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ORIGINAL ARTICLE

STUDY OF PREDICTIVE VALUE OF CLINICAL, LABAORATORY AND RADIOLOGICAL DATA IN THE DIAGNOSIS OF ACUTE APPENDICITIS

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ABSTRACT: Acute appendicitis, though one of the commonest emergencies in surgical practice. Failure of an early diagnosis could lead to the increased risk in its morbidity and mortality. However a negative appendectomy rate of about 25% is described in the surgical literature. This study was performed to evaluate the usefulness of commonly used laboratory tests like leucocyte count, C-reactive protein and use of diagnostic scores like Alvorado score along with radiological imaging modalities to diagnose acute appendicitis and decrease negative appendectomies rates. Misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis. **METHODS:** This study was done in Shadan Teaching Hospital with 200 patients of acute right iliac fossa pain including both genders and all ages. Out of 200 patients, 40 patients were managed conservatively and 160 patients were operated. Clinical evaluation done using Alvorado scores and radiological imaging like ultrasound and plain X-ray of abdomen before operation. Subsequently, histopath-ological findings of appendix specimen were compared with preoperative tools and results were noted. **STATISTICAL ANALYSIS:** The data were entered and analyzed using Statistical Package for Social Science (SPSS) version 14.0. The p value was taken as significant when less than 0.05. **RESULTS:** In proven acute appendicitis, both WBC count & serum CRP levels were raised. WBC count showed 80% sensitivity & 67% specificity in diagnosis. Alvorado score proved helpful to diagnose complicated appendicitis with significant high scores. Ultrasonography of Abdomen had accuracy of only 58.2% in diagnosis. **CONCLUSIONS:** Alvorado scoring method proved helpful in decision making for operative intervention in acute appendicitis.

KEYWORDS: Alvorado Score, Appendicitis.

INTRODUCTION: Appendicitis is an acute inflammation of the vermiform appendix is the most common cause of surgical intra-abdominal condition both in developed and developing countries and appendectomy is the most common emergency surgical operation.

The main symptom of acute appendicitis is abdominal pain or abdominal sensitivity. However, abdominal pain occurs with many conditions and only an estimated 5% of cases of abdominal pain are actually appendicitis. Although uncommon, appendicitis is very serious, and difficulty in diagnosing appendicitis in the emergency department makes appendicitis the 3rd leading cause of malpractice law suits. Diagnostic accuracy rates vary according to the patient.

It is the best in young adult males and considerably poor at extremes of age i.e., in children and elderly patients. The greatest diagnostic challenge appears in females of child bearing age in their 3rd to 4th decade of life especially in the mid-portion of menstrual cycle. Pelvic appendicitis in females may mimic pelvic inflammatory disease. Misdiagnosis of appendicitis is particularly common in children and infants with abdominal pain with estimates of initial misdiagnosis rates from 28% to 57% for under age 2-12 and almost 100% misdiagnosis for appendicitis in infants.

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Acute appendicitis, though one of the commonest emergencies in surgical practice can at times confuse the best of clinicians. Failure of an early diagnosis could lead to the increased risk of perforation and peritonitis with its attendant increase in the morbidity and mortality. However a negative appendectomy rate of about 25% was described in the surgical literature (Essentials of Surgical Practice., A. Cuschieri, 4th edition).[1]

The vermiform appendix is found only in humans, certain anthropoid apes and the wombat and some consider it being a degenerate and vestigial structure. Recently for a decade the appendix may be considered as a specialized structure useful in reconstructive biliary, tubal and urological surgery (Wheeler and Malone 1991).[2] Negative appendicectomy therefore robs the patient of a useful asset.

In a General Hospital, the appendectomy is the most frequently performed emergency surgical abdominal procedure. This constitutes about 25% of emergency abdominal surgeries in many hospitals, Melone and his associates estimated that 1 in 100 population may be expected to get acute appendicitis every year. Approximately 7 percent of the population will have appendicitis in their lifetime, with the peak incidence occurring between the ages of 10 and 30 years. There is no known method of prevention of acute appendicitis. Thus a surgeon confronting a patient suspected of having acute appendicitis is wedged between the perforation of appendix and negative appendicectomy.

Appendicectomy for suspected acute appendicitis is a common procedure. Despite technologic advances, the diagnosis of appendicitis is still based primarily on the patient's history and the physical examination. Prompt diagnosis and surgical referral may reduce the risk of perforation and prevent complications. The mortality rate in non-perforated appendicitis is less than 1 percent, but it may be as high as 5 percent or more in young and elderly patients, in whom diagnosis may often be delayed, thus making perforation more likely. The rate of normal appendices unnecessarily removed remains high (15-30%) despite several techniques and investigations used to improve the diagnostic accuracy.

Hence, comprehensive scoring systems were evolved in making an affirmative diagnosis of acute appendicitis. These scoring systems are mainly based on clinical symptoms and signs with minimal investigational support. The diagnostic criteria of appendicitis are poorly and not uniformly defined. The significance of acute inflammation confined to the mucosa is controversial. Some investigators equate mucosal inflammation with early appendicitis while others consider it a normal finding. The accuracy of the surgeon's assessment of the condition of the appendix is also well debated.

This study was performed to evaluate the usefulness of commonly used clinical variables and a simple laboratory tests like leucocyte count, C-reactive protein and appropriate utilization of diagnostic scores like Alvorado score and also the imaging modalities to diagnose accurately and to decrease negative appendectomies in a country like India where removal of normal appendix is an economic burden both on patients and health resources. Misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis.

The early and accurate diagnosis of acute appendicitis is still a difficult problem, although the treatment of appendicitis has remained the same for nearly a century. Despite introduction of ultrasound and special laboratory investigations (e.g., C-reactive protein), high diagnostic error rates are observed. As a consequence, perforation rates and rates of appendectomy with normal findings of 15% and more occur.

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In the last few years, several scoring systems have been developed for supporting the diagnosis of acute appendicitis. Initial evaluation studies have reported excellent results, indicating that scoring systems would be ideal as diagnostic aids because they have good performance and require no special equipment, being user-friendly and comprehensible to the clinician.

Clinical Variables	Definitions
Classical history	Onset of complaints with abdominal pain, followed by anorexia and/or vomiting
Anorexia	Loss of appetite after onset of the disease
Nausea or vomiting	Complaint of nausea and/or vomiting after onset of the disease
Pain migration to right iliac fossa	Onset of diffuse peri umbilical pain, followed by a shift to sharp pain located in the right iliac fossa
Mc Burney's Point	Point located between medial 2/3rd and lateral 1/3rd of Spino - Umbilical line
Tenderness over Mc Burney's point	Point of maximum tenderness located at Mc Burney's point during abdominal palpation
Rebound tenderness	Pain perceived strongest at McBurney's point when performing rebound tenderness test
Local rigidity	Involuntary increase in muscle tension at Mc Burney's point during palpation of the abdomen
Rectal examination	Tenderness in the right lateral wall of rectum during digital rectal examination

Table 1.1: Definitions of symptoms and signs used in diagnosis of Acute Appendicitis

SCORING SYSTEMS: Although there is much advancement in gastroenterology but no major improvement in diagnostic accuracy of acute appendicitis, which ranges from 25-90% and optimum rate, is 80% which is less in females than males. Scoring systems are valuable and valid instruments for discriminating between acute appendicitis and nonspecific abdominal pain. At present many scoring systems for the diagnosis of acute appendicitis are available.

Several investigations have created diagnostic scoring systems in which a finite number of clinical variables are elicited from the patient and each is given a numerical value. The sum of these values is used to predict the likelihood of acute appendicitis. The number of signs and symptoms included in the scoring systems vary.

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VARIOUS PUBLISHED SCORES FOR APPENDICITIS:

Lindberg Score	:	It is based on sex	
		Male	+8
		Female	- 8 points
White cell count	:	<9000/cmm	-14
		9000-13,900/cmm	+2
		> 14,000/cmm	+10
Duration of pain	:	< 12 hours	-1
		12-48 hours	0
		48 hours	+1
Progression of pain	:	yes	+ 3
		No	- 5
Relocation of pain	:	yes	+7
		No	-9
Vomiting	:	yes	+7
		No	-5
Aggravation by coughing	:	yes	+4
		No	-11
Rebound tenderness	:	yes	+5
		No	-10
Rigidity	:	yes	+13
		No	-4
Pain outside the lower		yes	- 6
Right quadrant		no	+4
CUT OFF POINTS:		- 26 or less = exclusion	
		-26 to 0 = monitoring	
		0 or more = operation	

Table: 1.2 Lindberg Score

Based on: Eskelinen Score

- 11.41 x tenderness : (right lower quadrant 2, other sites 1)
- 6.62 x rigidity : (yes 2, no 1)
- 4.25 x rebound tenderness : (yes 2, no 1)
- 5.88 x white cell count : (≥ 10,000/cmm 2, < 10,000 1)
- 3.51 x pain at diagnosis : (right lower abdomen 2, other areas 1)
- 2.13 x duration of pain : (< 48 hrs. 2, > 48 hrs. 1)

Table: 1.3 Eskelinen Score

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CUT – OFF POINTS:

< 50 exclusion.
50 – 57 monitorin.
> 57 operation.

Feature		Men	Women
Temperature	≥ 37.5^{0}C	+2	+2
White cell count	< 10,000/cmm	-12	-5
	> 10,000/cmm	+8	+4
Duration of pain	< 48 hours	0	-4
	> 48 hours	- 10	-4
Migratory of RIF pain	Yes	+12	+9
	No	-7	-5
Onset of pain	Suddenly	0	-
	Gradually	0	+2
Intensity of pain	Increasing	0	+3
	Decreasing	0	-7
	Unchanged	-2	-4
Pain aggravated by movement	Yes	+4	0
	No	-6	0
Pain aggravated by coughing	Yes	+5	+2
	No	-5	-2
Anorexia	Yes	0	+1
	No	0	5
Nausea	Yes	+1	+1
	No	-2	-9
Vomiting	Yes	+5	+5
	No	-3	-3
Fever before admission	Yes	+2	+2
	No	-1	-1
Rigors	Yes	+3	+4
	No	-1	-3
Diarrhea	Yes	+4	0
	No	-1	0
Rebound tenderness	Yes	+13	+11
	No	-8	-7
Rigidity	Yes	+18	+14
	No	-6	-6
Tenderness outside RIF	Yes	-5	-12
	No		3
Rectal tenderness	Yes	+2	+2
	No	-4	-4
Sex		1	-6

Table 1.4: Fenyo Score: Was used for men and women separately

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CUT OFF POINTS: < 11 monitoring.
> 12 operation.

Sex	Male	1	Female	0
WBC count	>11000	1	<11000	0
Guarding	Yes	1	No	0
Rebound tenderness	Yes	1	No	0
Migratory pain	Yes	1	No	0
Duration of pain	<24 hrs	1	>24 hrs	0
Type of pain	Intermittent	1	Others	0

Table 1.5: Izbicki Score

CUT OFF POINTS: < 2 monitoring
> 2 operation

Based on Duration of Pain	<48 hrs	1	Others	0
Vomiting	Yes	1	No	0
Tenderness RIF	Yes	1	Other areas	0
Low grade fever (38.8^0C)	Yes	1	No	0
Leucocytosis (more > 75%)	Yes	1	No	0

Table 1.6: Christian Score

CUT OFF POINTS: ≤ 3 monitoring
≥ 4 operation

	Score		Score	0
Duration of symptoms	<72 hrs	2	>72 hrs	-4
Initial periumbilical pain +2	Yes	+3	Other areas	-6
Migratory RIF pain	Yes	+5	No	-1
Previous attacks	No	+1	Yes	-2
Anorexia	Yes	- 1	No	-5
Nausea / vomiting	Yes	+2	No	-1
Diarrhea	No	+1	Yes	-3
Sex	Male	+3	Female	-2
Temperature 37.5–38.5^0 C + 3	<37.5^0 C	-3	> 38.6^0 c	-2
Tenderness RIF		+5	Other areas	-6
Rebound tenderness RIF +5	Generalized	+3	None	-1
Guarding, rigidity involuntary	Yes	6	No	-4
Mass RIF +5	Other areas	+1	No	-1
Rectal tenderness	Yes	+4	No	-4
Rectal mass right side +5	Other	-2	No	-1

Table 1.7: Ambjornsson Score

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CUT OFF POINTS: <10 monitoring.
>10 operation.

ALVORADO SCORE: Based on migration of pain, anorexia, nausea and or vomiting, tenderness in the RLQ, rebound tenderness, elevated temperature, leukocytosis, and shift to the left.

CHARACTERISTIC	SCORE
M = Migration of pain to the RLQ	1
A = Anorexia	1
N = Nausea and vomiting	1
T = Tenderness in RLQ	2
R = Rebound pain	1
E = Elevated temperature (≥ 37.3^{0}C)	1
L = Leukocytosis (> 10,000 / cmm)	2
S = Shift of WBC to the left	1
Total	10

Modified Alvorado Score consists of exclusion of shift left as criterion as suggested by Kalan and includes ultra sound findings as criterion.

CUT OFF POINTS: 1–4 exclusion, 5-6 monitoring and ≥7operation.

Alvorado Scoring System: It is based on three symptoms, three signs and two laboratory findings with total score equal to ten.[3]

Pain: The classic story of acute appendicitis is the onset of central abdominal pain followed by nausea or one or more episodes of vomiting with the pain after several hours, shifting to lower right abdomen. Appendicular pain starts first around the umbilicus. This is due to projection of pain sensation from the appendix on to the projection of pain to the 10th and 11th segments of the body (T_{10}, T11). As the appendix is adherent to the parities and once the parietal peritoneum gets inflamed, pain shifts from the umbilical region to the right iliac fossa. The classical visceral – somatic sequence of pain is present in only about 50% of cases proven to have acute appendicitis subsequently. A typical pain is common in the elderly with poor localization.

Vomiting: This symptom occurs in 4 out of 5 patients of acute appendicitis. It is a prominent feature of disturbance of the gastrointestinal tract. Vomiting usually occurs soon after the onset of pain and depends on the degree of distension of inflamed appendix and nervous receptability of the patient. The action is a reflex through the nerve plexus intimately associated with the stomach. In the later stage it may be due to the onset of peritonitis.

Tenderness: Tenderness on pressure has an important diagnostic significance. A surgeon often hesitates to diagnose appendicitis in its absence. It is particularly important as it persists after the spontaneous pain ceases, so long as the inflammatory reaction is going on. It may be either superficial

or deep, the latter being more important. The point of maximum tenderness is usually marked at the McBurney's point but it is far from constant as the appendix may be rotated in an area of 270^0 from McBurney's point. Nelson had described two other points of tenderness. If the maximum point of tenderness is elicited a little lower than the intersection of spinoumbilical line, to the lateral margin of the right rectus it is called as Clado's point. If the tenderness is two inches lower than the midpoint of the spinoumbilical line, it is known as Lotheissen's point. The accuracy of the tenderness depends on proximity of the inflamed appendix to the parietal peritoneum.

Rebound Tenderness (Blumberg's Sign): Acute discomfort is elicited by sudden removal of hand after initial pressure on right iliac fossa. This is also conditioned by the location of the inflamed appendix, the amount of irritation of the parietal peritoneum and the degree of sealing off by the omentum.

Fever: In typical cases temperature varies between 100^0 F and 103^0 F within the first 24 hours of onset of pain with a corresponding increase in pulse rate. The rise may be rapid or slow and in some cases subsiding or persisting for 24 – 36 hours returning to normal thereafter. The subsequent rise of temperature indicates foci of infection persisting. Sudden fall of temperature is a bad sign indicating perforation of the appendix or bursting of periappendicular abscess. Marked and persistent hyperpyrexia as an initial symptom bears poor prognosis.

Leucocytosis: A polymorphic leucocytosis is stressed by American authors as an important feature of acute appendicitis. It is clear that 80 – 85% of patients with acute appendicitis will have a total WBC count of over 10,000/cmm, neutrophilia >75% will occur in 78% of patients. When both are taken together < 4% of patients with acute appendicitis will have normal levels. Leucocytosis increases with the duration of disease process, but even perforated appendix may present with a normal white cell count. If WBC count is repeated after some hours, it remains high in acute appendicitis but tend to fall in those without appendicitis. The raised WBC count is a highly sensitive test for acute appendicitis.

Shift to the Left of Neutrophils: Systems for differential counting were employed at one time. Arneth, for example painstakingly recorded and tabulated from left to right the number of neutrophilic leucocytes with 1,2,3 etc. lobes and made other subdivisions. The term "shift to left" is derived from this practice and indicates an increase in proportion of cells with only one or very few lobes. Whereas "shift to the right" represent an increase in the proportion of multi segmented forms. Schilling used the term "regenerative shift" to refer to the increased proportion of juveniles and myelocytes that appear in the blood in response to an acute process and degenerative shift to the left to indicate a failure to mature as a result of depressed marrow function. He pointed out that when the shift is to the left there is increased number of immature forms in the blood but the nuclei of these cells are narrow, T, V, U shaped and deeply stained. These younger forms are band cells metamyelocytes and myelocytes. Normal variation in differential count is 2/3 of the neutrophils will have 3 lobes and 1/3 have 2 lobes.

C-reactive protein CRP: This is not used in the Alvorado score. It was first found in the serum of patients suffering from pneumonia caused by Streptococcus pneumoniae. Together with other acute

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phase-proteins, the serum level of CRP rises in response to any tissue injury. CRP concentration increases within 8 hours of the onset of tissue injury, peaks in 24-48 hours and remains high as long as there is continuing infection or tissue destruction. A multivariate analysis by Oosterhuis et al showed that serial CRP measurement can improve the accuracy of diagnosing acute appendicitis.

IMAGING MODALITIES IN DIAGNOSIS OF ACUTE APPENDICITIS:

1. **PLAIN RADIOGRAPHY:** Has been used for the diagnosis of acute abdomen since 1906. However there is no single sign that is pathognomonic of acute appendicitis in a plain film. Brooks et al in 1965 described several signs in case of acute appendicitis.[4]
    a. Presence of appendicolith
    b. Sentinel loop – dilated atonic bowel loop containing fluid level in RIF.
    c. Dilated caecum
    d. Widening / blurring of preperitoneal fat line.
    e. Haziness of right lower quadrant.
    f. Scoliosis concave to the right
    g. Right lower quadrant mass indenting the caecum
    h. Blurring of right psoas out line
    i. Gas in the appendix

However it lacks specificity, with similar findings in normal patients as well as other conditions. Added to this its sensitivity is only 8%.

2. BARIUM MEAL FOLLOW THROUGH: Schisgall et al in 1983 reported 95% accuracy in diagnosis of acute appendicitis in children by a barium meal follow through examination. This involved a slightly high (0.2 rads) radiation exposure as compared to barium enema. The signs of acute appendicitis are:

- Non – visualization of the appendix.
- Mass effect on the caecum.[5]

3. BARIUM ENEMA: Based on the rationale that the lumen of normal appendix can be demonstrated with barium enema, appendiceal luminal obstruction represents acute appendicitis. Rajagopalan et al found the following signs very suggestive of appendicitis on a barium enema examination.[6]

1. Persistent non-visualization of appendix.
2. Partial visualization.
3. Pressure effects on the caecum (3 sign).
4. Irritability of caecum or terminal ileum on fluoroscopy.

Post evacuation films appear to increase the diagnostic yield. But the procedure is cumbersome and time consuming. The advantage of barium enema is that they don't require specialized equipment. They can also diagnose certain conditions which may mimic acute appendicitis like colonic carcinoma, terminal ileitis, ischemic colitis.

4. ULTRASOUND: Deutsch et al were first to report ultrasonic visualization of an inflamed appendix in 1981 in a child suffering from acute leukemia. Sonographic criteria for the diagnosis of acute appendicitis (after Jeffery):

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1. Blind ending immobile non-compressible tubular structure in the RIF.
2. Cannot be displaced on pressure.
3. Bull's eye or target lesion diameter >6mm
4. Fecolith in the lumen.
5. Periappendiceal collection.
6. Hypo/hyper peristaltic loops in RIF.
7. Wall thickness more than 3 mm.
8. Loss of contour.
9. Local adynamicileus.
10. Graded probe tenderness over McBurney's point.
11. Complex mass.
12. Irregular asymmetry.

Miscellaneous signs cockade around target, tubular structure > 50 mm in length. It has specificity of 86% and sensitivity of 89%. The advantage is of excluding other diseases like terminal ileitis, ureteric stones, gynecologic disorders etc. It is non-invasive, can be used safely for pregnant patients and children with no radiation hazard.

5. COLOR DOPPLER: This examination is based on the principle that acute inflammation of the appendix is associated with increased blood flow to the region. But an earlier study found that absence of flow cannot definitely distinguish a normal from an inflamed appendix.

6. RADIO-ISOTOPE SCANNING: It is based on rapid accumulation of radio isotope labeled leucocytes at sites of infection. The method involves withdrawing 30-90ml of patient's blood, separating leucocytes by differential sedimentation and labeling them with radio isotope indicator usually technetium 99 or indium 111, scanning was done 2 hours after injection of this mixture. Indium – 111 scanning found sensitivity of 86% and specificity to be 93%. They help in reduction of the negative appendectomy rate after supplementing with ultrasound to rule out gynecologic conditions in women.

7. CT-SCANNING: Useful in obese patient and distended bowel loops where ileus makes visualization by ultrasound a problem. The common findings in acute appendicitis according to a study by Gale et al.[7,8]

1. Pericaecal inflammation	68%
2. Abscess formation	55%
3. Calcified appendicolith	23%
4. Abnormal appendix	18%

Such highly sophisticated equipment does not have a role in day-to-day diagnosis of acute appendicitis. Balthazar et al analyzed 100 cases with both ultrasound and CT scan and found the accuracy of CT scan to be 93% in contrast to 84% by ultrasound.[9] The sensitivity of CT scan was found to be 96%. It is more useful in detecting extent, location and nature of disease process.

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8. DIAGNOSTIC PERITONEAL LAVAGE/ASPIRATION CYTOLOGY: As a diagnostic modality for non-traumatic acute abdomen had been investigated by Evans et al in 1975 [10] and its utility was confirmed by Hoffman et al in 1988.[11] Barbee et al found diagnostic lavage in evaluating abdominal pain.

In 1984 Stewart et al showed that generalized peritoneal neutrophilia was present in case of acute abdomen, irrespective of site of inflammation. The same authors proved that it improved clinical decision making in doubtful cases of acute abdomen and decreased the number of negative laparotomies.[12]

9. DIAGNOSTIC LAPAROSCOPY: Kelling et al introduced laparoscopy as early as 1902, but its use in acute abdomen was reported only as late as 1970. Acute appendicitis could be excluded if some other pathology was identified to explain the clinical picture. Studies by Diebl, Deutsch and Leape et al scored the utility of laparoscopy in reducing negative laparotomy rate from 30% to 1.2%. While Spirtes and Anderson in separate studies recorded its safety in pregnant women in the first trimester. Hoffman summed up the signs of acute appendicitis as[11]

1. Partial or complete visualization of the inflamed appendix.
2. Pus in the RIF.
3. Omentum adherent to the structures of the RIF.
4. Inflammation of pericaecal tissues.

Deutsch et al reported an accuracy of 100%, while other studies reported sensitivity of 72-92%. The other advantage of laparoscopy is visualization and exclusion of differential diagnosis such as salpingitis, terminal ileitis, typhilitis, ectopic pregnancy, edometriosis, corpus luteal cysts, and tumor infiltrates, paraovarian cysts and mittelschmerz.

Laparoscopy is contraindicated in such conditions as obesity, previous laparotomy, sub umbilical scars, abdominal distension due to ileus, ascites, pregnancy etc. Anaesthetic considerations forbid creation of pneumoperitoneum in cardiopulmonary compromised patients.

Sl. No.	Modality	Predictive accuracy	Sensitivity	Specificity
1	Clinical score (Raminez et al)	91.7%	80%	81%
2	Radiography (brooks et al)	--	8%	--
3	Barium enema (sofer et al)	92%	100%	100%
4	Ultrasonography (Jeffrey et al)	93.9%	89.9%	96.2%
5	Colour Doppler (Quillin et al)	93%	87%	97%
6	CT Scan (Balthazar et al)	93%	92%	79%
7	Diagnostic aspirate (Caldwell et al)	--	91%	94%
8	Laparoscopy (Deutsch et al)	100%	92%	100%

Table 1.8: Comparison of different diagnostic modalities

COMPUTERIZED DIAGNOSTIC SYSTEMS: Structured data taken from history and physical examination may be fed into a previously programmed computer. Several individualized systems using up to 30 variables have been studied and found significant improvement in diagnosis of acute abdomen. Erikson et al reported an increase in diagnostic accuracy from 72-92% while negative

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laparotomy dropped from 18% to 6–10%.[13] There was also a fall in the incidence of perforation and morbidity. Gunn et al reported a substantial saving in terms of bed days, negative laparotomies and investigation which offset the initial cost of installing and running a computer.[14] Van Way et al studied the feasibility of computer aided diagnosis in appendicitis and reported that computer diagnosis is not more accurate than unaided diagnosis.

The advantage of computerized decision making is that it provides a non-invasive and accurate means of diagnosis. The disadvantage is that it requires special equipment and training, more over the very young, very old, and very sick cannot be adequately assessed.

METHODS: Patients of any age group and both genders presenting to the emergency department with pain in right lower quadrant of abdomen were included in the study. Of the 200 patients admitted 40 were kept for observation and treated non-operatively. They were discharged from the hospital with diagnosis of possibly acute mesenteric adenitis or nonspecific gastroenteritis. These patients were excluded from this study. Patients with presentation of urological, gynecological or surgical problems other than appendicitis and especially patients with mass in right iliac fossa who were managed conservatively, immunocompromised or with some medical illness were also excluded from the study.

In this series of 160 patients of acute appendicitis, who had undergone appendectomy with preoperative diagnosis of acute appendicitis were included. A detailed history was taken. Thorough physical examination and relevant laboratory tests (Total and differential white cell count and C-reactive protein, X-Ray abdomen and USG abdomen) was done in all cases. The records of these 160 patients were studied in a prospective manner. C-reactive protein and ALVORADO score were performed before operations but were not taken into account prior to the decision to perform a laparotomy to compare the surgeon's clinical diagnosis.

The decision to operate was made on the basis of history and clinical examination Appendectomy was done by using Grid – iron muscle splitting. The operative findings were recorded and histopathology of removed appendix done in each case. The inflammation of appendix was graded as acute simple appendicitis (Uncomplicated), gangrenous, perforated and normal in patients with normal appendix other possible conditions responsible for the symptoms and abnormal laboratory findings were also noted. The data were entered into a predesigned proforma and the results were assessed to establish the role of clinical examination with respect to white cell count and C-reactive protein and use of Alvorado scoring system in the final diagnosis of acute appendicitis.

The removed appendices from all 160 patients were sent for histopathological examination. The result was then used to categorize the operations as positive (Acute appendicitis) or negative exploration (Normal appendix).

The white blood count (WBC), CRP level and histopathology findings were compared to assess the impact of serum CRP measurements on the diagnosis of acute appendicitis.

Normal CRP level in our laboratory is 0-0.8 mg/dl.

Levels above 2.0 mg/dl were considered as high.

USG was done in all cases and the USG results were compared with histopathological reports to predict the impact of USG on diagnosis of acute appendicitis.

Alvorado score of all 160 patients were compared with the histopathological examination to note the distribution of the negative appendectomy with respect to the Alvorado score.

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The Alvorado score was divided into four categories:

SCORE	PREDICTION
1-4	Unlikely
5-6	Possible
7-8	Probable
9-10	Definitive

Table 2.1: The impact of Alvorado score on predicting acute appendicitis was studied

Statistical Analysis: The data were entered and analyzed using Statistical Package for Social Science (SPSS) version 14.0. The p value was taken as significant when less than 0.05 (Confidence interval of 95% was taken).

The Chi- Square Test was used to get the proportions and the difference between the study groups was assessed by using the Fischer's exact test.

RESULTS:

- A total of 160 patients, 98 males and 62 females were studied who were operated upon for acute appendicitis after a clinical diagnosis.
- The male to female ratio was 1.4:1
- The age distribution ranged from 11-70 years, mean being 20 years.
- The incidence of acute appendicitis was more in second and third decade (60%)
- The most consistent and frequent symptoms was pain starting in upper abdomen in 52% (82 patients) patients and then shifting to right iliac fossa. In 6% cases pain became generalized.
- In 67% patients (107 cases) pain started early morning or after mid night.
- A total of 114 patients (71%) presented within 24 hours of onset of complaints whereas 12 patients (8%) bad history of more than 72 hours. Four female patients were pregnant at presentation.
- In 21% patients, there was complaint of past history of similar attacks, with mild to moderate pain in right lower quadrant.
- On admission 67% (107 patients) had fever (> 99.2^{o} F) of variable degree. Majority of them had between 99.6 – 101^{0}F.
- Fever was high grade in cases of perforated or gangrenous appendices (25% cases).
- Patients felt pain on coughing were 88% (141).
- All the patients had tender right half of abdomen to variable degree of pressure. The site of tenderness was variable but in 92% cases patients had tenderness in the right iliac fossa.

Muscle rigidity and rebound tenderness were present in 73% (117 cases) and 72% (115) of all patients respectively. These signs were constantly present and more marked in all patients having gangrenous and perforated appendix. Rebound tenderness has high sensitivity rate in diseased appendices group, but its positivity does not confirm acute appendicitis.

Rovsing's sign, Psoas test and Obturator test were positive in more than 50 patients.

In this study, clinical diagnosis was the main stay but in every case total leucocyte count and differential leucocyte count were done.

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The mean hemoglobin level was 13.3gm/dl (range 9.1-16.9) gm/dl. The total leucocyte count ranged from 4600 to 22,800/mm^3 (mean 9356.6/mm^3). It was <10,000/mm^3 in 65(40.62%) patients and >10,000/mm^3 in 95(59.37%) cases. 74.3% patients with low TLC and 54.9% with TLC >10,000/mm^3 presented with history of less than 24 hours. Only 4.4% (7 patients) cases having TLC <10,000 / mm^3 have history of longer than 72 hours.

Neutrophilia of >75% was found in 120 (75%) cases and 16 out of 40 patients with gangrenous or perforated appendix had a TLC of less than 10,000/mm^3. After exclusion of cases with other surgical conditions necessitating exploration, the sensitivity and specificity of raised white cell count in acute appendicitis were 80 and 67% respectively.

Urine microscopy showed haematuria or pyuria in 35 (22%) patients. Twelve patients (7.5%) with abnormal urine microscopy had histopathological evidence of acute appendicitis.

Appendix was retrocecal in 104 (65%), pelvic in 26 (16%) cases, subcaecal in 2% and undetermined in 17% Appendix was gangrenous in 22 (13.8%) and perforated in 18 (11.3%) cases.

Microscopically 22 appendices were found normal after histopathology. So the negative appendicectomy rate was 14% (13 in females and 9 in males).

The operative findings in patients having normal appendix included acute mesenteric adenitis (12), ruptured ovarian cyst (3), acute pancreatitis (1) and gastroenteritis (1). Remaining 5 patients had no signs of abdominal pathology at operation.

Urine examination revealed pus cells more than 5-6 / HPF in 20 patients, red blood cells in 11 patients and in 32 patients there were traces of albumin. Half of these were finally diagnosed as acute appendicitis.

Post-operative nonspecific fever for one or two days was present in 28 cases (17.5%).

Post-operative complications were present in 24 patients (15%) and local wound infection was the most common among them. It ranges from stitch abscesses to deep infection. Local wound infection occurred more commonly in gangrenous appendix and after perforation. Superficial wound infection was present in 8 cases of uncomplicated acute appendicitis and 12 cases with complicated appendix. Deep wound infection was present in 4 cases of complicated appendicitis. No other serious complication was noted. There was no mortality in this study.

Histopathology	**TLC <10,000mm^3**		**TLC >10,000 mm^3**	
	Number	**%**	**Number**	**%**
Acute appendicitis	42	26.25	56	35
Gangrenous appendicitis	6	3.8	16	10
Perforated appendix	4	2.5	14	8.8
Normal appendix	13	8.12	9	5.6

Table 3.1: Total leucocyte count and histopathology of appendix

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Clinical Presentation	Patients% Age (n=160)
Pain	100
Pain right iliac fossa	52 (83)
Pain epigastrium which localized to RIF	14 (22)
Pain starts at umbilical region, later localized to RIF	34 (55)
Duration of pain < 24 hours	71 (114)
Shifting of pain	42 (67)
Nausea	94 (150)
Vomiting	72 (115)
Anorexia	87 (139)
Fever between 99.2-101^{0}F	67 (107)
Constipation	52 (83)
Diarrhea	8 (13)
Urinary complaints	22 (35)
Cough sign	88 (140)
Tenderness right iliac fossa	92 (147)
Rebound tenderness	72 (115)
Muscle guarding	73 (117)
Rovsing's sign	55 (88)
Psoas test	50 (80)
Obturator test	23 (37)

Table 3.2: Summary of the clinical presentation of all 160 cases in this study

Histo-pathological Grading	Ultrasound findings		Total
	1#	2##	
Acute simple appendicitis	43 (26.9%)	55* (34.4%)	98 (61.3%)
Gangrenous appendicitis	22** (13.8%)	0	22 (13.8%)
Perforated appendix	18** (11.3%)	0	18 (11.3%)
Normal appendix	0	22** (13.8%)	22 (13.8%)
Total	**83 (51.9%)**	**77 (48.1%)**	**160 (100.0%)**

Table 3.3: Proportion of study population according to histo-pathological finding and ultrasound

* $p<0.05$ significant,

** $p<0.00$ highly significant

#- USG findings suggestive of acute appendicitis

##- USG findings suggestive of normal appendix

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Alvorado Score	Histo-pathological Grading				Total
	Acute simple appendicitis	Gangrenous appendicitis	Perforated appendix	Normal appendix	
Unlikely (score 1 to 4)	17 (10.6%)	0 (0.0%)	0 (0.0%)	8 (5.0%)	25 (15.6%)
Possible (score 5 to 6)	35 (21.9%)	0	0	9 (5.6%)	44 (27.5%)
Probable (score 7 to 8)	36 (22.5%)	3 (1.9%)	6 (3.8%)	4* (2.5%)	49 (30.6%)
Definitive (score 9 to 10)	10 (6.3%)	19** (11.9%)	12** (7.5%)	1* (6%)	42 (26.3%)
Total	**98 (61.3%)**	**22 (13.8%)**	**18 (11.3%)**	**22 (13.8%)**	**160 (100.0%)**

Table 3.4: Proportion of study population according to Alvorado score and histopathological

* $p<0.05$ significant ** $p<0.00$ highly significant

DISCUSSION: The accurate clinical diagnosis of acute right iliac fossa pain remains a difficult clinical problem as the differential diagnosis of such pain is not always straightforward. Acute appendicitis is the most common non traumatic surgical emergency and in spite of all diagnostic modalities it is confusing for the clinician. The diagnosis is made purely based on history, clinical examination and some laboratory investigations. New diagnostic techniques such as estimation of C-reactive protein, peritoneal aspiration cytology, scoring and computer analysis, graded compression ultrasonography, computed tomography, non-contrast helical computed tomography and laparoscopy have been introduced in recent years. The drawback with these techniques is involvement of additional costs and lack of free availability. Due to these factors, these modalities have not gained wide acceptance as routine diagnostic investigations of acute appendicitis. Imaging techniques have been shown to add very little. A certain diagnosis can only be obtained at surgery and after pathological examination of surgical specimen.

The “difficulty” alluded to by Cope relates to our inability to reliably diagnose appendicitis on clinical grounds.[15] The varieties of presentation and the variability of signs are such that even the most experienced surgeons may remove normal appendix or “sit on” those that have perforated. The squeal of delayed diagnosis may result from late presentation by the patient but are sometimes due to the initial failure of the clinician to make the correct diagnosis. The sequelae of delayed treatment include a higher incidence of postoperative sepsis and longer hospital stay. Therefore, misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis.

Difficulty in diagnosis arise in very young, elderly patients and females of reproductive age because they usually have atypical presentation and many other conditions also present like appendicitis and literature shows that 2-7% of all adults on exploration have diseases other than

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appendicitis. Against this, it is generally accepted that unnecessary surgery should be avoided, and this aspect of care is usually measured by the proportion of appendix that are normal on histology. A negative appendectomy rate of 20-40% has been reported in literature and many surgeons would accept rate of 30% as inevitable. Removing normal appendix is an economic burden both on patients and health resources.

In the present study, I have emphasized on the importance of clinical examination and utilization of Alvorado score in making a confident diagnosis of acute appendicitis and thereby decreasing the negative appendicectomy rate.

In the present series, total of 160 patients presenting to this hospital with the complaints of right lower abdomen pain who were ill enough to warrant surgery for suspected acute appendicitis were evaluated.

The incidence of acute appendicitis was more common in males than in females. The male to female ratio is 1.4:1 and the age distribution ranged from 11-70 years, mean being 20 years. The incidence of acute appendicitis is variable in both sexes. In one study male to female ratio was 2.2:1.2. as C. K. Pillar (1992) observed that the incidence of acute appendicitis was more in males than in females. [16] Walker SJ et al in a series of 248 patients had 1.3:1 ratio.[17] In Lewis et al series of 1000 cases, the incidence of acute appendicitis was found to occur most commonly in the age group of 20-30 years in both males and females. The male to females' ratio was 3:2. It can be seen from the given statistics, that there are no set patterns for incidence of the disease in both sexes and it is highly variable.

The exact cause of male preponderance in most studies is not known. J. B. Hedawoo et al (1994) observed that the commonest age group affected was between 20 to 30 years of age. The male to female's ratio was 1.8:1. In comparative international study the commonest age group was 10-30 years as 90%. According to Amir M and Shami IH, 44.8% cases were in their 2nd decade and 30% cases were in 3rd decade with a gradual decrease in incidence with age.[18] Nazir A et al in a series of 100 patients has quoted 56% patients between 13-20 years and 32% patients between 21-30 years and Walker SJ et al in a study of 248 patients has mean age 18 years and 38% patients were between 21-30 years.[17] Male to female ratio in the present study was 1.4:1. In the present study the mean age of 20 years and male predominance of 1.4:1 is similar to other studies.

Hence in all the above series including the present series appendicitis is more common in males than in females.

In this study, it was observed that pain was present in all the cases (100%) and was a major presenting symptom, which coincides with other studies like Hubble, Barker Solomon (1960) and N.S. Bhandari et al (1982) who have also mentioned that pain was present in all cases. Majority of the patients had aching type of pain and colicky pain was noted in 28 patients.

The site of pain, most often complained of was in the right iliac fossa. The classical shift of pain from the umbilicus to the right iliac fossa was seen in 52% of patients with acute appendicitis.

This is similar to the study of Adesunkanmi AR, who reported lower abdominal pain in all cases of appendicitis.[19] In our study, majority of the patients (52%) started pain in right iliac fossa.

And in 48% patients, pain started in the umbilical or epigastric region and later migrates to right iliac fossa. In the literature, the migration or shifting of pain to right iliac fossa is variable and is found in 30-64% of the patients.

In our study it was noted in 42% patients. Lee et al in a large series of 766 patients emphasized migratory pain with positive predictive value of 91% which was more than leucocytosis,

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CT scan and ultrasonography. So when migration or shifting to right iliac fossa is present, appendicitis is likely, while absence of migration does not indicate a normal appendix.

In our study duration of pain was less than 24 hours in 71% patients at the time of presentation. In 21% of the cases, there was a previous history of similar attacks of pain in right iliac fossa.

Anorexia, was the other most common symptom after pain in this study. It was found in 87% of the patients. This figure more or less compares with the literature. According to two studies, anorexia was present in 82% and 77.7% patients respectively.[16, 18] It seems a reliable symptom and one should deeply inquire about this symptom. Anorexia was also present in 53.3% of cases with normal appendix. In our study 94% patients experienced nausea and 72% had vomiting once or twice usually in the early part of disease. This complaint always followed the pain. Vomiting is more common among teenagers and the younger age group. The remaining patients had nausea (94%) and dislike for food. Review of literature shows that 51-69% of patients with appendicitis had vomiting.[18] It seems that this symptom has high sensitivity rate but less specificity, as quite a large group of patients (30-50%) with normal appendix also had this symptom. In comparative study by Ohmann C et al, right lower quadrant pain was present in more than 95% of cases and in more than 65% of cases, there was history of nausea, vomiting and anorexia.[20] Anorexia, nausea and vomiting are found in 93-96% of cases of appendicitis. If none of these three symptoms are present, the diagnosis should be seriously questioned.

The incidence of vomiting by other authors was 75% of patients in Schwartz series and 36% of patients in Hubble et al series. Sir Zachary Cope has said that nausea and vomiting depends upon the amount of distension of the inflamed appendix and secondly the reflex nervous susceptibility of the patient.

In the present series, low grade fever was complained of by 67% of the cases and there was a corresponding rise in the pulse rate, whereas in N.S. Bandari et al (1982) series, tachycardia and rise in temperature were noticed in all the cases. Smith (1965) showed that only 60% of the patients had a rise in temperature. This difference may be due to delay in coming to the hospital and treatment outside the hospital by antibiotics and analgesics. In a few patients there was high-grade fever up to 101^0F and these were the cases with perforated and gangrenous appendicitis (25%). On admission low-grade fever was noticed in 67% of the patients. This is correlated with a study by Smith (1965) that showed mean temperature more than 100.4^0F in case of perforated and gangrenous appendicitis There was no discernible correlation between the clinical condition of the patient and the blood pressure. However it was observed in the present series that the blood pressure was less than normal in cases where appendix was either perforated or gangrenous and patient was dehydrated.

Bowel disturbances were present in 60 patients in the form of constipation or diarrhea. Constipation was more common than diarrhoea. Constipation was present in 52% cases, though constipation is not a common presenting symptom of acute appendicitis and is found in 4-18% of cases in some studies. The probable reason for constipation is late presentation of patients with presence of anorexia for three to four days and less intake of food. Diarrhea was found in 8% of patients in our study which is similar to a study by Rasmussen and Hoffman, who reported that diarrhea was found in about 7% of the patients with simple acute appendicitis. [21]

Urological symptoms, commonly dysuria and burning micturition were found in 22% of the cases in our study. Most of these patients were female. The probable cause of this was dehydration

and in few pyuria and microscopic hematuria might have been the cause. In simple acute appendicitis urinary symptoms were found in 3 to 11% of cases. [21]

Pain on coughing was present in 88% patients in this study, while Ishtiaq AC et al concluded that it is a reliable sign and was present in all patients with positive appendicitis.

Majority of the patients presented within 48 hours after the onset of pain, with most of them presenting between 7-12 hours after the onset of pain.

Incidence of various physical signs as reported by Rajendra et al (1978), has been compared with the present series as follows:[22]

Signs	Present Series in Percentage	Rajendra Bhatnagar et al Series in Percentage
Tenderness in RIF	92	98
Muscle guarding in RIF	73	20
Rovsing's sign	55	05
Rebound tenderness	72	21
Psoas test	50	20
Obturator test	23	40
Distension of abdomen	04	08
Rectal tenderness	28	15

Table 3.5: Physical signs in diagnosis of Acute Appendicitis

The degree of tenderness was different in each individual patient, but in obese patients and in older age groups tenderness was elicited on deep palpation. These patients had relatively mild tenderness. Degree of tenderness also depends on difference in sensitivity to pain in different individuals. Incidence of tenderness in our study compares well with other series where tenderness could be elicited in 96-100% patients with appendicitis. After a review of different studies, it has been concluded that the importance of right iliac fossa tenderness is, that in the absence of tenderness acute appendicitis is unlikely. Muscle guarding and involuntary rigidity were noted in 73% cases. This sign was 100% present in perforated and gangrenous appendix. A study by Adesunkanmi AR (1993), muscle guarding was present in 81% cases.[19]

On clinical examination of the patient, tenderness in the right iliac fossa was the most consistent feature in 92% of cases whereas in Rajendra Bhatnagar series it was present in 98% of the patients, which coincides with present series.

In the present study rebound tenderness was found in 72% cases and was helpful in diagnosis. It was more marked and persistent in cases of perforated and gangrenous acute appendicitis. It was also present in three out of 22 cases of normal appendices According to Alshehri MY et al rebound tenderness was present in 94.7% cases of acute appendicitis and rebound tenderness and muscle guarding has more than 77% specificity in cases of acute appendicitis.

In the present series the incidence of abdominal rigidity was 22%, perforated appendix constituted 9% of cases, of which 4% had diffuse peritonitis with appendicular abscess and 5% were due to gangrenous appendicitis and remaining 4% due to acutely inflamed appendicitis with peritonitis. The increase incidence of abdominal rigidity may be due to late presentation of cases (as compared to Rajendra Bhatnagar series 15%). Rovsing's sign was present in 55% of the cases, which

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is significantly more than Rajendra Bhatnagar series the reason may be late presentation of the cases in present series.

Psoas test was positive in 50% of the patients though the percentage of retrocaecal appendix was 65% of the cases. This test is suggestive of inflamed focus in contact with the psoas muscle. In Rajendra Bhatnagar series it was present only in 20% of cases. Obturator test was positive in 23% of cases and it indicated inflammation of appendix. In this study pelvic appendix was present in 16% of cases. In Rajendra Bhatnagar series, obturator test was positive in 40% of cases.

The digital examination of the rectum was done routinely in all the cases. There was tenderness in right wall of the rectum in 28(17.5%) patients. Almost all appendicular abscess, gangrenous and perforated appendicitis had tenderness in right rectal wall, whereas in N.S. Bhandari et al 1982 series rectal tenderness were revealed in 10% of appendicular lump cases only. In adult female patients, vaginal examination was done routinely, to exclude any pelvic pathology.

The total leucocyte count is widely used to aid the diagnosis of acute appendicitis. Its diagnostic value varies from useful to misleading. The total leucocyte count alone is not diagnostic because it has low specificity. Various studies have reported that 80% to 85% patients with acute appendicitis will have a total white cell count of over 10,000/mm^3 [19] However the present study shows that only 59.3% cases had TLC>10,000/mm^3 which is almost similar to the findings of a series that reported a raised TLC>10,000/mm^3 in only 49% of 354 patients.[18] A raised TLC is regarded as a sensitive test for acute appendicitis but is not diagnostic because of its relatively low specificity and does not add much to the management is patients with undutiful clinical findings. The sensitivity (80%) and specificity (67%) of the raised white cell count in the present study correlated with other study where it showed sensitivity 88.7% and 70% specificity.

In a series of 248 patients of acute appendicitis by Walker et al,[17] sensitivity and specificity of combined leucocyte count and neutrophilia was 95.7% and 61.5% thus although raised white cell count may be highly sensitive test for acute appendicitis, it has low specificity and has little diagnostic value. Even a perforated appendix may be associated with a normal white cell count.

In the present study 10 patients (6.3%) with gangrenous or perforated appendix had a TLC of less than 10,000/mm^3. So in those cases where the white cell count varies with clinical signs, the clinical judgment should be considered more reliable.

Histopathology	TLC<10,000mm^3		TLC>10,000mm^3	
	Number	%	Number	%
Acute appendicitis	42	26.25	56	35
Gangrenous appendicitis	6	3.8	16	10
Perforated appendix	4	2.5	14	8.8
Normal appendix	13	8.12	9	5.6

Table 3.6: Total leucocyte count and histopathology of Appendix

In the present study, urine microscopy revealed haematuria and pyuria in 35 (22%) patients and amongst these 12 (7.5%) had acute appendicitis. The effect of acute appendicitis on right kidney and urine analysis has been investigated by Puskar et al who reported in abnormal urine microscopy in 48% of their 84 patients with acute appendicitis.[23] The authors concluded that inflammation is the major cause of abnormal urine analysis and transient pelvic calyceal dilation in some patients

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with acute appendicitis. They further emphasized that haematuria, pyuria and proteinuria can be found in patients with acute appendicitis, but should not mislead the surgeon in the diagnosis of acute appendicitis. Fragosos and associates reported 6% of their 200 cases presenting with urinary symptoms and found some alteration in urine analysis in 45% of their cases.[24]

In the present series, patients with histopathologically proven acute appendicitis, both the WBC count and serums CRP level were significantly raised. Serum CRP level was normal in 13 negative explorations (Normal appendix on histopathology). A multivariate analysis by Oosterhuis et al showed that serial CRP measurement can improve the accuracy of diagnosing acute appendicitis.[25,26] However CRP is an acute phase reactant and can be increased in many other inflammatory processes, hence it is not a specific marker.

Plain X-ray abdomen was taken in erect posture. Three patients had ground glass appearance, suggestive of diffuse peritonitis and four patients had fluid levels localized to the caecum. Free gas under diaphragm was not present in any perforated appendix. Sentinel loop in right iliac fossa was seen in two cases and obliteration of psoas shadow seen in two cases, where as in Saeho (1978) reported three examples of pneumo peritoneum associated with perforated appendix.[27]

Ultrasound scanning of the abdomen was done in all the patients. Ultrasound showed evidence of appendicitis in 80 patients only with an accuracy of 58.2% whereas Chen S.C et al (1998) series reported an accuracy of 91.6% for detecting acute appendicitis.[28] Probably this difference may be due to resolution power of equipment, presence of ileus, inadequate preparation of patient and experience of the radiologist.[29,30]

Histo-pathological Grading	**Ultrasound Findings**		**Total**
	1#	**2##**	
Acute simple appendicitis	43 (26.9%)	55* (34.4%)	98 (61.3%)
Gangrenous appendicitis	22** (13.8%)	0	22 (13.8%)
Perforated appendix	18** (11.3%)	0	18 (11.3%)
Normal appendix	0	22** (13.8%)	22 (13.8%)
Total	**83 (51.9%)**	**77 (48.1%)**	**160 (100.0%)**

Table: 3.7 Proportion of Study as per histopathogical finding & ultrasound

#- USG findings suggestive of acute appendicitis

##- USG findings suggestive of normal appendix

* $p<0.05$ significant ****** $p<0.00$ highly significant

USG was able to diagnose complicated cases of appendicitis easily however in acute simple appendicitis it missed out on 55 cases (34.4%) cases which is statistically significant. However, in none of the normal appendix did the USG misdiagnose as acute appendicitis. So it can be concluded that although USG is good in detecting complicated appendicitis, it misses out on many cases of acute simple appendicitis

The simple system of Alvorado score was applied to the present study. There was little difference in percentage of present series and M.D. Barber series.

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Score	Present series in Percentage	M.D. Barber series in Percentage
1 to 4	15	12.12
5 to 6	28	25.45
7 to 8	30	30.90
9 to 10	27	31.51

Table 3.8: Comparison of the score percentage in present series with MD Barber series

Alvorado Score	Histo-pathological Grading				Total
	Acute simple appendicitis	Gangrenous appendicitis	Perforated appendix	Normal appendix	
Unlikely (score 1 to 4)	17 (10.6%)	0 (0.0%)	0 (0.0%)	8 (5.0%)	25 15.6%
Possible (score 5 to 6)	35 (21.9%)	0 .0%	0 .0%	9 5.6%	44 27.5%
Probable (score 7 to 8)	36 22.5%	3 1.9%	6 3.8%	4* 2.5%	49 30.6%
Definitive (score 9 to 10)	10 6.3%	19** 11.9%	12** 7.5%	1* .6%	42 26.3%
Total	**98 61.3%**	**22 13.8%**	**18 11.3%**	**22 13.8%**	**160 100.0%**

Table 3.9: Proportion of study population according to Alvorado score and histopathological finding

* $p<0.05$ significant

** $p<0.00$ highly significant

As can be seen in the above chart on comparing Alvorado score with HPE report in the 160 operated cases it is found that distribution of normal appendix is very less-4(2.5%) in score of 7-8 and 1 (0.6%) in the score of 9-10 with a p value < 0.05 where as it is more 8(5%) in score of 1-4 and 9(5.6%) in score of 5-6 Also distribution of complicated appendicitis was found to be very high 19 (11.9%) for gangrenous and 12(7.5%) for perforated in the score of 9-10 which is statistically significant.

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So it can be concluded that ability of Alvorado score to rule out normal appendix when the score is 7 or more is significant ($p<0.05$).

The negative exploration rate of 14% (22 patients) in the present study is consistent with the figure of 12-30% mentioned in various studies. Negative appendectomy rate was higher in females (13) than males (9). In a study by Anderson et al the rate of normal appendix being removed was twice higher in women than in men. [31]

In the present study 65% cases had appendix in retrocecal position. 16% cases were having pelvic and 2% subcaecal. Position of appendix remained uncertain in a large group of cases. This uncertainty of position may be due to non-genuine manipulation to deliver the appendix.

Position of the Appendix	Present Series%	Bailey and Love's %	Wakely %	Collins %
Retrocaecal	65	74.0	60.18	10.2
Pelvic	16	21.0	30.01	78.5
Subcaecal	2	01.5	02.26	01.2

Table 3.10: These figures correlate with the literature which shows 72% of appendix lies in retrocecal position, which is considered to be the most common location of appendix.

The specimens of appendix were then studied for the presence of any obstructive element. In the present study there were fecoliths in 12.35% of cases, inflammatory adhesion in 20.22% of cases, parasite and eggs of tapeworm in 1.12% of cases. No specimen showed carcinoid tumor of the appendix whereas in Stephenson in 1961 found Enterobius vermicularis in 2% of 4000 appendices and 12% of these were associated with acute appendicitis.[32] Melis M.V. in 1998 found that, the specimen of appendix had calculi, completely obstructing the lumen of the appendix.[33]

Microscopic examination was done in all the cases to correlate the clinical findings. The changes that occured depend upon the duration of the attack, previous appendicular disease and the degree of inflammation.

The earliest change noticed was the destruction of the mucous membrane and edema of the wall with hemorrhage in places and accumulation of inflammatory cells. As the duration of the symptoms increased there was the appearance of early fibroblasts. Where the inflammation had spread beyond the serosa, there was evidence of periappendicular inflammatory reaction.

Series	Number Cases	Normal Appendix	Uncomplicated Appendicitis	Complicated Appendicitis
Amir M, Shami IH, 1992	210	7.2% (75% females)	79.5% (167 patients)	13.3% (28 patients)
Ijaz Ahmed 1993	1156	13.7% (89% females)	65.8% (761 patients)	20.5% (237 patients)
Walker SJ et al, 1995	248	24.3% (67% female)	58.5% -	17.2% -
Hale DA et al 1997	4950	13% (9% female)	66% -	21% -

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Lee LS et al, 2001	766	15.7%	69.7%	14.6%
David R et al 2001	280	15.5%	58.7%	25.8%
Nazir A et al 2002	100	11% (all females)	69%	20%
Paajamen H et al 2002	80	21%	34%	45%
Present Study, 2004-07	160	14% (22 pts)	61.25% (98 pts)	25% (40 patients)

Table 3.11: Comparative study of different series regarding pathological diagnosis

In present study the commonest type of appendicitis was acute simple appendicitis (Uncomplicated) present in 61.25% (98) of the patients. Whereas in Martin Brumer series it was present in 69.3% of the patient's[34] and M.K. Babu et al (1995) series acute appendicitis was present in 47.49% of the cases.

In present series, acute perforative appendicits was present in 11.25% of the cases whereas in Roland Anderson (1994) series found appendix was perforated in 16% of the patients.[35]

CONCLUSION: Acute appendicitis is the most common reason for emergency abdominal surgery and must be distinguished from other causes of abdominal pain. Atypical presentations are not uncommon as many inflammatory and non-inflammatory conditions may mimic the presentation of acute appendicitis. This is especially seen in females and in the extremes of age. These and other factors resulted in the relatively high rate (15-30%) of negative explorations for acute appendicitis.

Family physicians play a valuable role in the early diagnosis and management of this condition. However, the overall diagnostic accuracy achieved by traditional history, physical examination, and laboratory tests has been approximately 80 percent. The ease and accuracy of diagnosis varies by the patient's sex and age, and is more difficult in women of child bearing age, children and elderly persons. If the diagnosis of acute appendicitis is clear from the history and physical examination, prompt surgical referral is warranted.

In atypical cases, ultrasonography and computed tomography (CT) may help lower the rate of false-negative appendicitis diagnoses, reduce morbidity from perforation, and lower hospital expenses.

Ultrasonography is safe and readily available, with accuracy rates between 71 and 97 present, although it is highly operator dependent and difficult in patients with a large body habitus. While there is controversy regarding the use of contrast media and which CT technique is best, the accuracy rate of CT scanning is between 93 and 98 percent. Disadvantages of CT include radiation exposure, cost, and possible complications from contrast media.

In the present study of 160 cases of acute appendicitis, the results were analyzed and compared with Indian and Western literature and following conclusions were made.

Although true prevalence of acute appendicitis varies from country to country and race to race, it is not uncommon in our country. As it is said that appendicitis is the disease of younger age, our study supports this view but no age is immune to appendicitis. In this series maximum number of patients was seen in the second and third decades:

- Appendicitis is most common abdominal emergency and appendicectomy constitutes the commonest emergency surgery performed in Shadan Hospital of Hyderabad.
- The present study revealed that males were affected more than the females and the commonest age groups affected were in the second and third decades of life.
- This scoring system is a dynamic one, allowing observation and critical re-evaluation of the evolution of the clinical picture. Its application improves diagnostic accuracy and consequently reduces negative exploration and complication rates.
- When migration or shifting to right iliac fossa is present, appendicitis is likely, while absence of migration does not indicate a normal appendix.
- Anorexia, seems a reliable symptom and one should deeply inquire about this symptom.
- A raised TLC is regarded as a sensitive test for acute appendicitis but is not diagnostic by itself because of its low specificity and does not add much to the management in patients with undoubtful clinical picture. Its significance is in its use with Alvorado score, not as a separate entity.
- An increase in C-reactive protein levels to more than 2.5 mg/dl is not a definite indicator of acute appendicitis.
- Ultrasonography and plan X-ray of the erect abdomen were helpful in some of the doubtful cases but it doesn't replace the clinical skills of General Surgeons. The ultrasonography has made its dent in the confirming the diagnosis of an acute appendicitis. Also it helps in ruling out other pathologies.

The main stay of diagnosis is by thorough clinical evaluation by eliciting the different tests. Alvorado scoring reduces the negative appendectomy rate. One should go ahead with the surgery when the score is 7 or more as the chances of negative appendectomy is very less with this score. If the score is 5-6, it is equivocal and help of USG /CT is to be taken to rule out appendicitis. If score is <5 conservative (non-operative) treatment is to be given. During the course of non-operative management the patient is to be evaluated at regular intervals for any increase in score and the necessary action to be taken.

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