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Diagnostic Accuracy of Ultrasonography Compared with Laparoscopy in Acute Right Iliac Fossa Pain: A Cross Sectional Survey

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Abstract

Objectives: To study the clinical features and ultrasound findings (USG) among male and female patients presenting with RIF pain and to determine the diagnostic accuracy of USG as compared with diagnostic laparoscopy in patients presenting with RIF pain. **Study Design:** Cross sectional prospective study.**Methodology:** Data was collected from all male and female patients aged 11-60 years presenting with right lower abdominal pain after taking informed consent. Structured questionnaire was used to obtain information on patient's history, physical examination, USG and laparoscopy findings. Data was entered and analyzed using SPSS software version 20.0. Descriptive statistics were calculated and Chi square test at 5% level of significance was applied. Diagnostic accuracy of USG was calculated as sensitivity, specificity, positive likelihood ratios and negative likelihood ratios. **Results:** A total of 120 patients were included in the study. 62 (51.7%) were females, while remaining 58 (48.3%) patients were males. The most common cause of right lower abdominal pain was acute appendicitis followed by right ovarian cyst and right lower ureteric stone. No statistically significant difference was observed in the distribution of USG finding among male and female patients. Sensitivity and specificity of USG in diagnosing appendicitis was 87.27% and 73.85% respectively. **Conclusion:** Diagnostic Laparoscopy has a definite role in the evaluation of acute as well as chronic pain in right lower abdomen.
Keywords: Appendicitis, Ultrasonography, Laparoscopy, Diagnostic Methods.

Introduction

Laparoscopy (from Ancient Greek λαπάρα (lapara), meaning 'flank, side', and σκοπέω (skopeo), meaning 'to see') is an operation performed in the abdomen or pelvis using small incisions (usually 0.5–1.5 cm) with the aid of a camera. The laparoscope aids diagnosis or therapeutic interventions with a few small incisions in the abdomen.[1] There are a number of advantages to the patient with laparoscopic surgery versus the more common, open procedure. These include reduced pain due to smaller incisions, reduced hemorrhaging and shorter recovery time. The key element is the use of a laparoscope, a long fiber optic cable system that allows viewing of the affected area by snaking the cable from a more distant, but more easily accessible location[2]. Two types of laparoscopes are commonly used, (i) a telescopic rod lens system, that is usually connected to a vedio camera (single chip or three chip), and (ii) a digital laparoscope where the charge-couple

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device is placed at the end of the laparoscope[3].In 1901, Georg Kelling of Dresden, Germany, performed the first laparoscopic procedure in dogs, and, in 1910, Hans Christian Jacobaeus of Sweden performed the first laparoscopic operation in humans[4].
The field of minimally invasive surgery has experienced an explosive growth in last two decades. Diagnostic laparoscopic surgery has been in an armamentarium of the surgeons for many years as a useful technique for evaluating pelvic pathology[5].
Pain in right iliac fossa (RIF) is frequently encountered problem especially in children and females. Acute abdominal pain may be a simple thing, or it may be a dangerous and life threatening one. In most of the patients, the clinical signs and symptoms are masked by the treatments given by the different physicians at different hospitals at different points of time. Different radiologists giving different reports of imaging studies and advising to correlate clinically. In these circumstances, there is an absolute need to search for an alternate diagnostic tool[6,7]. Ultrasonography (USG) of abdomen is one of the most frequent investigations asked by surgeon in acute abdominal conditions. USG super cedes other radiological imaging modalities as it is easily available, cost effective, portable, no known side effects, non-invasive and requires minimal patient preparation [8]. In 1986 Puylaert used ultrasonography for diagnosing acute abdomen conditions preoperatively in various pathologies like acute appendicitis[9].

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Although abdominal USG has the advantage of being inexpensive and less risky, however, a radiologist cannot always be available on short notice, which can lead to diagnostic delays that have detrimental consequences for patient. In addition, it remains dependent on the extent of training and reliability of the interpretation of the imaging results by a non-specialist in radiology [10]. In contrast, diagnostic laparoscopy gives many advantages in the management of several intra- abdominal conditions like acute appendicitis, pelvic inflammatory disease, hollow viscus perforation, bowel ischaemia etc. where the correct diagnosis could not be established clinically or even with the help of imaging studies like USG[11].The standard teaching is whenever in doubt, always do a laparotomy and open the abdomen and see the things. But now laparoscopy is an excellent tool, whenever the diagnosis is in doubt. It is far better than open laparotomy. Correct diagnosis and best treatment are possible by laparoscopy in most of the abdominal emergencies[12].Though there are multiple diagnostic modalities available for diagnosis of RIF pain even today there are no set guidelines for its diagnosis and further management. Therefore, this study was conducted with following objectives:

1. To study the clinical features and ultrasound findings among male and female patients presenting with RIF pain

2. To determine the diagnostic accuracy of ultrasound as compared with diagnostic laparoscopy in patients presenting with RIF pain.

Methodology

This was a prospective cross-sectional survey conducted at Saraswathi Institute of Medical Sciences and Hospital, Hapur (UP), India. The study was conducted for a period of one year.

All male and female patients aged 11-60 years presenting with right lower abdominal pain and not contraindicated for diagnostic laparoscopy with written informed consent were taken up for the study. These patients were examined clinically and subjected to ultrasound first then diagnostic laparoscopy. Patients who had any complication such as ascites, pregnancy, suspicion of malignancy, any severe comorbid illness, uncorrected bleeding disorders, or unfit for general anesthesia (GA) were excluded after initial screening.

Ethical approval was obtained from the Institutional Ethical Committee prior to the commencement of the study. Each participant was explained in detail about the procedure and informed consent was obtained prior to data collection. In case of children, informed consent was obtained from the parents/guardians.

Data was collected using a pre-tested structured questionnaire. Information collected included socio-demographic characteristics of the patient, detailed history, physical examination, investigations, USG and diagnostic laparoscopic findings, and laparoscopic intervention performed. Investigations performed included a complete haemogram, Liver Function Test (LFT) and other baseline investigations as per requirement.

Each patient was subjected to USG abdomen and pelvis performed by the radiologists on the same day of presentation and relevant findings were documented. These findings were then compared with findings of diagnostic laparoscopy performed afterwards. Diagnostic laparoscopy was performed under GA within 24 hours of presentation. Nasogastric tube & urinary catheters were used to decompress stomach & urinary bladder respectively. Intravenous (IV) antibiotics were started preoperatively & continued for 48 hours to 5 days depending on the per-operative findings.

Statistical Analysis

Data was entered and analyzed using SPSS software version 20.0. Mean and standard deviation were calculated for continuous variables, whereas, frequency and percentages were calculated for categorical variables. Independent t test was applied to compare the mean age difference between males and females. Chi square test at 5% level of significance was applied to detect any statistical difference in the distribution of clinical features and USG findings among male and female patients. For the expected cell count less than 5; Fishers Exact test was applied. Bar chart and pie diagram were used for graphical representation of the data. Sensitivity, Specificity, Positive Predictive Values (PPV), Negative Predictive Values (NPV), Positive likelihood Ratios, and Negative likelihood Ratios indicators were calculated to see the diagnostic accuracy of ultrasonography (USG) as compared with standard tool i.e. diagnostic laparoscopy in the patients having pain in the RIF. Statistical significance was seen at p-value < 0.05.

Results

A total of 120 patients were included in the study, 62 (51.7%) were females, while remaining 58 (48.3%) patients were males. Maximum number of patients belonged to the age group of 31-40 years (40.0%), followed by age group of 20-30 years (33.33%). The age wise distribution of male and female patients is shown in Table 1.

Figure 1 shows the clinical features of patients presenting with RIF pain. All the patients were positive for RIF tenderness along with right lower abdominal pain. The most common symptom was nausea/vomiting (94.17%) followed by anorexia (82.5%). Rebound tenderness and fever was documented in 62.5% and 42.5% of the patients respectively.

The ultrasound findings of the patients are depicted in Figure 2. On the basis of USG, the most common cause of right lower abdominal pain was acute appendicitis (54.17%) followed by right ovarian cyst (13.33%) and right lower ureteric stone (9.17%). In about 16% patients, the USG was apparently normal. No statistically significant difference was observed in the distribution of USG finding among male and female patients (P value: 0.16). Table 2

On the other hand, 55 patients were diagnosed with acute appendicitis laparoscopically, 10 had a right ovarian cyst, 9 were diagnosed with salpingitis and 4 patients with haemorrhagic ovarian cyst. A total of 4 patients had no obvious pathology as seen on diagnostic laparoscopy. The findings of diagnostic laparoscopy are summarized in Table 3.

Table 4 gives the results for diagnostic accuracy of USG as compared to laparoscopy for diagnosing acute appendicitis. It was seen that 55 patients with acute appendicitis (diagnosed by gold standard i.e. Diagnostic Laparoscopy) were examined by USG and 48 of them had the disease, thus giving USG a sensitivity of 87.27%. Out of 65 patients who tested negative for acute appendicitis on diagnostic laparoscopy, 48 were correctly excluded by USG. Therefore, the specificity of USG of acute appendicitis was 73.85%. PPV of the test was 73.85 % and NPV was 87.25%. Overall accuracy of the USG test in detecting acute appendicitis was 80.0%.

Similarly, the diagnostic accuracy of USG for detecting right ovarian cyst, and pelvic inflammatory disease (PID) are summarized in Table 5 and 6 respectively. Overall the accuracy of USG was 83.87% and 85.48% in case of right ovarian cyst and PID respectively.

Table 1: Age distribution of patients

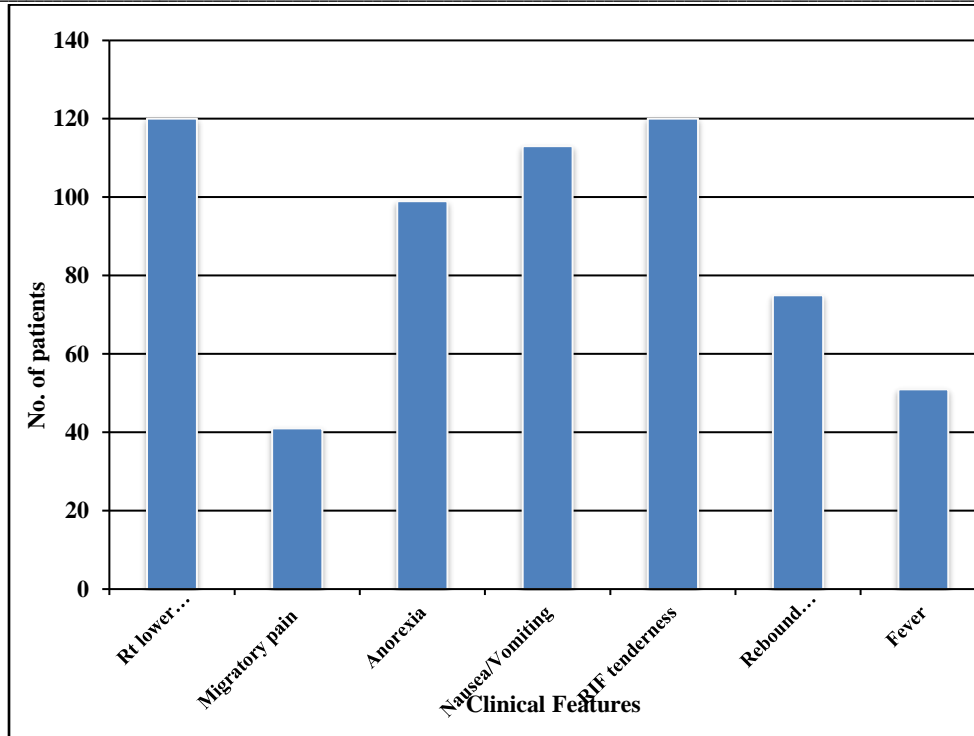| Sex	Number	Age (In Years)		t value	P value
		MIN-MAX	Mean ± SD		
Male	58	16-60	37.10±11.62	1.756	0.082
Female	62	16-52	33.95±7.45		
Total	120	16-60	35.48±9.78		

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Fig 1: Distribution of clinical features of patients presenting with RIF pain
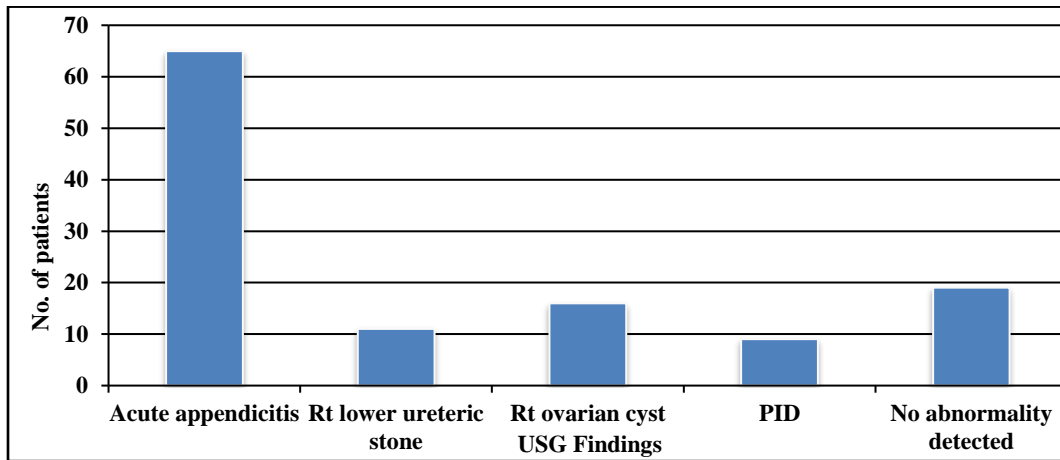

Fig 2: Distribution of USG findings of patients presenting with RIF pain

Table 2: Distribution of RIF abnormality as seen on ultrasonography among male and female patients presenting with RIF pain

USG Findings	Sex		Chi Square Statistic	P Value
	Male (n=58)	Female (n=62)		
Abnormality detected	46 (79.3)	55 (88.7)	1.987	0.159
No Abnormality detected	12 (20.7%)	7 (11.3%)		

Table 3: Distribution of Diagnostic Laparoscopic findings in total cases diagnosed as no abnormality detected on USG

Laparoscopic findings	No. of patients	Percentage(%)
Acute appendicitis	4	21.05
Appendicular abscess	1	5.26
Adnexal torsion	1	5.26
Adhesions	1	5.26
Salpingitis	2	10.53
Hematosalpinx	1	5.26

Meckel's diverticulum	1	5.26
Iliocaecal tuberculosis	1	5.26
Right ovarian cyst	1	5.26
Small bowel intussusception	1	5.26
Perforated caecal carcinoma	1	5.26
No abnormality detected	4	21.05
Total patients of No abnormality detected on USG	19	100.0

Table 4: Role of USG in detection of acute appendicitis

USG Results	Diagnostic Laparoscopy Results		Total	95 % Confidence Interval (CI)
	Positive	Negative		
Positive	48	17	65	
Negative	07	48	55	
Total	55	65	120	
Sensitivity (%)			87.27%	75.52%-94.73%
Specificity (%)			73.85 %	61.46%-83.97%
Positive Likelihood Ratio			3.34	2.19-5.08
Negative Likelihood Ratio			0.17	0.08 -0.35
Disease Prevalence			45.83%	36.71%-55.17%
Positive predictive value (%)			73.85%	64.96%-81.13%
Negative predictive value (%)			87.25%	77.18%-93.29%
Accuracy (%)			80.0%	71.72%-86.75%

Table 5: Role of USG in detection of Right ovarian cyst

USG Results	Diagnostic Laparoscopy Results		Total	95 % Confidence Interval (CI)
	Positive	Negative		
Positive	8	8	16	
Negative	2	44	46	
Total	10	52	62	
Sensitivity (%)			80.00%	44.39%-97.48%
Specificity (%)			84.62%	71.92%-93.12%
Positive Likelihood Ratio			5.20	2.56-10.56
Negative Likelihood Ratio			0.24	0.07-0.82
Disease Prevalence			16.13%	8.02%-27.67%
Positive predictive value (%)			50.00%	32.99%-67.01%
Negative predictive value (%)			95.65%	86.37%-98.71%
Accuracy (%)			83.87%	72.33%-91.98%

Table 6: Role of USG in detection of PID

USG Results	Diagnostic Laparoscopy Results		Total	95 % Confidence Interval (CI)
	Positive	Negative		
Positive	4	5	9	
Negative	4	49	53	
Total	8	54	62	
Sensitivity (%)			50.00%	15.70%-84.30%
Specificity (%)			90.74%	73.43%-92.20%
Positive Likelihood Ratio			5.40%	1.82-15.98
Negative Likelihood Ratio			0.55	0.27-1.11
Disease Prevalence			12.90%	5.74%-23.85%
Positive predictive value (%)			44.44%	21.28%-70.31%
Negative predictive value (%)			92.45%	85.90% -96.10%
Accuracy (%)			85.48%	74.22%-93.14%

Discussion

Pain in the right iliac fossa (RIF) is considered one of the most common manifestations of the patients who are referred to the ED. Right lower abdominal pain often presents a diagnostic problem to the surgeon. Intensity of the pain and pain threshold differs from patient to patient. Increasing number of medico- legal litigations force the surgeons to arrive at the correct diagnosis and prompt treatment[13].Horton MD et al described sensitivity rates (varying from 0.755 to 0.90), specificity rates (varying from 0.73 to 1) and accuracy rates (varying from 0.76 to 0.96) of USG in diagnosis of patients with right lower abdominal pain. The relatively low sensitivity rates of Ultrasound indicate its low validity[14].In the present study, the incidence for age and sex distributions of patients

are in concordance with the study conducted by Dr. Himanshu et al who also reported similar incidence for age and sex distributions of patients presenting with right lower abdominal pain. In their study of total 130 patients, all the patients were in between 13 to 60 years. Out of 130, 66 patients were males and 64 patients were females and the maximum number of patients were in age group of 20- 30 years followed by age group of 31-40 years[15].Clinical features of the patients with RIF pain documented by Tauro LF et al. are in concordance with those reported by our study. All the patients in their study had history of abdominal pain with RIF tenderness and vomiting was found to be present in 91% of cases irrespective of pathology[16].In our study, 65 patients had appendicular pathology, 16 had a right ovarian cyst, and 19 patients had no finding when

examined through an ultrasound. Almost similar results were published by Moawada Burai et al[17] in their study where 19% cases showed no findings on USG, whereas 48% were diagnosed with appendicitis, and 13% with right ovarian cyst. In the present study USG showed an overall accuracy of 80.0% with sensitivity of 87.27%, and specificity of 73.85% for diagnosing acute appendicitis. Rioux M et al. demonstrated the sensitivity of 93% for USG in acute appendicitis and of 45 patients with proven appendicitis, 5 patients had histological evidence of chronic inflammatory changes with superimposed acute changes[18]. Study conducted by Ahmad Y et al. stated that USG showed an overall accuracy of 66% with sensitivity of 75%, specificity – 60%, PPV = 55.5%; and NPV = 78% for appendicular pathology[19] Tauro LF et al. in their study found that the overall sensitivity and specificity of USG was 91.37% and 88.09% respectively and PPV = 91.37% and NPV = 88.09% with 90% overall accuracy in diagnosing appendicitis. Majeed et al. showed that USG had sensitivity of 96.1% to detect true positive cases and specificity 56.52%, PPV was 88.1% and NPV was 81.25% with accuracy of 87% to detect cases of appendicitis[20].The current study revealed that ovarian cysts were the second cause of RIF pain. Although appendicitis is more frequent than ovarian cyst. However, acute pelvic pain in women is the primary reason for ED admission. It was observed that 16 patients(13.33%) of RIF fossa pain were diagnosed with ovarian cysts. Page et al[21] reported that gynecological causes of acute pain were adnexal torsion, ectopic pregnancy, and hemorrhagic ovarian cyst rupture. This finding is consistent with our study; this study reported that ovarian cysts were the most common frequent cause of pain in female. In the present study, it was observed that right lower ureteric stone and PID were the third and fourth etiologies of RIF pain, respectively. Moodi et al. reported that the incidence of the lower ureteric stone was 16%[22]These results are near to our findings. All these findings supports the fact that various etiologies cause RIF pain and are not attributed to appendicitis only. In the current study, it was observed that the incidence of ovarian cyst was common in age group of 20-29 years and 30-39 years. Jone reported that the prevalence of ovarian cyst was common in age group of 38 years. These results agrees with our findings that majority of ovarian cyst affect female in the age group 20-39 years.

Conclusion

Diagnostic Laparoscopy has a definite role in the evaluation of acute as well as chronic pain in right lower abdomen. USG though an easily available and cost-effective modality but should be reserved for use in circumstances where laparoscopy is not available or feasible. Diagnostic laparoscopy is helpful in confirming a diagnosis made on clinical grounds and radiological evaluation. By establishing definitive diagnosis, definitive treatment can be initiated early thus reducing patient's suffering and improving clinical outcome.

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