used is the graded compression. This has the advantage of displacing gas filled bowel loops between the abdominal walls. This helps in better visualization of the appendix free from the intestinal loops. Lean patients have higher rates of detection of appendicitis with USG.³⁹⁻⁴¹

FIG:9 VARIOUS METHODS OF GRADED COMPRESSION



“The patient should be placed in the supine position for the ultrasound examination, and a high-frequency linear array transducer should be applied to the anterior abdominal wall over the area of maximal tenderness”

Limitations in visualising normal appendix

Various factors like obesity and position of the appendix may limit the normal visualisation of appendix. Various USG techniques help the radiologist in such cases. Patients may be put in left lateral or a posterior manual technique, may help in visualising the appendix in case of the appendix being retrocaecal in position.

Sometimes the ascending in the right iliac fossa may mislead the scanning radiologist. These bowel loops may also sometimes appear as a non peristaltic loop. At times like these, added techniques like posterior manual compression or the left lateral decubitus would be of use.

Posterior manual compression is done with additional compression given to the patient's back in an anterior direction by keeping a hand in the posterior of the trunk in the right lumbar region.

Lateral decubitus position is used to visualise the region posterior to the caecum, and hence in visualisation of the difficult retrocaecal appendix.



“Posterior manual compression is performed by placing one hand on the patient's back, applying forced compression in the antero medial direction added to graded compression with the transducer on the anterior abdominal wall”

FIG:10 Posterior manual compression



“Visualization of the retrocaecal appendix is done in a lateral flank approach or by turning the patient to the left lateral decubitus position in order to obtain views posterior to the caecum”

FIG:11 Left lateral decubitus position

FIG:12 Ascending colon mimicking appendix



“ The ascending colon should be identified first as it appears as a nonperistaltic structure containing gas and fluid”

NORMAL VISUALISATION OF APPENDIX IN USG



“ Longitudinal axis that measures greater than 6 mm in diameter and lacks peristalsis”

FIG :13 Longitudinal scan



“Transverse view, the distended appendix has a target-like appearance”

FIG:14 Target sign in transverse scan

Inflamed appendix appears as

- A Aperiistaltic
- B Blind loop
- C Non-compressible
- D Diameter greater than 6 mm



FIG: 15 PICTURE OF AN INFLAMMED APPENDIX

The inflamed wall of the appendix appears laminated. Sometimes appendicolith may be seen. This appendicolith are nothing but inspissated secretions that has lodged in the very narrowed lumen of the

appendix. They are seen in USG as a white echogenic structure which gives a post acoustic shadowing.

Appendicolith is a contributory factor in the diagnosis of appendicitis. Other additional findings can be identified that may give a clue to the diagnosis. These include the caecal wall thickening and the periappendiceal fat stranding.

A very good and experienced radiologist could even find these minor details that may lead us to the diagnosis of appendicitis

Main clue to the diagnosis may come from the patient himself. Typical patients with appendicitis will have right iliac fossa tenderness, which the patient may localize. The most tender point shown by the patient could be picked up by the radiologist as the probe tenderness.

Additional use of colour Doppler may clinch the diagnosis of appendicitis. The colour Doppler in the diagnosis of acute appendicitis was first presented by LimHK and Quillin SP. The findings in Doppler is the presence of peripheral increase in vascularity of the appendix.

This is due to the fact of the increased flow in the inflamed wall and periappendiceal region. Loss of peripheral vascularity should alert

the radiologist performing the scan to look for the wall of appendix, as the disappearance of Doppler signal, in other wise an inflamed appendix, is that it is going for gangrene or perforation.

It is important to mention these findings so that it alerts the operating surgeon to make an urgent decision to operate the patient , as the perforated appendix ,in itself has grave complication leading to long term morbidity and mortality if ignored.

Appendicitis presents in most atypical manner, with many disease process mimicking it. It is so atypical that even an experienced surgeon may remove normal appendix. Surgeon's upper limit of negative appendectomy rate is 20%. This is done in order to avoid the unnecessary complication of perforated appendix in case of delay.

Hence there should be a balance between negative appendectomy and perforation rate .Ultrasound has come a long way and is now routinely recommended by the referring physician or the surgeon to diagnose a case of appendicitis in the most atypical and equivocal case.

Puylaert introduce the graded compression technique and reported a sensitivity of 89% and specificity of 100%. Lots of studies which came following him also reported the same level of sensitivity and specificity.

A meta-analysis by Doria lists “sensitivity of ultrasound as 88% and 83% and its specificity as 94% and 93%, for children and adults, respectively”.⁴²

Many studies were done comparing the usefulness of ultrasound in the diagnosis of appendicitis. One study compared the diagnosis of appendicitis in two groups with one group, was diagnosed of appendicitis with only clinical findings and the other with help of ultrasound.

It was found the group one who were mainly diagnosed on the clinical basis had 93% sensitivity and hence had many false positive cases. Depending on only this value it was found that at least 10 more patients were taken for surgery, for no reason or cause, with just clinical basis findings only.

The second group of patient who were diagnosed on only the USG findings had sensitivity of 81%, where in few patient who needed surgery were left untreated as patients were misdiagnosed as normal. This is due to the low sensitivity of USG which might lead to the complication of perforation. So if only USG findings were taken into account there is a chance of patients with inflamed appendix, left

untreated leading to morbidity. All studies pin point that any imaging findings is never to override the clinical judgment.

But the picture changes when the specificity is taken into account as a USG shows a specificity of 95% while that of clinical diagnosis 44%. This shows that greater number of false positive was present in the patients who were clinically diagnosed. These patients were to undergo unnecessary procedure of appendectomy. The procedure itself has its own complication. This number of false positive is not acceptable in any of the clinical diagnosis.

Appendix being a vestigial organ allows the acceptability of unnecessary surgery to a certain extend but this could not be the case in other grave disease .But on the other hand ultrasound has 95% of specificity thereby reducing the unnecessary operation.

Both NAR and PR were also low in the second group who underwent USG. There was a statistical significant drop in NAR from 25% in first group to 7.4% in the second Group. The perforation rate symmetrically decreased from 15.6% to 15% in group one and two respectively. This small difference was however sharp. This was in

different to other studies that show PR rate to increase with decrease in NAR⁴².

Some studies did not take into account the gangrenous appendix into perforation, hence this falsely gave a low PR rate. Gangrenous appendix is more or less and definitely has higher a probability, to go in for perforation, if timely intervention is not carried out. So a study could do no justice if it does not takes the gangrenous appendix into account.

As seen earlier bringing the USG as the diagnostic work up for acute appendicitis, both NAR and PR has decreased which very well shows the reciprocal relation of NAR and PR. Hence adding ultrasound, decrease the negative appendectomy rate without increasing the perforation rate.

Study by **Stefan pug et al** showed a decrease in NAR from 36.6% to 3.2 with use of ultrasound. Negative appendectomy and PR both being an adverse outcome, both could be added to get total adverse outcome without taking into account their mutual relationship. It was found that adverse outcome dropped from 40.6% 22.4% . The study gives a clear

picture of the use of ultra sound in the diagnostic work up of acute appendicitis.

Though the importance of ultrasound in equivocal cases are helpful, because of its false positive and negative values it must not be allowed to override the clinical acumen.

Hence for good clinical outcome ,combining the ultrasound and clinical findings should be done. Some studies show that clinical Alvarado score of 8 would need no ultrasound findings to diagnosis and these patient were taken for surgery without subjecting the patient for ultrasound.

At the other extreme clinical score of 4, patients were not taken for surgery, only on the basis of ultrasound finding. The usefulness mainly, lay in the clinical score of 4 –8. Within this intermittent score the clinician and surgeon find it difficult to decide on ,with only the clinical findings and also in case of equivocal clinical diagnosis.

Added value is present when the ultrasound could pickup additional findings that clinch the alternate diagnosis for abdomen pain and help in excluding the diagnosis of appendicitis.

Some of the works on USG using graded compression by **Terasawa and co workers**⁴³ showed an overall “sensitivity 0.86% Specificity 0.81% PPV – 84% NPV – 85%”.

Meta analysis in Korea⁴⁴ showed “sensitivity of 86.7% and specificity of 80% and reported accuracy of ultrasound to be 86% - 96%” .

Advantages of USG

- Safe in pregnancy
- No risk of radiation exposure
- Short scan time
- No need for contrast
- Non invasive
- Easily performed in small children
- Added benefit of diagnosing other alternate cause of abdominal pain

Though its usefulness has been well described it has its own

disadvantage and pit falls

- First and the fore most is that it is an operator depended, hence the final diagnosis also depends on the experience of the radiologist, performing the scan.
- Individual skill is important⁴⁵
- It is inferior to other imaging techniques like CT , in sensitivity
- It has low negative predictive value it could not confidently exclude the diagnosis of appendicitis
- Difficult in female population because of overlap of symptoms⁴⁶⁻⁵⁰.
- Difficulty in getting adequate good graded compression in obese patient and in patients who had previous abdominal surgery
- Sometimes the location of the appendix also leads to misdiagnosis
- Most of the false positive is due to non-visualizations or only the tip of the appendix is inflamed⁴⁵⁻⁴⁷.

While positive ultrasound findings have a relatively high positive-predictive value, identification of a normal appendix is sometimes difficult.

Excellent results have been achieved at select centres. No visualization of the appendix, being reported to have a negative-predictive value of 90% ⁵¹.

Graded-compression USG remains our first-line method. It can be performed at any time, regardless of specific patient's preparation. But in some equivocal cases subsequently they should undergo Computed Tomography assessment ^{52,53}. However it is non-invasive, non-ionising, less expensive and also repeatable.

CT AND ITS ROLE IN DIAGNOSING ACUTE APPENDICITIS

There is an increasing surge for using CT in diagnosing appendicitis. It has an excellent sensitivity, specificity and accuracy in the preoperative diagnosis of acute appendicitis. The benefit of CT is still controversial. There are greater number of patients who are subjected to CT imaging and were still not operated.

Improved CT technology, its wide spread availability and the trend in present days, where the clinical diagnosis is becoming image

dependent ,there has been increasing use of CT technique. CT is good in excluding the diagnosis of appendix and also added benefits of giving an alternative diagnosis.

Various CT techniques are in use including

- Unenhanced Helical CT⁵⁷⁻⁵⁹.
- Targeted are focused appendiceal techniques using rectal contrast⁵⁴⁻⁵⁶
- IV enhanced CT
- IV with oral or without oral contrast^{61,62}
- Low dose CT
- IV with caecal air insufflations⁶⁰

There is always debate over which technique is appropriate or good

The use of IV technique has its own **disadvantage** listed,

- Allergic reaction to contrast⁶³
- Cost related
- Extravasations of contrast material⁶⁴
- Tissue injury due the above leakage
- Added to all is the patient's inconvenience

Use of **oral contrast**⁶⁸ has as the added **disadvantage** of

- Patient discomfort.
- Increase in the scan time and also waiting time.
- Some case if the contrast do not reach the caecum – the imaging becomes a total failure.

Advantages of oral contrast⁶⁵

- When ceacum and ileum fills with contrast, appendix is visualized well behind the background of contrast.
- On the pre – text of the appendix filling with contrast appendicitis could be ruled out.

Many studies favour ,and some have found no difference in accuracy rate on using oral contrast. **Anderson et al**⁶⁶ and **Keyzer etal**⁶⁷ quoted “No difference in sensitivity, specificity, positive predictive value are negative predictive value if oral is used or not”.

Unenhanced CT

Unenhanced scan decrease the time of scanning as there is no need for oral contrast .It eliminates the risks associated with iv contrast. **Ege et al** concluded that Unenhanced CT has a “ sensitivity of 96%, specificity of 98%, positive predictive value of 97%, and negative predictive value of 98%”⁶⁹. **Heaston et al.** showed a “sensitivity of 84% and a specificity of 92%”⁷⁰ for unenhanced CT.

Non – focused Technique

Non – focused Technique gave a high diagnostic accuracy when larger population sample were used with average prevalence of acute appendicitis. This is the most commonly used CT technique .

Rao et al used and reported cases with use of oral and colon contrast with prevalence of 53%⁵⁴ of acute appendicitis with diagnostic accuracy of 98%⁵⁵”. This is based on the routine body imaging technique used in early days. It uses both IV and oral contrast.

It has the advantage of finding both normal and inflamed appendix with added advantage of finding extra appendiceal pathology. Though helical CT with iv or oral or only rectal or other combination is available this non-focused technique is widely used due to the fact that other technique in due course reduces the accuracy rate.

Focused technique or the Appendiceal CT

Appendiceal CT is a focussed CT Technique and is advised for patient when the clinician suspect acute appendicitis to be the only cause for the patient's pain. Helical Scanning with 5 mm collimation and 5mm thickness is used.

Upper abdomen is left out covering only 15 cm of the lower abdomen and the upper pelvis centered at the tip of the caecum. Small rectal catheter is used to instill contrast into the colon with average volume of 900 ml of contrast. No iv or oral contrast is used in this technique. The scan time is complete in 20 – 30 minutes .

Negative was reported if the contrast filled the lumen or the lumen is filled with air .Reported positive if the appendix is enlarged > 6 mm and if the appendix is not opacified or filled with contrast. Positivity is given if specific signs like arrow head and cecal bar sign is present. Appendicolith is another positive sign of appendicitis.

The main disadvantage is that other alternate diagnosis may be missed as the entire abdomen is not covered in the scan. But this technique can confidently confirm or exclude the diagnosis of acute appendicitis.

Rhea et al quoted “Focused appendiceal CT may lower both fixed and variable cost in caring the patient with appendicitis”⁷² .

Rho et al “Focused technique reduces the use of hospital resource”⁷³

Fefferman et al reported high “sensitivity (97%), specificity (93%), positive predictive value (90%), and negative predictive value(98%)⁷¹” in focussed technique.

The highest ,a CT accuracy for diagnosing acute appendicitis is also from this technique of about 93 to 98%.As only limited section is covered, the radiation dose to the patient is also minimal with reduced exposure and cost. This technique also reduces the appendiceal perforation rate from 22 to 14% and the negative appendectomy rate from 20 to 7%⁷³.

Focussed techniques depend on expert interpretations and may not always provide an alternate diagnosis for pain in patients with acute symptoms. Imaging every patient with suspected appendicitis may be impractical at many centres , because helical CT facilities and on-site radiologists, experienced in interpretation are not readily available.

Low dose protocol

Taking into account the radiation from standard dose, CT low dose protocol with no use of iv or oral contrast was used. This technique may be adequate for diagnosing acute appendicitis . It is in the hands of the radiologist to bring a change. Many studies based on low does CT are done

KeyZer at al quoted “ No difference in sensitivity and specificity value in diagnosing acute appendicitis on using standard does and simulated low does” ⁶⁷

Seo et al after having made studies with low does technique and came up with the same results.

Contradicting KeyZer et al, studies have shown compromise in low dose technique like

- Alternate diagnosis and finding normal appendix
- Loss of reader confidence
- Loss of accuracy and diagnostic confidence.

But still noise reducing post processing algorithm can be used to increase the diagnostic accuracy in low dose technique. This kind of improvement in post processing will decrease the noise and increase the image quality. The next issue in low dose technique is the explanation of alternate diagnosis, in case that had been reported negative for appendicitis.

To be reported as false positive it had to be “ an equivocal diagnosis of the disease with no differential diagnosis”. CT scans to be reported as true negative “ the image must give either an alternate diagnosis or must report it has normal findings”.

CT has been increasingly incorporated in most institution because of high accuracy rate, an easy available range at present time. It has the advantage of decreasing the NAR without increasing the perforation rate

CT CRITERIA FOR DIAGNOSIS OF ACUTE APPENDICITIS

The primary diagnostic criteria for acute appendicitis is visualization of a

- Thickened and distended appendix width >6 mm
- Mural thickening and enhancement and
- Wall thickening of appendix >2mm
- Periappendiceal stranding⁶⁵

Secondary diagnostic criteria are

- Appendicolith,
- Periappendiceal abscess,
- Small-bowel obstruction,
- Pericaecal inflammation
- Target appearance - Concentric inflammatory thickening of appendix
- Presence of air both in intralumen and extralumen

The sensitivity and specificity of a pelvic and abdominal CT scan are 94 percent and 95 percent, respectively ⁴³.

The additional benefit of CT is that alternative diagnoses are made in up to 15 percent of patients ⁷⁴

A definitive CT diagnosis of acute appendicitis can be ruled out if there is air or contrast in the appendiceal lumen

If rectal contrast is given two signs help in identifying appendicitis. They are,

➤ **The caecal bar sign**

The contrast filled caecum is seen distinctly due the interface created by the inflammatory soft tissue thickening at the base of the appendix.

➤ **The arrow head sign⁷⁹**

It is the contrast filling in the caecum, with the arrow pointing to the point of occlusion in the appendix. It is not seen all the films. Thin section will better depict this sign in CT. And it is also a necessary prerequisite that the caecum must be well distended with contrast.

➤ **Caecal apical thickening.**

Though both CT and USG have a synergistic value ,many radiologist are in favour of CT, as they are more confident in interpreting CT than sonography.⁸⁰

Imaging techniques in suspected acute appendicitis have definitely results in fewer unneeded laparotomy.^(74,75,76)

Routine imaging is ,cost-effective and would also result in less delay before proper treatment.

Effect of CT imaging on false positive

Surgically Accepted False Positive and Negative appendectomy rate among the surgeons is 20%⁸² which has dramatically decreased in the recent years by the liberal use of preoperative imaging technique like CT and USG.

The False Positive rate is more in females compared to men due to the overlap of gynaecological symptoms which is as high as 42% while many studies have shown reduction in the above rate with increased use of imaging. Some large scale studies have shown no improved clinical outcome⁸¹.

Various studies have shown that there has been increase in use of CT by the physicians and surgeon, as the first line imaging modality. There is a decline in the USG imaging. However USG may play its role in some diagnosis, mainly in female patients like fibroid, ovarian cyst and pelvic inflammatory disease.

And also as the CT usage has increased, so is the decrease in the appendiceal perforation with statistical significance of $p < 0.001$.

There is also a significant decrease in the false positive diagnosis with preoperative use of CT.

Negative Appendectomy – Effect of Imaging

NAR was defined “as the portion of pathologically normal appendices removed surgically in patients suspected of having acute appendicitis”. Literature shows that 15-25% of such normal appendix was removed^{82,83}.

The need to reduce the unnecessary appendectomy is due the fact, to avoid the risk of surgical complication and the cost. But it itself is double edged sword. Surgeons have the upper limit of negative appendectomy rate of 20%⁸⁴. This is to avoid the negative and grave consequence of delayed diagnosis and perforation.

The diagnostic accuracy of clinical findings is about 80%⁸⁵. This may fall to 60% to 68% percent in women population due to the overlap of the gynaecological symptoms⁸⁴⁻⁸⁶. There has been an increase in diagnostic accuracy to above 83% to 98% percent if in addition to the clinical findings the imaging findings from CT and ultrasound are combined^{73,75,88}. There has been marked increase in the clinical outcome by using these imaging modalities.

Studies have show there has been significant decrease in NAR value in women who have gone with preoperative imaging. One such study have shown the overall sensitive of CT 96% and PPV (Positive predictive value) 96% and correctly diagnostic in 89%. Same studies showed ultrasound sensitive to be 86% and PPV 95% with correct diagnosis in 79%⁹⁰.

Prior studies have reported NAR of 5 to 16 % in men and 11 to 34% in women⁸⁷. The most common misdiagnosis in women is the pelvic inflammatory disease which is the major cause of increase in negative appendectomy rate in women.

The studies also showed a decrease of about 27% in the negative appendectomy rate some 34% to 7% in CT and to about 8% with USG imaging⁹⁰.

“**Rao et al**” showed a significant ($P<0.001$) decrease in NAR for women from 35% to 11% in CT imaging⁸⁹. Studies showed low NAR value in males and boys regardless of preoperative imaging.

Coming to the perforation rate, literature shows perforation rate of 14-31% Patients who underwent CT imaging had higher perforation rate compared to those who had not. It was later proposed that delay in

the time of CT imaging may be the cause of increased perforation rate in the study group that undergo CT Examination.

Karakas et al reported “ PR of 54% in children who underwent CT to PR of 20% with no imaging done”⁹¹ ,possibly due to delay in imaging

Most of the surgeons depend on the imaging technique, only when clinical findings are equivocal. Perforation rate and NAR are inversely relative, in that any increase in negative appendectomy rate, usually decrease the PR and decrease the number of study people who are kept under observation.

Studies also suggested that more than the in hospital stay the delay from the patients side play a major role in the perforation rate and that the high perforation rate is unrelated to the imaging technique performed.

Another study showed that the preoperative CT has significant decreased in the NAR in age group of < 45 years in women, but did not have any effect in male and women in > 45 years . The study has the similar conclusion as the study seen early in literature.

Raman et al showed that with increase in the percentage of patients who undergoes CT image from 18.5 to 94.2% ($P < .00001$),NAR decreased from 16.72 – 8.7% with statically significant p value < 0.0001 ^{89,92}.

“**Rhea at al**” showed a decrease in NAR from 20 to 7% while **Rao et al** quoted “11 to 5% CT imaging showed false positive of 1.7 to 10% and false negative of 0 to 2.4%”⁸⁹.

Another study by “**Raja et al**” showed with increase use in CT from 1% to 97.5% ($P < 0.0001$), NAR decrease from 23% to 1.7% ($P < 0.0001$) with female rate decreasing from 29.8% to 1.6% and male rate decreasing from 15.5 to 1.8 both having P Value of < 0.0001 which was statically significant⁹³.

AIMS AND OBJECTIVES

AIM AND OBJECTIVE

- To subject the patients admitted in emergency department suspected of acute appendicitis on clinical grounds ,to imaging technique ,both CT and USG.
- To calculate the sensitivity ,specificity ,positive predictive value and negative predictive value for both CT and USG having the histopathology findings as gold standard.
- To find the diagnostic accuracy of both the imaging technique in diagnosing acute appendicitis

RATIONALE FOR THE STUDY

Acute appendicitis is mostly, clinically diagnosed disease where the surgeons or the physician depends mostly on the clinical scores and physical examination and physical signs.

But there is increase in the negative appendectomy rate, depending only on clinical findings .So the surgeons favour the use of imaging technique like CT and USG ,if not in all cases ,at the least in atypical and equivocal ones where there is a need to rule out or confirm the diagnosis of acute appendicitis

Literature shows many studies that have debated over the best modality for diagnosing acute appendicitis. Most of them come up with more or less the same results.

USG is a non invasive ,cheap ,readily available technique with no need for contrast .But however it has its own limitation being operator depended ,highly depending on the skill and experience of the radiologist who scan. And also other factors like the built of the patient and the various position of the appendix ,makes it difficult for the scanning radiologist to visualise the appendix..CT on the other hand has the limitation of ionising radiation, but it also has the benefit of definitely ruling out appendicitis or confirm it because it has more specificity.

Both the USG and CT has the advantage of alternate diagnosis if the diagnosis of appendicitis is ruled out. Both the technique have definitely reduced the rate of negative appendectomy in recent years.

Hence adding the imaging modality either of the two or both, would benefit the attending surgeon over the treatment strategy. Deciding over which technique is the best modality, with high diagnostic accuracy is important, to be cost effective, avoid unnecessary surgery, and the study would answer the above doubts

- Prospective observational study
- Sample size-100 patient
- Study period - 6 months
- Study center- Institute: Rajiv Gandhi Government General Hospital

Inclusion criteria.

This is a Prospective observational study conducted in Patient who was admitted in the emergency department at Rajiv Gandhi Government Hospital from march 2014 to august 2014 with symptoms of acute abdomen pain and clinical findings highly suspicious of appendicitis.

- Main criteria was to take into account patients who have undergone both the imaging techniques of CT and USG.
- The criteria was to select patients who had both imaging done and were taken for surgery on clinical findings

This study protocol was approved by the ethical committee of the institutions and the departmental review board and institutional informed consent guidelines were observed

Exclusion criteria

- Patient with inflammatory focus like mesenteric adenitis found through initial USG screening and history
- PID, non specific enterocolitis were excluded .

- Patients who were in need of immediate surgery and no time for imaging modality.
- Non consenting patient.
- Patients who had only one imaging done or no imaging done were excluded

METHODOLOGY

Subject:

Patients who were admitted in the causality surgical emergency ward within the age group of 15-45 who presented with clinical findings and symptoms of acute appendicitis like right iliac fossa pain ,fever and vomiting were enrolled in the study. A total study sample of 100 was selected The clinical history regarding present history was taken in the prescribed proforma. Informed consent was obtained from each participating patient and the protocol was approved by the institutional ethical committee.

USG PROTOCOL

A routine USG was done in SONOSCAPE machine for the upper abdomen and pelvis using a 3-5-MHz convex transducer to rule out alternative abnormalities related to solid organs and to rule out free fluid. Then graded compression and colour Doppler sonography of the right lower quadrant giving attention to the site of maximal tenderness was performed using a linear transducer.

The normal appendix was visualised as a blind ended loop with no peristalsis. The graded compression technique is used to displace the bowel loops, allowing differentiation between an incompressible inflamed appendix and compressible normal bowel loops.

The presence of appendicitis was a blind-ended tubular structure anterior to the iliac vessel non compressible with diameter greater than 6mm. On Doppler there is increase in peripheral vascularity in the wall of the appendix due to the mural inflammation.

Appendicolith, peritoneal fluid, periappendicular fat stranding and other additional findings were also recorded.

Total time of 10-15 min on an average was taken. The USG findings were reported as positive, negative or inconclusive for acute appendicitis. Alternative diagnoses, when achieved, were also reported.

CT PROTOCOL

Examinations were performed on a MDCT performed using a 4-slice C scanner (TOSHIBA) at 120 kVp and 100 mAs; a pitch of 1 was used. CT of the lower abdomen and pelvis, from the xiphoid to the pubic symphysis, was performed with 80 mL of non-ionic contrast material Iohexol 350 (Omnipaque 350) was injected through a 18-gauge cannula placed in the volar aspect in the cubital vein at a flow rate of 4 ml/s and delay of 50 sec.

Axial reconstructions from the raw data were done at 3 mm thick, at 2 mm increments were obtained. The second data set was reformatted coronal at a thickness of 3 mm with 3 mm increments. No oral contrast was used.

The normal appendix when visualized was reported. The CT report was positive, negative, or inconclusive. The criteria for appendicitis is similar to that of USG. Alternative diagnoses, when achieved, were reported

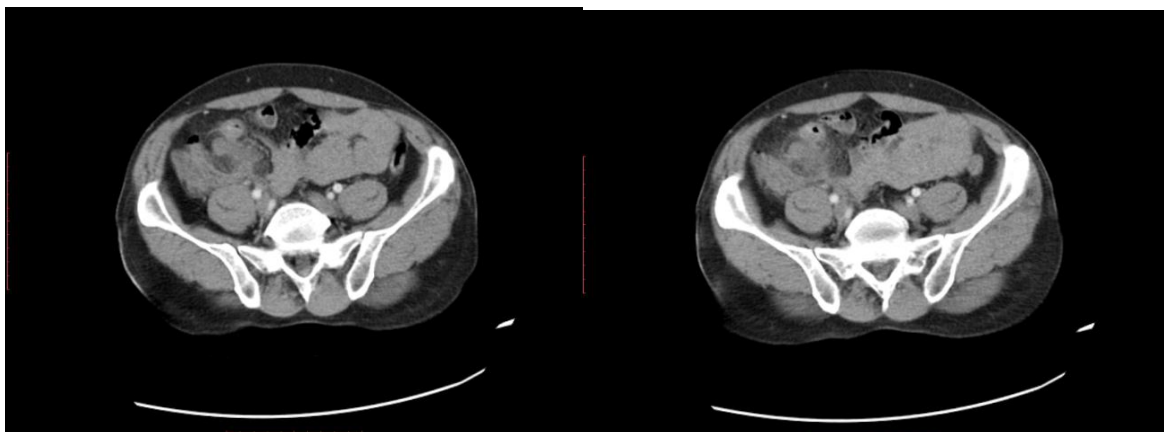
CASE 1

- 52/MALE
- h/o abdominal pain 3 days
- Clinical diagnosis of appendicitis

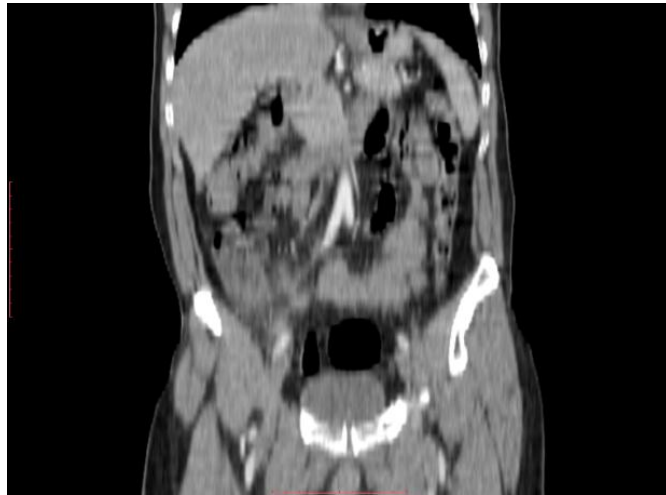
USG



CT-AXIAL



CT-CORONAL



USG-Presence of visualisation of appendix with a rent noted in the wall with adjacent areas of collection that does not show vascularity

CT- confirms the findings of USG and in addition shows the extent of the collection with pericaecal wall thickening

SURGICAL FINDINGS -12cm inflamed appendix and perforated and adherent to mesentery. Caecal wall inflamed and 50 ml purulent fluid drained from the right iliac fossa

HISTOPATHOLOGY- Perforated appendix

CASE 2

- 37/MALE
- Abdominal pain predominately right iliac fossa
- Clinically diagnosed as appendix

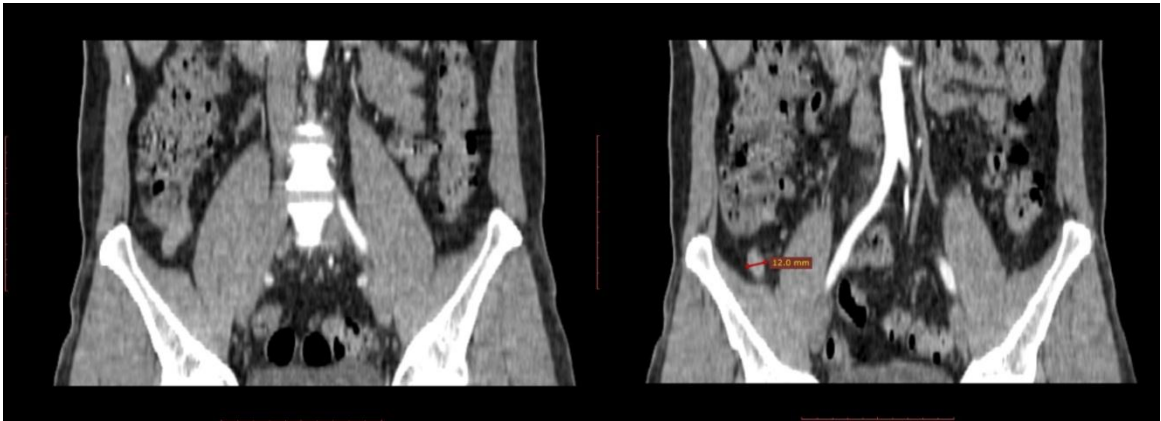
USG



CT-AXIAL



CT-CORONAL



USG of adjacent collection noted.

CT-Findings in USG is confirm- Shows dilated tubular structure in right iliac fossa which is not compressible , measuring 12mm with thickened wall and increased peripheral vascularity .No evidence ed with adjacent fat stranding .

SURGICAL FINDINGS-Lap appendectomy done which showed inflamed appendix

HISTOPATHOLOGY- Inflamed appendix

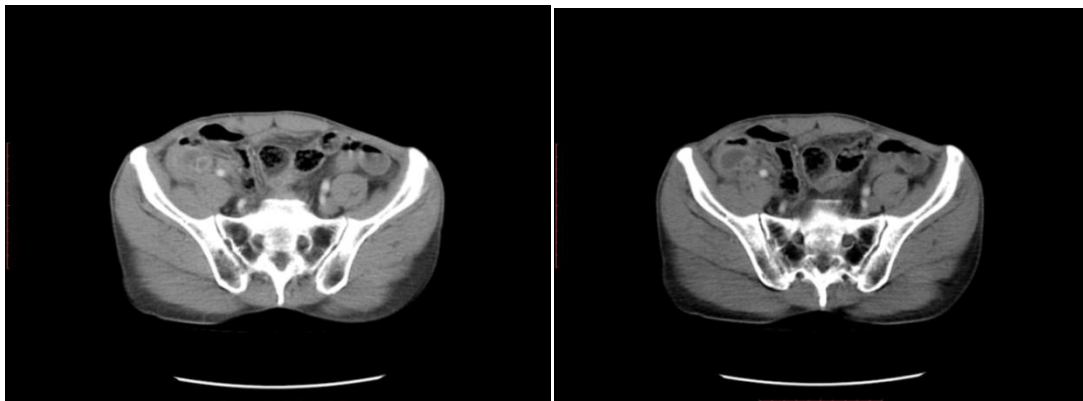
CASE 3

- Abdominal pain, fever vomiting
- Clinical diagnosis of acute appendicitis

USG



CT-AXIAL



USG-Presence of visualisation of appendix with a rent noted in the wall with adjacent areas of collection that does not show vascularity.Pericaecal wall thickening noted.

CT- confirms the findings of USG and in addition shows the the extent of the collection with pericaecal wall thickening..Mural wall enhancement of the appendix and a discontinuity in the appendicular wall noted.

SURGICAL FINDINGS - 13cm inflamed and perforated appendix and adherent to mesentry. Caecal wall inflamed and 100 ml purulent fluid drained from the right iliac fossa.

HISTOPATHOLOGY- Perforated appendix

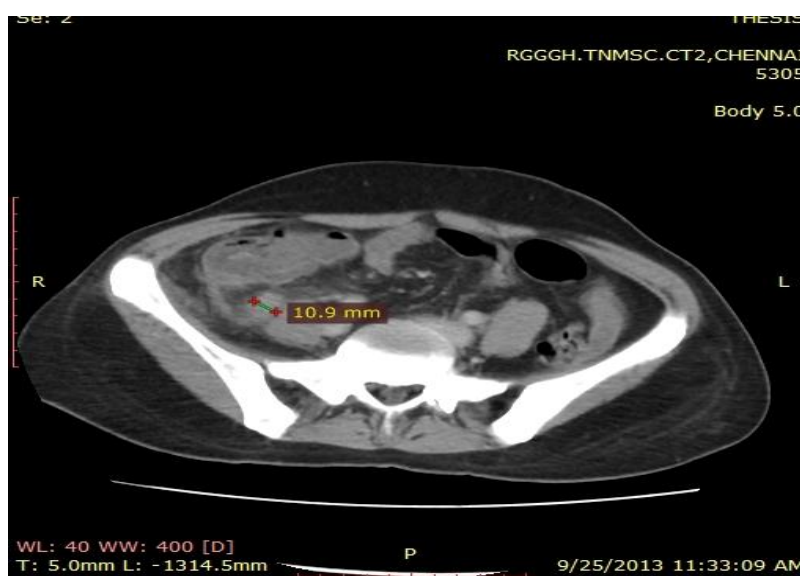
CASE 4

- Abdominal pain ,vomiting ,diarrhoea ,fever
- Clinical diagnosis of gastro enteritis with high suspicion for appendicitis

USG



CT-AXIAL



CT-CORONAL



USG-dilated non compressible tubular structure in right iliac fossa with breach in the wall of the appendix noted with adjacent collection

CT-appendix-10.9mm with stranding. caecal wall thickening and stranding with pericaecal fluid collection. Extramural air pockets noted. No evidence of breach in the wall noted.

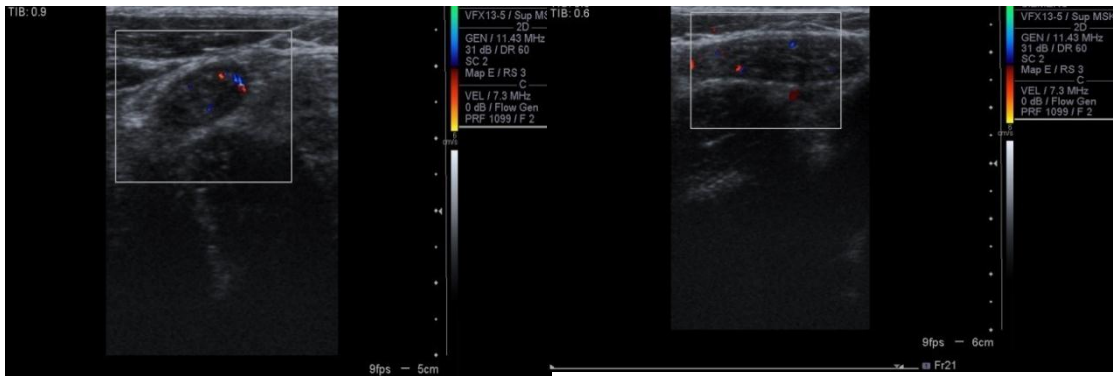
SURGICAL FINDINGS-10 cm inflamed and adherent to mesentery. Caecal wall inflamed and 50 ml purulent fluid drained.

HISTOPATHOLOGY-Perforated appendix

CASE 5

- Abdominal pain and fever
- Clinical findings of right iliac fossa tenderness and guarding

USG



CT-AXIAL



CT-CORONAL



USG- dilated non compressible tubular structure in right iliac fossa of 11mm in diameter with peripheral vascularity

CT- confirms the findings of USG and in addition

SURGICAL FINDINGS -Surgical-12cm and inflamed

HISTOPATHOLOGY- Inflamed appendix

CASE 6

- Mild abdomen pain, diarrhea
- Right fossa tenderness

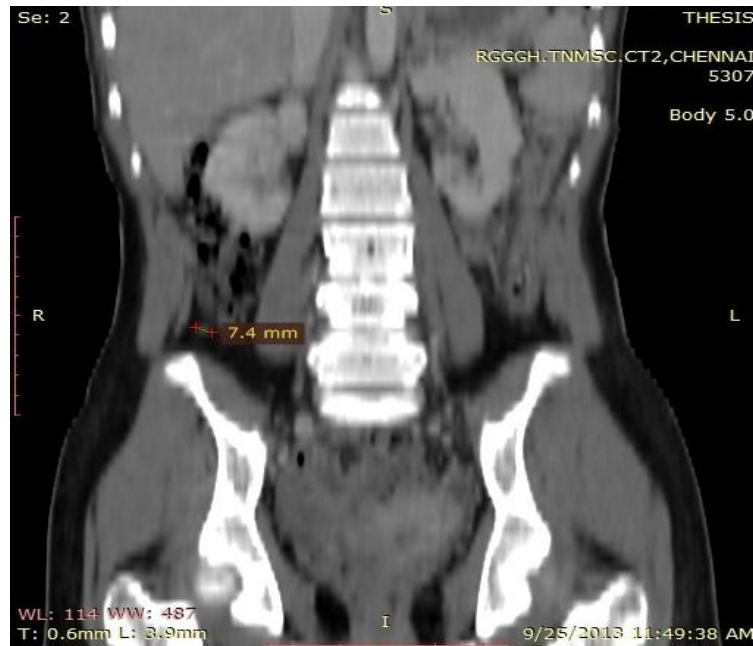
USG



CT-AXIAL



CT-CORONAL



USG-Normal

CT-appendix-7.7mm with minimal wall thickening. No e/o fat stranding

SURGICAL FINDINGS-inflamed appendix

HISTOPATHOLOGY-Negative

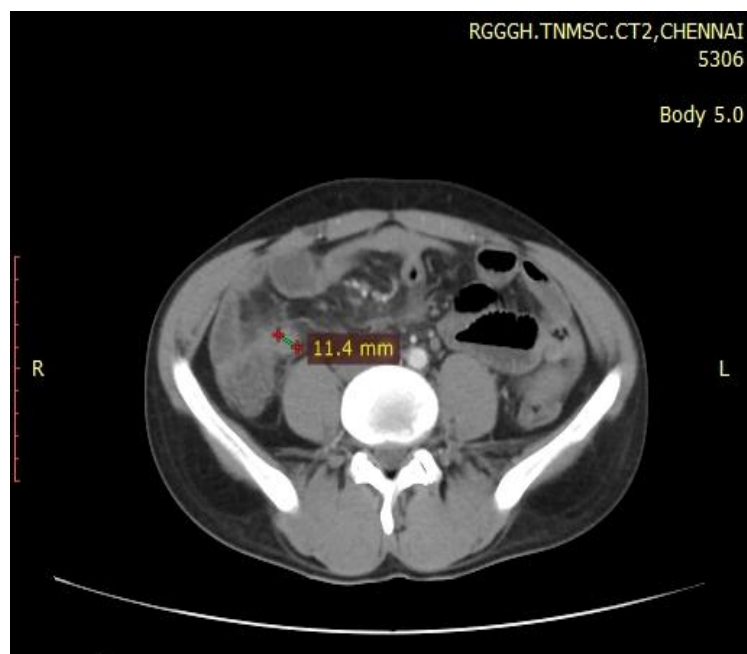
CASE 7

- Abdomen pain
- Clinical diagnosis of acute appendicitis

USG



CT-AXIAL



CT-CORONAL



USG- dilated non compressible tubular structure in right iliac fossa of 12.5mm in diameter with peripheral vascularity

CT-appendix 12.4mm with wall thickening and pericaecal fat stranding and minimal fluid

SURGICAL FINDINGS-10cm inflamed and adherent to mesentery.

HISTOPATHOLOGY-Inflamed appendix

STATISTICAL ANALYSIS

STATISTICAL ANALYSIS

SEX DISTRIBUTION:

SEX	FREQUENCY	PERCENT
FEMALE	37	37.0
MALE	63	63.0
Total	100	100.0

Table:1 shows the sex distribution of no of study group among the 100 patients taken for surgery.The table shows the predominance of male patient in the study sample with about 67% and females are 37%.

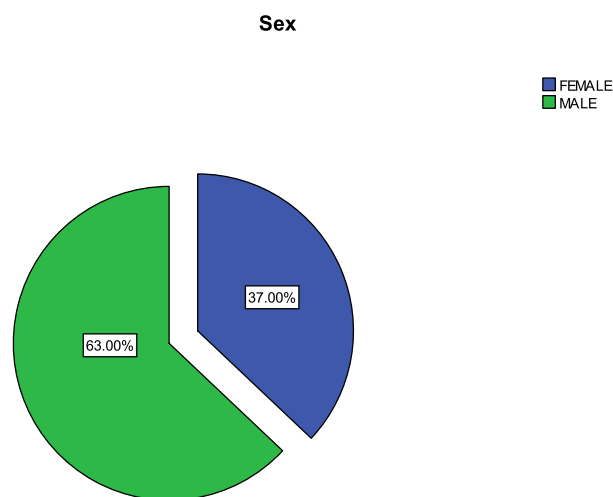


Fig: 16 shows graphic representation of the percentage of male and female in the study group

AGE FREQUENCY TABLE

AGE	FREQUENCY	PERCENT
LESSTHEN 20	35	35.0
21 TO 30	44	44.0
31 TO 40	15	15.0
41 TO 50	4	4.0
51 TO 60	2	2.0
TOTAL	100	100.0

Table:2 The above table give the frequency of distribution of age group in patients with appendicitis. The highest noted in the age group of 21-30 years Of about 44% irrespective the sex.

TOTAL MALE PATIENT

AGE	MALE
LESSTHEN 20	22
21 TO 30	33
31 TO 40	5
41 TO 50	2
51 TO 60	1
TOTAL	63

Table:3 Shows the frequency of age distribution in male patients with majority falling in 21-30 years of age group making about 52% of the male followed next in frequency by < than 20 year age group.

TOTAL FEMALE PATIENT

AGE	MALE
LESSTHEN 20	13
21 TO 30	11
31 TO 40	10
41 TO 50	2
51 TO 60	1
TOTAL	37

Table: 4 Shows the distribution of cases in female patient with large no falling in the age group of < than 20 years in contrast to the male patients where it fell in the age group of 21-30 years.< than 20 years occupy 35% and 21-30 years of about 29%

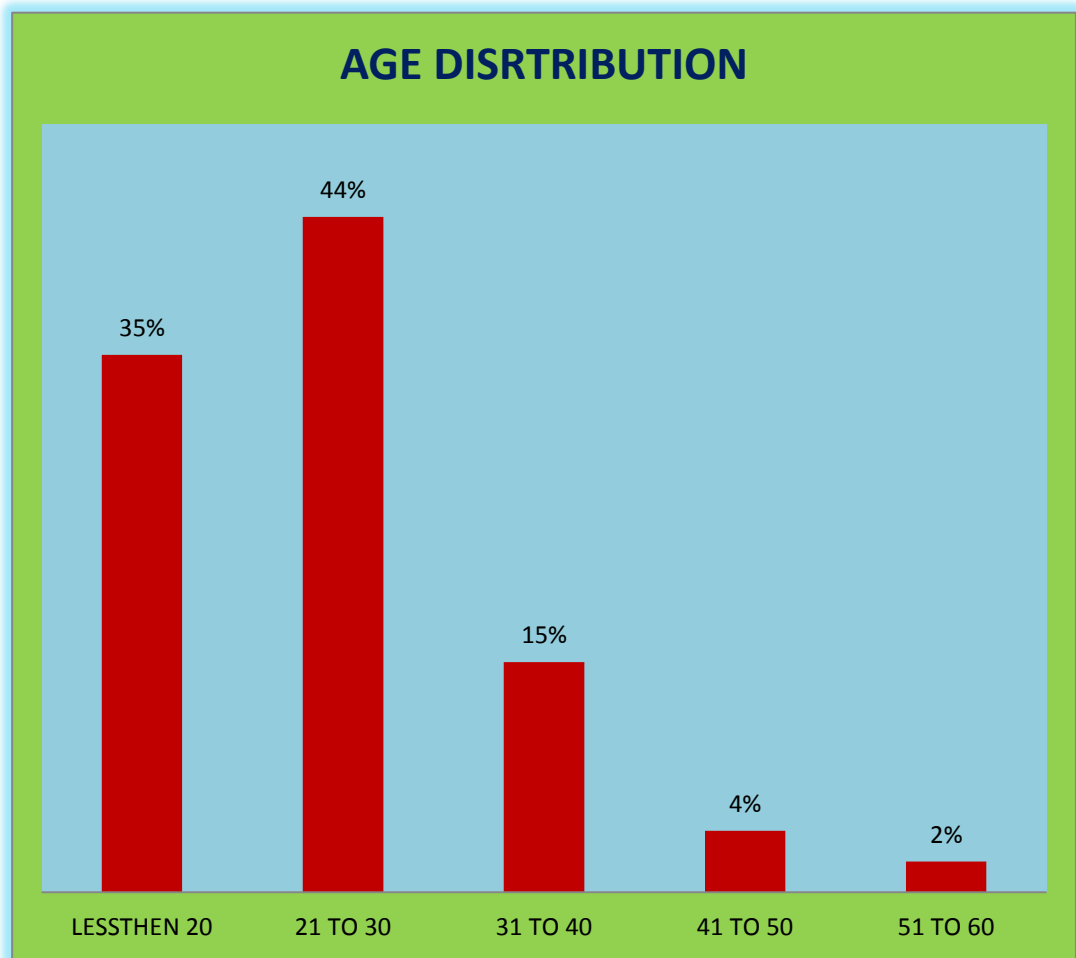


FIG: 17 The above bar diagram is a diagrammatic representative of the overall age distribution .Shows the total percentage of patients in the respective age group

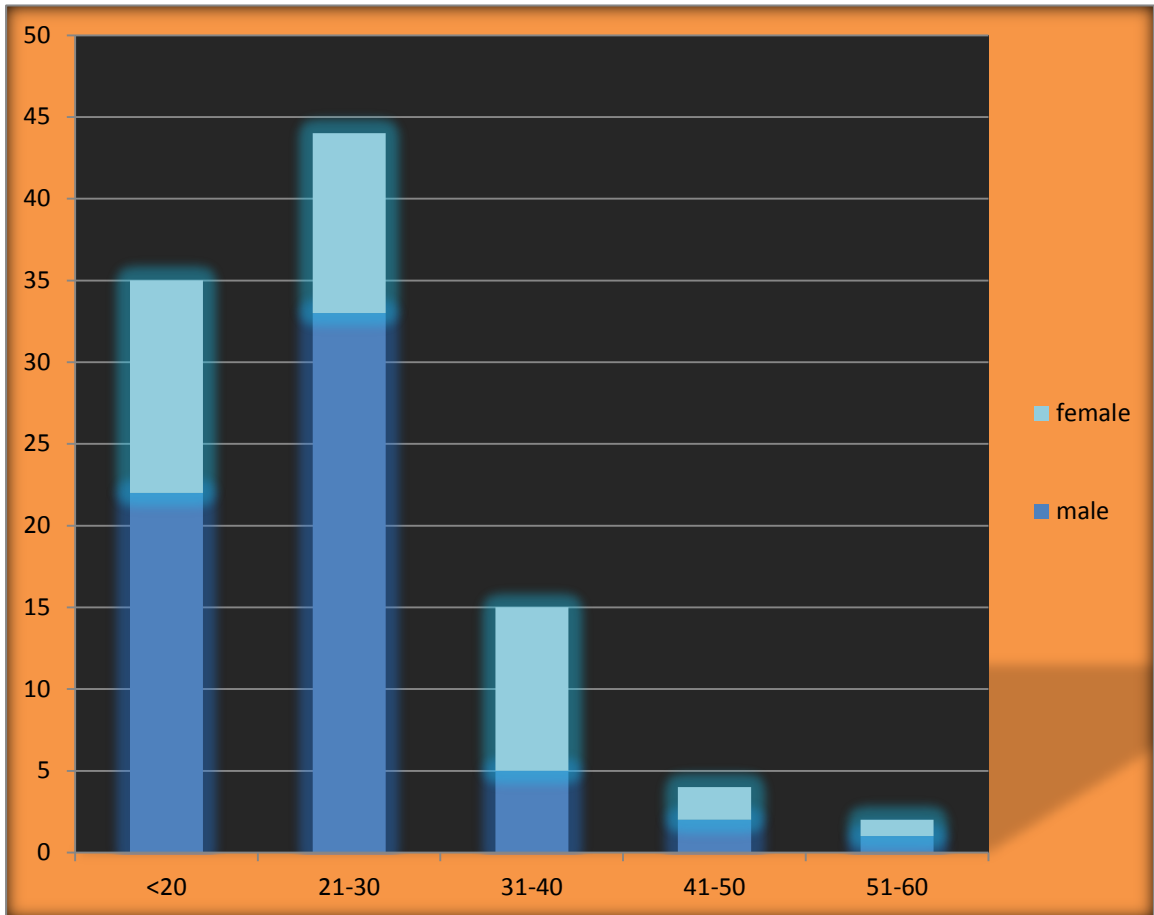


FIG: 18 The above diagram compares the frequency of male to female in the respective age group. Both male and female the highest frequency range in the age group of 21-30 years.

CT IN DIAGNOSIS

CT	FREQUENCY	PERCENT
NORMAL	11	11.0
POSITIVE	89	89.0
TOTAL	100	100.0

Table:5The above table shows the number of case reported positive for appendix in the 100 study sample.89 patients were positive and 11 were negative.

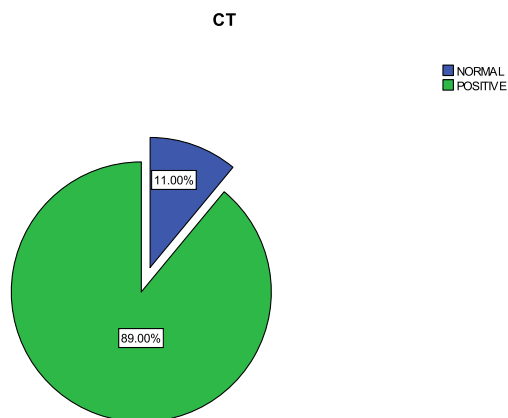


FIG: 19 The above pie diagram is a diagrammatic representation of the table 5.

CT AND HISTOPATHOLOGY CORRELATION (FIG: 20)

		HISTOPATHOLOGY EXAMINATION		TOTAL
		INFLAMMED APPENDIX	NORMAL	
CT	NORMAL	3	8	11
		27.3%	72.7%	100.0%
CT	POSITIVE	88	1	89
		98.9%	1.1%	100.0%
TOTAL		91	9	100
		91.0%	9.0%	100.0%

Table:6 The above table shows correlation CT with HPE findings. Among the 100% patient CT was found positive for acute appendicitis in 89 patient and negative in 11 patient. And among the 11 patient who had negative findings 8 were also found to have negative histo pathology findings and 3 had positive in HPE . Among the 9 patient negative in HPE findings 1 patient had CT Finding of minimal fat stranding with normal size appendix measuring 6 mm which was given as positive.

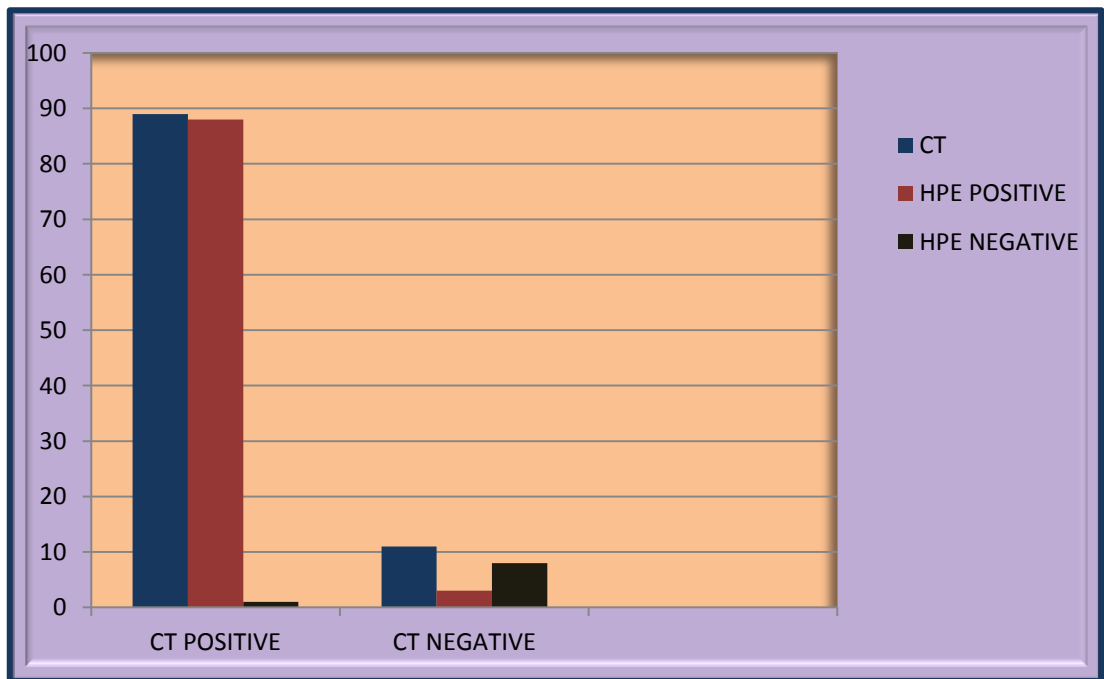


FIG:20

SENSITIVITY	0.97	(95% CI 0.91 TO 0.99)
SPECIFICITY	0.89	(95% CI 0.56 TO 0.98)
POSITIVE PREDICTIVE VALUE	0.99	(95% CI 0.94 TO 1.00)
NEGATIVE PREDICTIVE VALUE	0.73	(95% CI 0.43 TO 0.90)

Table:7 gives the sensitivity and specificity of CT in diagnosing appendicitis .The confidence interval is about 95% .CT as a modality for diagnosing a case of appendicitis has 95% to correctly diagnose it when done for a large group in the population not considering the prevalence of the disease in the community

SYMMETRIC MEASURES					
		VALUE	ASYMP. STD. ERROR	APPROX. T	P VAL
MEASURE OF AGREEMENT	KAPPA	-.171	.062	-7.829	.001

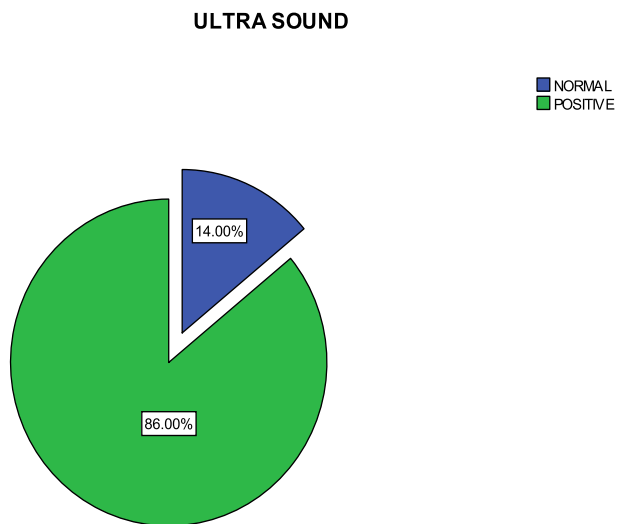
Table:8The above table gives the degree of agreement the kappa value and significance of correlation the P value .

ULTRASOUND IN DIAGNOSIS

ULTRA SOUND	FREQUENCY	PERCENT
NORMAL	14	14.0
POSITIVE	86	86.0
TOTAL	100	100.0

Table 9 shows the number of patients who were diagnosed positive and negative using USG. Among the 100 study group

Fig:21 Gives a graphic representation of table 9.



ULTRASOUND AND HISTOPATHOLOGY EXAMINATION

Crosstab					
			HISTOPATHOLOGY EXAMINATION		Total
			INFLAMMED APPENDIX	NORMAL	
ULTRA SOUND	NORMAL		7	7	14
			50.0%	50.0%	100.0%
	POSITIVE		84	2	86
			97.7%	2.3%	100.0%
Total			91	9	100
			91.0%	9.0%	100.0%

Table:10 Of the USG findings of the 100 patient n= 86 were found positive n=14 showed negative .

Of the 14 negative cases 7 case shows HPE Finding of acute appendicitis The remaining 7 cases were true negative with HPE findings also negative for the disease .The 86 positive findings in USG 84 also showed HPE positive of appendicitis and 2 cases were negative in HPE report

Fig 22 is graphic representation of table 10

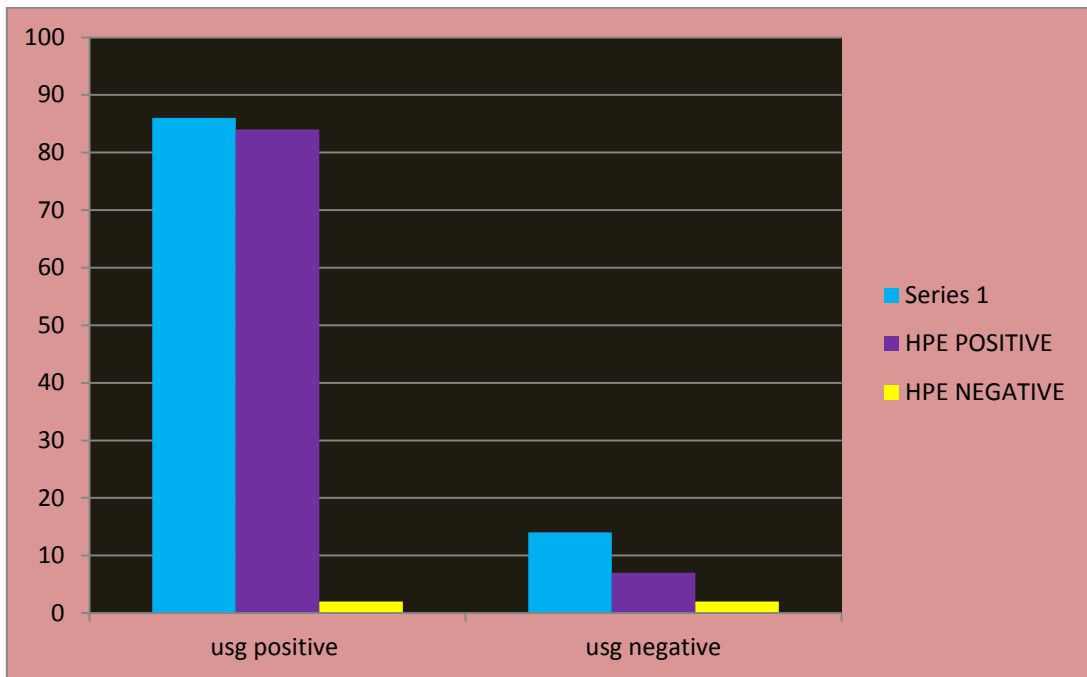


Fig :22

SENSITIVITY	0.92	(95% CI 0.85 TO 0.96)
SPECIFICITY	0.78	(95% CI 0.45 TO 0.94)
POSITIVE PREDICTIVE VALUE	0.98	(95% CI 0.92 TO .99)
NEGATIVE PREDICTIVE VALUE	0.50	(95% CI 0.27 TO 0.73)

Table:11 Gives the sensitivity and specificity of USG in diagnosing appendicitis. The confidence interval is about 95%. USG as a modality for diagnosing a case of appendicitis has 95% to correctly diagnose it when done for a large group in the population not considering the prevalence of the disease in the community.

SYMMETRIC MEASURES					
		VALUE	ASYMP. STD. ERROR	APPROX. T	P VALUE
MEASURE OF AGREEMENT	KAPPA	-.144	.057	-5.780	.001

Table :12 The above table gives the degree of agreement the kappa value and significance of correlation the P value.

SURGICAL CORRELATION

SURGICAL EXAMINATION	FREQUENCY	PERCENT
INFLAMMED APPENDIX	98	98.0
NORMAL	2	2
TOTAL	100	100.0

TABLE 13:shows the number of cases that was found positive in surgery .Of 100 n=94 were positive and n=6 were negative

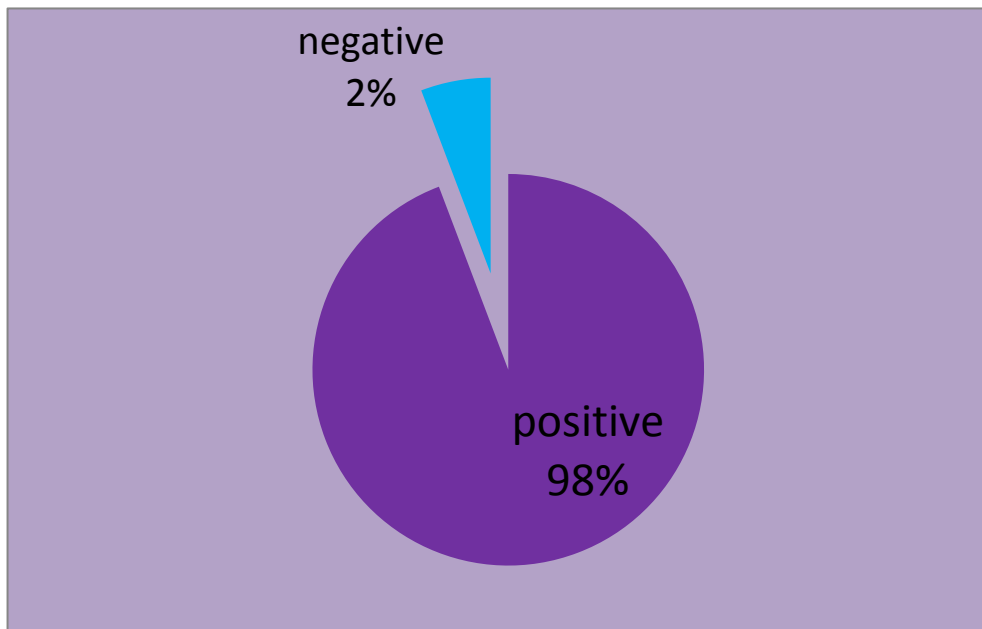


Fig:23 .Graphic representation of table 13

HISTOPATHOLOGY

HISTOPHTHOLOGY EXAMINATION	FREQUENCY	PERCENT
INFLAMMED APPENDIX	91	91.0
NORMAL	9	9.0
TOTAL	100	100.0

TABLE:14 Shows the number of cases that was found positive in histopathology .Of 100 n=91 were positive and n=9 were negative

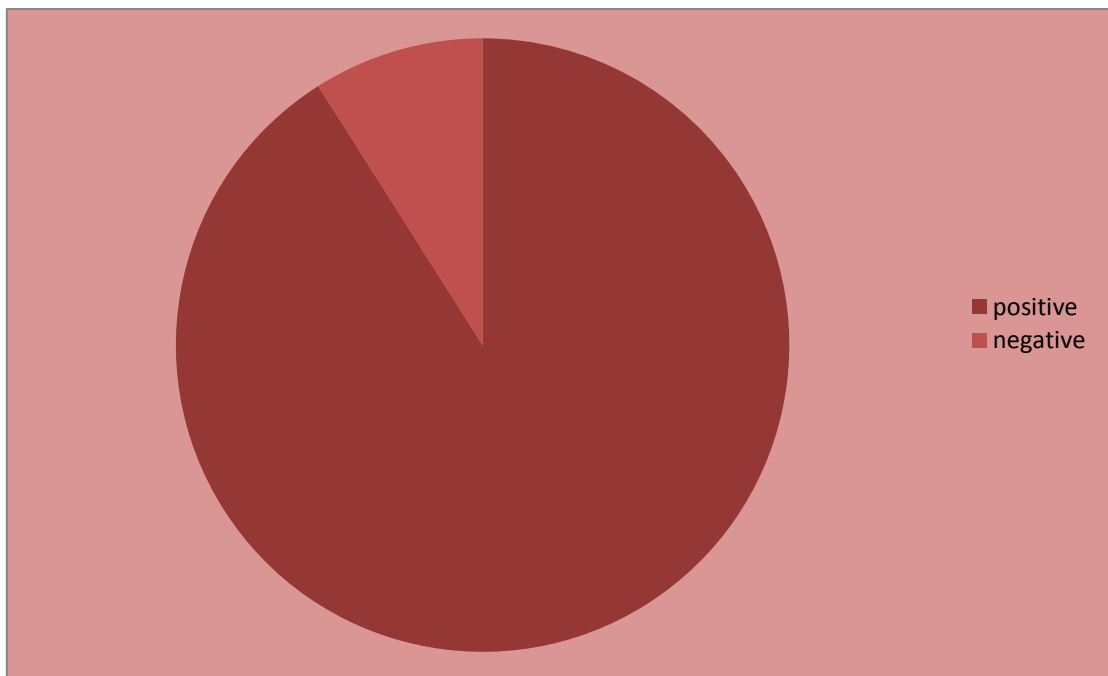


Fig:24 Graphic representation of table 14

SURGICAL EXAMINATION * HISTOPATHOLOGY

EXAMINATION

	HISTOPATHOLOGY EXAMINATION		TOTAL
	INFLAMMED APPENDIX	NORMAL	
SURGICAL EXAMINATION INFLAMMED APPENDIX	91 92.9%	7 7.1%	98 100.0%
NORMAL	0 .0%	2 100.0%	2 100.0%
TOTAL	91 91.0%	9 9.0%	100 100.0%

Table:15 Of the surgically positive case of n=98 n= 91 were found positive in HPE n=7 showed negative .

Of the 2 negative cases in surgery it was also found negative in HPE reports

SENSITIVITY	1.0	(95% CI 0.96 TO 1.00)
SPECIFICITY	0.22	(95% CI 0.66 TO 0.55)
POSITIVE PREDICTIVE VALUE	0.93	(95% CI 0.86 TO .96)
NEGATIVE PREDICTIVE VALUE	0.50	(95% CI 0.34 TO 1.0)

Table: 16 Gives the sensitivity and specificity of surgical findings with respect to clinical acumen in diagnosing appendicitis

The confidence interval is about 95% .USG as a modality for diagnosing a case of appendicitis has 95% to correctly diagnose it when done for a large group in the population not considering the prevalence of the disease in the community

SYMMETRIC MEASURES					
		VALUE	ASYMP. STD. ERROR	APPROX. T	P VAL
MEASURE OF AGREEMENT	KAPPA	.342	.181	4.543	.001

Table:17 The above table gives the degree of agreement the kappa value and significance of correlation the P value .

RESULTS AND OBSERVATION

OBSERVATION AND DISCUSSION

The study was done in a tertiary institution. Patient admitted in emergency department with abdominal pain and classical symptoms of acute appendicitis like a fever, right quadrant pain and vomiting, who were examined by the surgeons and taken for surgery based on clinical symptoms were taken in to study.

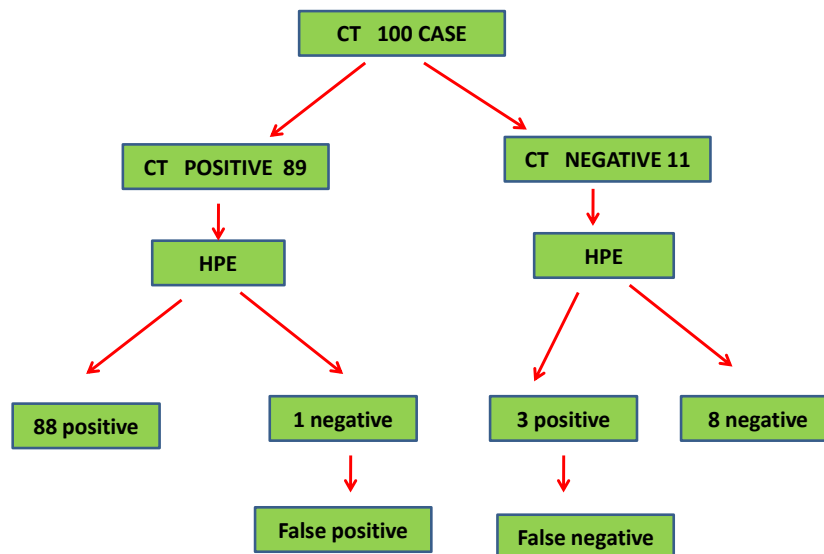
And among these patients, who did not undergo any imaging, due to the reasons like the condition of the patient of severe pain suspected of perforation and people who did not consent for USG or CT imaging and people who have undergone only one imaging like either CT or ultrasound were excluded from the study. Women presenting with signs of pelvic inflammation were ruled out.

The study did not take in to account the age and sex of the patient however the sex distribution in the study showed male to be predominant than female patient.

Among the total of 100 patient 37 were female and 63 were male. The common age group under the presentation was 21 - 30 years with 33 of 63(52%) in male and 11 of the 37(29%) in female falling in this age group. The next common age group is < 20 years with 22 of

63(34%) in male and 13 of 37(35%) in female Considering the overall percentage of age group 44% falls in 21 to 30 year ,35% < 20 years, 15% in 31 to 40 years, 4% in 41 to 50 years and 2% in 51 to 60 years of age . So the study show that the diagnosis of acute appendicitis was common in 21 to 30 year both in male and female patient.

COMPUTED TOMOGRAPHY(CT)

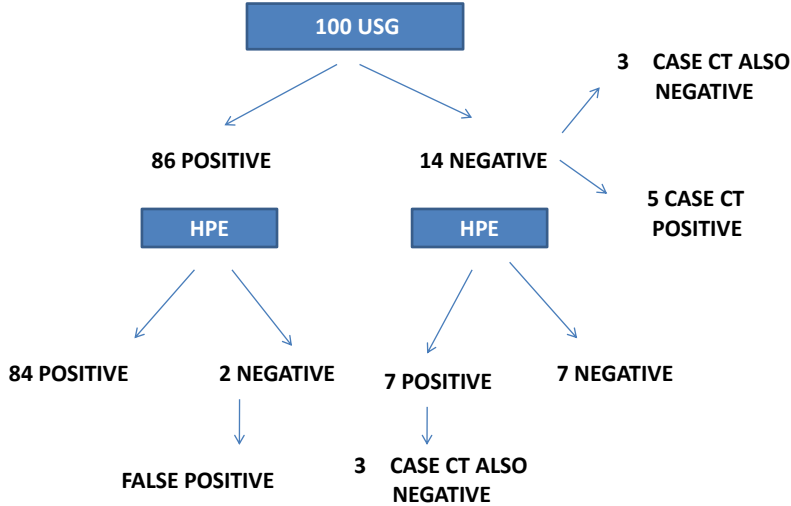


Among the 100 patient, CT was found positive for acute appendicitis in 89 patient and negative in 11 patient .Of the 11 patient who had negative findings 8 were also found to have negative histo pathology findings .Of the 9 patient negative in HPE one Female

patient had CT finding of minimal fat stranding with normal size appendix measuring 6 mm which was given as positive.

And three case showed both surgical and Pathological inflamed appendix with negative CT findings. From the history it was found that two of the patient had been treated with IV antibiotic for 3 days outside .Whether this history and intervention had affected the image findings is not known.

USG



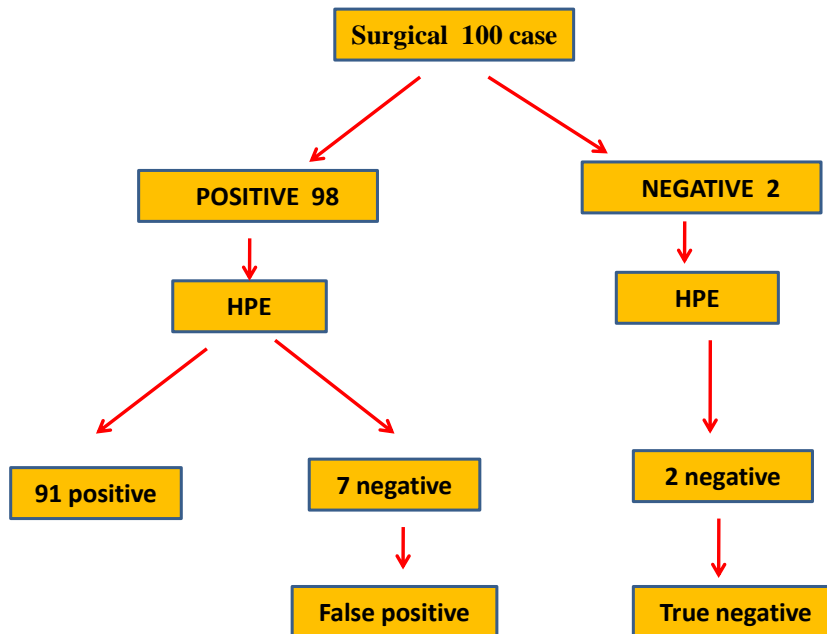
As of the USG findings of the 100 patient 86 were found positive which Shows ultrasound finding of acute appendicitis . 14 showed was reported negative .Of the 14 negative cases 7 case shows HPE Finding of acute appendicitis .

Of it two patient were obese patient whose appendix was not visualized out and another 2 patient had only tip of appendix inflammation which was not identify .These 4 cases were picked up by CT which reported positive.

Two of the 14 patient had treated with antibiotic outside and the last one case was an early appendicitis and the last 3 cases were also missed by CT which was reported negative. The remaining 7 cases were true negative with HPE findings also negative for the lesion.

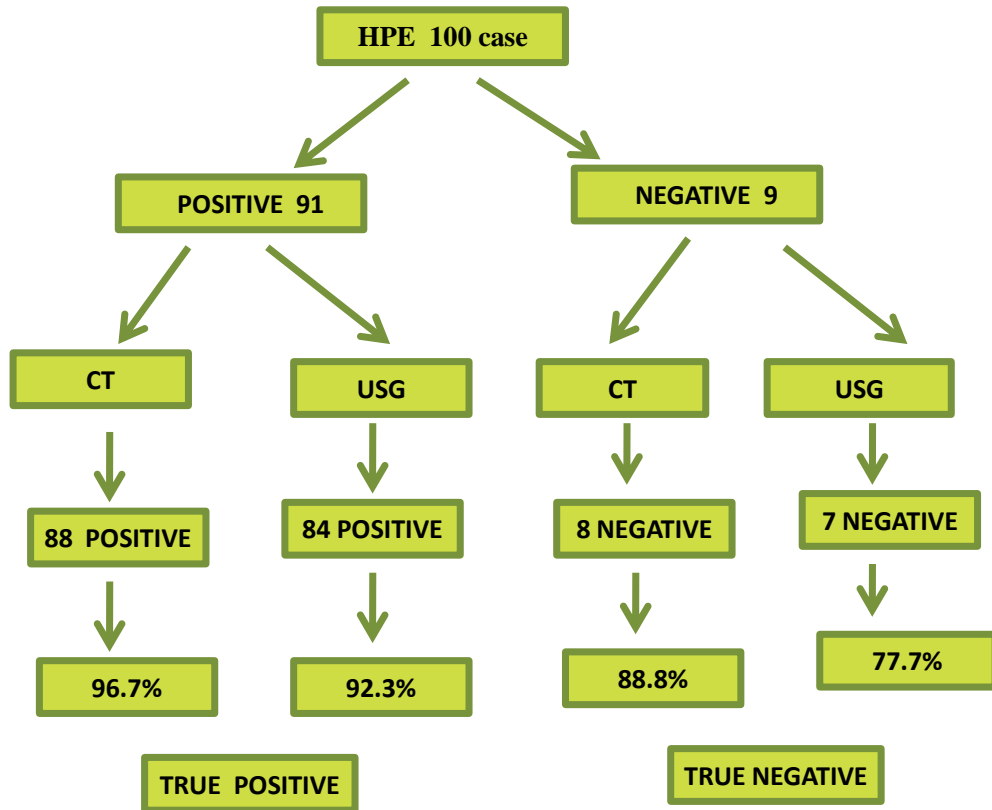
The 86 positive findings in USG 84 also showed HPE positive for appendicitis .Two case were reported positive in USG which showed negative findings in all CT ,HPE and surgery. Some case showed probe tenderness which was reported as negative but just was mentioned as probe tenderness, this was decided considering ,that the pain threshold varies and could not be confidently given positive unless the appendix is visualised ,in view of reducing the reporting of false positive cases.

SURGICAL



In the study, patients were taken for surgery based on the clinical findings by the surgeon. Of the 100 patients taken for surgery 98 cases were reported positively as inflamed appendix. Of the 98 cases positive in surgery 91 cases were reported positive in HPE also. Hence on basis of clinical findings there is 92.8% probability of correctly diagnosing cases of acute appendicitis. Two cases were reported negative which was also reported negative in HPE.

HISTOPATHOLOGY



The above algorithm shows an overview of the histopathology report. Of the 100 cases taken for surgery 91 cases were histopathology proven positive. Of the 91 cases CT showed positive findings in 88 cases which comes to about 96.7%.

Hence CT has 96.7% probable of correctly diagnosing a positive case of acute appendicitis with confidence interval of 95%.

With respect to USG of the 91 cases positive in histopathology ultrasound showed positive findings in 84 patients amounting to about 92.3%, hence USG has 92.3% probable of correctly diagnosing an appendicitis.

Coming to the negative findings in HPE, Of the 100 cases 9 cases were reported negative in histopathology CT also showed negative findings in 8 cases covering about 88.8% and USG showed negative findings in 7 out of the 9 negative in histopathology.

Hence the percentage that USG could correctly diagnose a negative case of appendix comes to about 77.7%

Negative appendectomy as of according to the study is 9% with 9 cases taken for surgery on clinical grounds was found to be negative. If in addition to the clinical acumen CT and USG findings were to be taken into account 6 cases out of the 9 negative cases could have been avoided.

STATISCAL REVIEW

Histopathology examination is the gold standard and hence the CT findings and the USG findings are compared to the histopathology reports received. As all the patients taken into study had both imaging done comparing the negative appendectomy rate is arbitrary and hence HPE reported perforated appendix were taken as positive inflamed appendix.

The sensitivity, specificity , negative and positive predictive value was calculated.

Sensitivity is the diagnostic accuracy and correctly identifies those who have the disease.

The specificity is the ability of a test to identify correctly all those who do not have the disease.

Predictive value is the diagnostic power of the test.It depends on the above parameters and the prevalence of the disease.P-value here is calculated using chi square test .It gives the significance of difference between two proportion and value < 0.05 is statistically significant

CT

The study shows a sensitivity of 97% and specificity of 89%, positive predictive value of 99% and negative predictive value of 73%. All the values have a confidence interval of 95% .

The study has 95% probability of giving the result if used in a large population. The p value also falls in the significant value of <0.001 . Comparing the parameters with the studies done earlier the study shows comparative similar results.

Many studies have come up with values of sensitivity -96% and PPV-96% . Yet another study gives a sensitivity of 87-100%, specificity of 83-99% and PPV of 92-99%⁸⁸ again which is near to our result.

USG

USG shows a sensitivity of 92% and specificity of 78%, PPV-98% and NPV- 50%. All the values have a confidence interval of 95% . The study has 95% probability of giving the result if used in a large population. The p value also falls in the significant value of <0.001

Comparing the parameters with the studies done earlier the study shows comparative similar results. Many other studies reviewed in literature shows similar results.

Puylaert et al ³⁵ in his studies found the sensitivity and specificity to be 89% and 100% respectively. **Terasawa and coworker** ⁴³ showed 86% of sensitivity ,81% specificity ,PPV -84% and NPV-85%. Another **Korean meta analysis** ⁴⁴ gave sensitivity and specificity as 86.75 and 90% which is comparable with the study.

COMPARING THE ACCURACY AND CT AND USG

	CT	USG
SENSITIVITY	0.97	0.92
SPECIFICITY	0.89	0.78
PPV	0.99	0.98
NPV	0.73	0.50

TABLE:18 Comparing the accuracy of CT and USG. From the above table it clearly shows that CT is more sensitive ,specificity ,PPV, NPV.

RESULT

From the study it is concluded that CT is more sensitive, specificity ,PPV, NPV. Hence the CT investigation is more accuracy than USG in diagnosing cases of appendicitis.

CONCLUSION



CONCLUSION

Acute abdomen pain is the most common symptom we encounter in most of the emergency department. Of these 41% of them are unknown and a case of acute appendicitis makes about 4.3%. Evaluating a case of appendicitis is mainly clinical ,depending on the clinical scores and signs.

But there is increase in the negative appendectomy rate on depending only on clinical findings . And also in patients with atypical and equivocal clinical findings surgeons are in favour of imaging modalities for arriving at a diagnostic conclusion ,rather than to keep the patient in observation. As the later has lead to increase in the percentage of perforation rate .

Considering the imaging technique ,there comes a question which is the best or which is the first modality to be considered. Usually USG is the first primary techniques ,considering its easy availability, low cost and reproducible with no radiation .

But it has its own pitfalls ,being operator dependent ,highly depending on the skill and experience of the radiologist who does the scan.And also other factors like the built of the patient and the various

position of the appendix ,makes it difficult for the scanning radiologist to visualise the appendix .

Sometimes USG also gives a equivocal findings were in we are forced to switch over to CT or other modalities.CT on the other hand is more specific than USG and hence could rule out appendicitis .Both the imaging technique could give an alternate diagnosis if appendicitis is ruled out.

Literature shows many studies that have debated over the best modality for diagnosing acute appendicitis.Most of them come up with more or less the same results.Both the technique have definitely reduced the rate of negative appendectomy in recent years.

Most of the studies including our study has shown that CT has more sensitivity,specificity ,Negative predictive value and Positive predictive value in diagnosing appendicitis.

Weighing the cost versus the radiation and the real need to rule out appendicitis ,and the dire need in search of alternate diagnosis should be considered before deciding over which imaging modality to choose.

But CT without doubt has definitely more diagnostic performance than USG in acute appendicitis and our study also proves the same.

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ANNEXURES



ETHICAL COMMITTEE

INSTITUTIONAL ETHICS COMMITTEE MADRAS MEDICAL COLLEGE, CHENNAI-3

EC Reg No.ECR/270/Inst./TN/2013
Telephone No : 044 25305301
Fax: 044 25363970

CERTIFICATE OF APPROVAL

To

Dr.G.Geetha,
Post Graduate,
Barnard Institute of Radiology,
Madras Medical College,
Chennai - 600 003.

Dear **Dr.G.Geetha,**

The Institutional Ethics Committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "**Comparing the Diagnostic accuracy of Ultra sound and CT in diagnosis of acute appendicitis**" No. 17062014

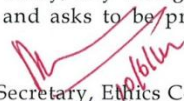
The following members of Ethics Committee were present in the meeting held on 03.06.2014 conducted at Madras Medical College, Chennai-3.

- | | |
|---|-----------------------|
| 1. Dr. C.Rajendran, M.D, | -- Chairperson |
| 2. Dr.R.Vimala, M.D,
Dean, MMC, Ch-3 | -- Deputy Chairperson |
| 3. Prof. Kalaiselvi, M.D,
Vice Principal, MMC, Ch-3 | -- Member Secretary |
| 4. Prof. Nandhini, M.D,
Inst. of Pharmacology, MMC, Ch-3 | -- Member |
| 5. Prof.G.Muralidharan, M.S,
Prof & HOD General Surgery, MMC, Ch-3 | -- Member |
| 6. Prof. Md Ali, MD., DM.,
Prof& HOD of MGE, MMC, Ch- 3 | -- Member |
| 7. Prof. Ramadevi, Director i/c,
Biochemistry, MMC, Ch- 3 | -- Member |
| 8. Prof. Saraswathy, MD.,
Director, Pathology, MMC, Ch- 3 | -- Member |
| 9. Prof. Tito, Director, i/c.
Inst. of Internal Medicine, MMC | -- Member |
| 10. Thiru.S.Ramesh Kumar,
Administrative Officer, MMC, Ch-3. | -- Lay Person |
| 11. Thiru. S. Govindasamy, BA., BL | -- Lawyer |
| 12. Tmt.Arnold Saulina, MA MSW | -- Social Scientist |

We approve the proposal to be conducted in its presented form.

Sd/Chairman & Other Members

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


Member Secretary, Ethics Committee
Vice-Principal
Madras Medical College
Chennai-600 003.

PATIENT CONSENT FORM

Title of the Project

**“Comparing the Diagnostic accuracy of CT & Ultrasonography in the
Diagnosis of acute appendicitis”**

Institution : **Barnard Institute of Radio Diagnosis,**
Madras Medical College,
Chennai-600 003.

Name : Date :

Age : IP No :

Sex : Project Patient No :

The details of the study have been provided to me in writing and explained to me in my own language.

I confirm that I have understood the above study and had the opportunity to ask questions.

I understood that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected.

I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

I have been given an information sheet giving details of the study.

I fully consent to participate in the above study regarding the diagnosis of appendicitis with CT and USG and comparing the accuracy of both the test.

_____	_____	_____
Name of the Subject	Signature	Date

_____	_____	_____
Name of the Investigator	Signature	Date

PROFORMA

“COMPARING THE ACCURACY OF CT AND ULTRASONOGRAPHY IN THE DIAGNOSIS OF ACUTE APPENDICITIS”

Name:

Age:

Sex:

IP/ OP number:

Address:

Contact number:

HISTORY:

Abdomen pain

Fever

Vomiting

Menstrual history

Previous surgeries

EXAMINATION FINDINGS.

Right iliac fossa tenderness

Guarding

Abdominal distension

INVESTIGATION

Hemoglobin

White blood cell count

Platelet count

CRP

Serum creatinine

Blood urea

USG ABDOMEN

CT ABDOMEN

SURGICAL FINDINGS

HISTO PATHOLOGY FINDINGS

PLAGIARISM

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INTRODUCTION

Vague abdomen pain is the most commonly encountered symptom in the emergency department at any hospital. It may be associated with vomiting, fever and diarrhoea but the most distressing symptom is the pain. As the pain threshold varies from person to person the severity of the disease could not be evaluated taking , only this symptom into account.

The various cause of the abdomen pain may vary from benign to life threatening disease. Diagnosing and treating the condition in time lies in the hands of the surgeons or the physician who handle them. Time is a very important factor as any delay may lead to grievous consequences like perforation , and may lead to morbidity and in some case also mortality. Hence timely diagnosis is crucial and remains a challenge to the people in medical field.

Appendicitis the most common cause of abdomen pain in patients admitted at the emergency department. Diagnosing this in

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INTRODUCTION

Vague abdomen pain is the most commonly encountered symptom in the emergency department at any hospital. It may be associated with vomiting, fever and diarrhoea but the most distressing symptom is the pain. As the pain threshold varies from person to person the severity of the disease could not be evaluated taking only this symptom into account.

The various cause of the abdomen pain may vary from benign to life threatening disease. Diagnosing and treating the condition in time lies in the hands of the surgeons or the physician who handle them. Time is a very important factor as any delay may lead to grievous consequences like perforation, and may lead to morbidity and in some case also mortality. Hence timely diagnosis is crucial and remains a challenge to the people in medical field.

Appendicitis the most common cause of abdomen pain in patients admitted at the emergency department. Diagnosing this in young male patient is mostly straight forward, but the same becomes a problem in premenopausal women with similar clinical history and symptoms.

MASTER CHART

MASTER CHART

S. No	Name	Age	Sex	Ultra Sound	CT	Surgical Findings	HPE
1	Shanthi	21	F	P	P	IA	IA
2	Dhanalakshmi	19	F	P	P	IA	IA
3	Vasunthara	31	F	P	P	IA	IA
4	Mumtaz	15	F	P	P	IA	IA
5	Kalavathy	39	F	P	N	N	N
6	Perumal	19	M	P	P	IA	IA
7	Shankar	37	M	N	N	IA	N
8	Arunkumar	17	M	P	P	IA	IA
9	Vijayan	22	M	P	P	IA	IA
10	Karunakaran	35	M	P	P	IA	IA
11	Sujatha	18	F	P	P	IA	IA
12	Rajeswari	32	F	P	P	IA	IA
13	Nandhini	23	F	P	P	IA	IA
14	Kumar	16	M	N	N	IA	IA
15	Thevaraj	27	M	P	P	IA	IA
16	Padma	22	F	P	P	IA	IA
17	Gayathri	25	F	P	P	IA	IA
18	Abraham	25	M	P	P	IA	IA
19	Raja	15	M	P	P	IA	IA
20	Gajendran	21	M	P	P	IA	IA
21	Anjali	32	F	N	N	IA	N
22	Vijaya	21	F	P	P	IA	IA

23	Lalitha	37	F	P	P	IA	IA
24	Mahesh	29	M	N	N	IA	N
25	Rangasamy	27	M	P	P	IA	IA
26	Govindhammal	17	F	P	P	IA	IA
27	Sharmila	6	F	P	P	IA	IA
28	Suseela	41	F	N	N	IA	N
29	Suganya	23	F	P	P	IA	IA
30	Valarmathi	17	F	P	P	IA	IA
31	Mahesh	29	M	P	P	IA	IA
32	Vinay	21	M	P	P	IA	IA
33	Babu	15	M	P	P	IA	IA
34	Chinnappan	52	M	P	P	IA	IA
35	Alexzander	23	M	P	P	IA	IA
36	Rekha	34	F	P	P	IA	IA
37	Nagaraj	25	M	N	N	IA	IA
38	Rohini	25	F	P	P	IA	IA
39	Venkatammal	35	F	P	P	IA	IA
40	Gopi	18	M	P	P	IA	IA
41	Satish	18	M	P	P	IA	IA
42	Arumugam	26	M	P	P	IA	IA
43	Vani	52	F	P	P	IA	IA
44	Lakshmi	17	F	P	P	IA	IA
45	Krishnaveni	43	F	N	P	IA	IA
46	Jayavel	13	M	P	P	IA	IA
47	Selvam	28	M	P	P	IA	IA
48	Deepan	17	M	N	N	IA	IA

49	Chinnaiyan	23	M	P	P	IA	IA
50	Shakila	16	F	P	P	IA	IA
51	Meera	27	F	P	P	IA	IA
52	Usha	19	F	P	P	IA	IA
53	Krihna	15	M	P	P	IA	IA
54	Rajesh	22	M	P	P	IA	IA
55	Manjula	33	F	N	P	IA	N
56	Kumar	15	M	N	P	IA	IA
57	Gandhi	21	M	P	P	IA	IA
58	Joseph	17	M	P	P	IA	IA
59	Velu	27	M	P	P	IA	IA
60	Rangan	16	M	P	P	IA	IA
61	Manimegala	29	F	P	P	IA	IA
62	Sulochana	18	F	P	P	IA	IA
63	Sasikala	17	F	P	P	IA	IA
64	Manimegala	21	M	P	P	IA	IA
65	Kalavathy	35	F	P	P	IA	IA
66	Mari	29	M	P	P	IA	IA
67	Kathirvel	29	M	P	P	IA	IA
68	Abirami	16	F	P	P	IA	IA
69	Vanaja	25	F	P	P	IA	IA
70	Anam	27	F	N	N	IA	N
71	Ravi	17	M	P	P	IA	IA
72	Preethi	17	F	P	P	IA	IA
73	Mathialagan	42	M	N	P	IA	IA
74	Mohanraj	29	M	P	P	IA	IA

75	Saravanan	23	M	P	P	IA	IA
76	Sivakumar	15	M	P	P	IA	IA
77	Usha	35	F	P	P	IA	IA
78	Rajkumar	21	M	P	P	IA	IA
79	Elumalai	36	M	P	P	IA	IA
80	Sakthivel	14	M	P	P	IA	IA
81	Selvam	25	M	N	N	IA	N
82	Rajan	22	M	P	P	IA	IA
83	Selvam	29	M	P	P	IA	IA
84	Vijayakumar	21	M	P	P	IA	IA
85	Selvaraj	38	M	P	P	IA	IA
86	Bala	14	M	P	P	IA	IA
87	Balakumar	22	M	P	P	IA	IA
88	Pandian	26	M	P	P	IA	IA
89	Balakrihsnan	48	M	N	P	IA	IA
90	Sundar	17	M	P	P	IA	IA
91	Ajith	25	M	P	P	IA	IA
92	Subramaniyan	19	M	P	P	IA	IA
93	Aswin	28	M	P	P	IA	IA
94	Amarnath	14	M	P	P	IA	IA
95	Vijayan	39	M	P	N	N	N
96	Lakshmanan	18	M	P	P	IA	IA
97	Nakul	25	M	P	P	IA	IA
98	Jayakumar	27	M	P	P	IA	IA
99	Sidharth	17	M	P	P	IA	IA
100	Ramu	24	M	P	P	IA	IA