

## Comparative Study between Ultrasound Findings and Intra-operative Findings in Non-traumatic Abdominal Pain

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### ABSTRACT

**Background:** In acute abdomen the patient experiences sudden severe abdominal pain which may suggest a threat to his or her life and may or may not demand immediate operative interference. It is important to make early diagnosis, and a delay will worsen the condition and may lead to a fatal outcome. **Objective:** The aims of this study are to determine the ability of ultrasound to diagnose non traumatic acute abdominal conditions, analysis of ultrasound findings and its correlation with clinical findings, laboratory and other radiological investigations along with operative findings, wherever possible. **Patients and methods:** The study is comprised of patients who presented with non-traumatic acute abdominal pain during the period from August 2015 to August 2016 in the department of Surgery in Aswan University. **Results:** A total of 200 patients were included in this study and underwent abdominal ultrasonography. The sensitivity of ultrasound in diagnosis was 81.0% and specificity of ultrasound was 83.0%. **Conclusion:** The accuracy of ultrasound in diagnosing non-traumatic abdominal pain helps to reduce negative laparotomy rate and is cost effective. Hence ultrasonography should be a part of routine surgical investigation.

### INTRODUCTION

Nevertheless, only one quarter of patients who have previously been classified with an acute abdomen actually receive surgical treatment, so the clinical dilemma is if the patients need surgical treatment or not and, furthermore, in which cases the surgical option needs to be urgently adopted<sup>1,2</sup>.

The evaluation of patients with acute abdominal pain can pose a diagnostic challenge for physicians as patients may present with atypical symptoms. These atypical presentations may help account for the over 25% of abdominal pain cases labeled as “nonspecific” or “undifferentiated”<sup>3</sup>. The lower cost and in particular, the lack of radiation exposure are the most important advantages of US compared to CT. Another important advantage of US examination is the possibility to correlate the US findings with the point of maximal tenderness<sup>4</sup>.

Acute abdomen has a sudden onset, can persist for several hours to days and is associated with a wide variety of clinical features, which are specific to underlying condition or disease<sup>5</sup>. However, despite its frequent occurrence, it is sometimes difficult to manage because no matter how thorough the work-up is, specific diagnosis is

not possible in 30% of cases<sup>6</sup>. The causes are numerous, from the relatively trivial to immediately life-threatening ones and attempts to reach a diagnosis must sometimes be curtailed in the interest of immediate treatment<sup>7</sup>. The commonly observed conditions are appendicitis, intestinal obstruction, and gynecological pathologies, with acute appendicitis being the most commonly occurring abdominal acute condition in emergency departments<sup>8</sup>.

Of all the imaging procedures available for the evaluation of an acute non traumatic abdomen, ultrasound scan (USS) appears to be the first line modality because it is easily available, cost-effective, portable, easily reproducible, non invasive, requires minimal patient preparation and has no known side effects<sup>9</sup>. Furthermore, USS offers a real-time dynamic examination, and this characteristic conveys dynamic information about bowel motility and changes in position as well as to depict blood flow<sup>10</sup>. Studies have shown that abdominal radiographs are not sensitive in the evaluation of adult patients presenting with non traumatic abdominal pain<sup>11</sup>.

Several studies have evaluated the diagnostic accuracy of abdominal USS in acute abdomen and have found high sensitivity and specificity<sup>12</sup>. Inappropriate use of ultrasound in the assessment

of acute abdominal pain can lead to an increase in the workload of the personnel involved, prolonged inpatient stay, possible delay in treatment, and increased hospital costs<sup>13&14</sup>.

## PATIENTS & METHODS

This prospective study was conducted from August 2015 to August 2016 on 200 consecutive patients referred to the department of surgery in Aswan University Hospital with non traumatic abdominal pain as their chief complaint. Pregnant ladies, patients with abdominal trauma, acute abdomen due to gynecological pathologies were excluded from our study. After obtaining consent, clinical information were recorded in preformed Performa.

Detailed abdominal ultrasound was done. After ultrasound traditional three-views (upright chest x-ray, supine and upright abdominal x-rays) abdominal x-rays were taken. Left lateral decubitus film was taken only in 3 cases. The patient was kept in a given position for 10 minutes before the horizontal-ray radiograph to allow time for any free gas to rise to the highest point. The bladder was emptied before the supine radiograph was taken and the area from the diaphragm to the hernial orifices was included in the film. Plain x-rays were evaluated by a radiologist. The images were interpreted with only the knowledge that patients presented with abdominal pain. Ultrasound was done by a radiologist. If free fluid or collection was seen in the peritoneal cavity ultrasound guided aspiration was done. Special investigations like intravenous urography, contrast studies of gastrointestinal tract, and CT scan of abdomen were conducted in 1, 4 and 43 cases respectively because of equivocal findings on USS and abdominal x-rays.

Final diagnosis was made on the basis of operative findings/therapeutic response/histopathological/laboratory findings. These data were analysed manually to meet the objectives of the study.

### Statistical analysis

The essential information was entered into the computer spreadsheet. The US findings were compared with surgical, medical and/or clinical

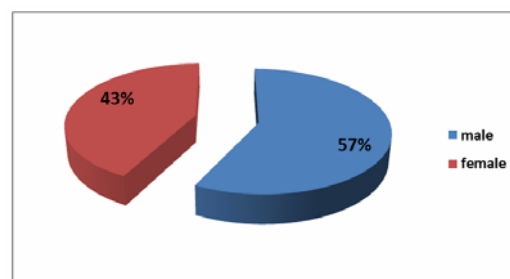
findings where applicable. Statistical package for social sciences (SPSS) for windows version 21.0 (SPSS Inc.) was used to analyze the data using the appropriate descriptive and inferential statistical methods and displayed by means of varied statistical presentations. The degree of agreement of the various clinically related procedure tools in terms of a specific diagnosis was determined by the use of Kappa statistics, which indicated the degree of agreement beyond chance. The Kappa value could range from 0 to 1. Statistical significance was set at  $P < 0.05$ . Diagnostic performance markers were sensitivity, specificity, positive predictive value (PPV), negative predictive value, and diagnostic accuracy.

### Ethical consideration

Written informed consent was obtained from all the study subjects and approval for the study was obtained from the Hospital Ethical and Research Committee of the OAUTHC, Ile-Ife, Osun State.

## RESULTS

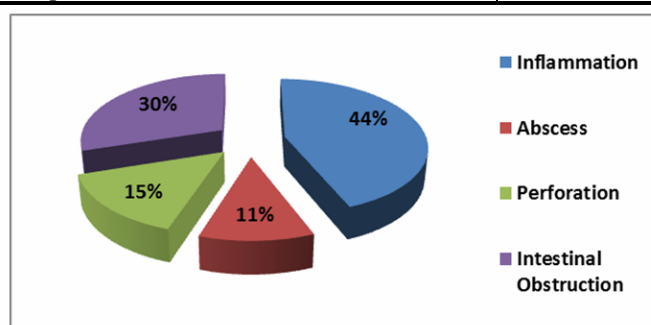
This prospective study was conducted in 200 acute abdomen patients referred to department of radiology for x-ray and ultrasound from emergency. Age of the patient ranged from neonate to 75 years. Most of the patients in our study were in the age group 31-40 years. Mean age of the patients was  $31.34 \pm 19.2$  years. Most of the patients in our study were males (57.5%). Male: Female ratio was 1.42:1.



**Fig (1):** Sex distribution in study group

**Table (1):** The causes of acute abdomen recorded in our study in 200 cases and their percentage.

Item	No. (%) "n=200"
<b>1- Inflammation:</b>	<b>88(44.0%)</b>
-Acute appendicitis	71(35.5%)
-Acute cholecystitis	9(4.5%)
-Acute pancreatitis	6(3.0%)
-Diverticulitis	2(1.0%)
<b>2- Abscess:</b>	<b>22(11.0%)</b>
-Appendicular abscess	11(5.5%)
-Pelvic abscess	5(2.50%)
-Psoas abscess	3(1.50%)
-Subphrenic abscess	2(1.0%)
-Liver abscess	1(0.5%)
<b>3- Perforation:</b>	<b>30(15.0%)</b>
-Perforated appendix	16(8.0%)
-Perforated duodenal ulcer	12(6.0%)
-Perforated colon	2(1.0%)
<b>4- Intestinal obstruction (IO):</b>	<b>60(30.0%)</b>
-Adhesive IO	23(11.5%)
-Irreducible external hernia	15(7.5%)
-Strangulated internal hernia	5(2.5%)
-Intussusception	5(2.5%)
-Cancer colon	5(2.5%)
-Mesenteric vascular occlusion	3(1.5%)
-Congenital intestinal atresia	3(1.5%)
-Annular pancreas	1(0.5%)

**Fig (2):** The causes of acute abdomen recorded in study group**Table (2):** Role of Ultrasonography in acute abdomen.

Item	Diagnostic by US	Confirm with other investigations <sup>a</sup>	Change with other investigations <sup>a</sup>	p-value
<b>Inflammation "n=88"</b>	33(37.5%)	31(35.22%)	24(27.27%)	P<0.02*
<b>Abscess "n=22"</b>	9(40.9%)	6(27.27%)	7(31.81%)	P<0.03*
<b>Perforation "n=30"</b>	6(20.0%)	18(60.0%)	6(20.0%)	P<0.001**
<b>Intestinal obstruction "n=60"</b>	25(41.67%)	21(35.0%)	14(23.33%)	P<0.002**
<b>Total "n=200"</b>	<b>73(36.5%)</b>	<b>76(38.0%)</b>	<b>51(25.5%)</b>	<b>P&lt;0.01*</b>

<sup>a</sup>: Other investigations include laboratory studies, plain abdominal x-rays, intravenous urography, contrast studies of gastrointestinal tract, CT scan and histopathological diagnosis.

When compare between accuracy of unique diagnoses by ultrasonography and with different diagnoses were (36.5%) in total patients with only

US vs. (38.0%) in confirm with other investigation, but change in (25.5%) with significance difference ( $P < 0.05$ ).

**Table (3):** Role of confirm US with operative in acute abdomen.

Item	Prove	Disprove	p-value
Inflammation "n=88"	70(79.54%)	18(20.45%)	$P < 0.001^{**}$
Abscess "n=22"	19(86.36%)	3(13.63%)	$P < 0.000^{***}$
Perforation "n=30"	24(80.0%)	6(20.0%)	$P < 0.000^{***}$
Intestinal obstruction "n=60"	49(81.67%)	11(18.33%)	$P < 0.000^{***}$
<b>Total "n=200"</b>	<b>162(81.0%)</b>	<b>38(19.0%)</b>	<b><math>P &lt; 0.000^{***}</math></b>

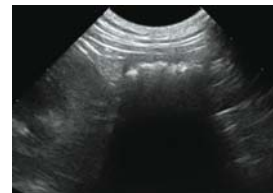
The correlation of US findings with surgical findings in this study showed high US diagnostic performance markers in most of the cases of non traumatic acute abdomen. All the disease entities showed good kappa agreement beyond chance, and they were all statistically significant ( $P < 0.001$ ) with highest prove in abscess diagnosis (86.0%).

**Table (4):** Sensitivity & Specificity of US diagnosis in acute abdomen.

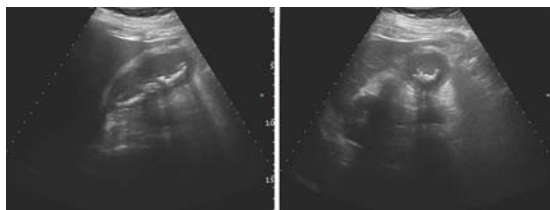
Item	Sensitivity	Specificity
Inflammation "n=88"	79.54%	88.3%
Abscess "n=22"	86.36%	83.0%
Perforation "n=30"	80.00%	79.7%
Intestinal obstruction "n=60"	81.67%	91.0%
<b>Total "n=200"</b>	<b>81.0%</b>	<b>83.0%</b>



**Fig. 2:** Invagination of 1 portion of the GI tract (intussusceptum) into the lumen of another (intussuscipiens); this is often referred to as the *target sign* when seen in the transverse plane because of the multiple layers of adjacent intestinal walls.



**Fig. 3:** Ultrasound of small intestinal foreign material typically appears hyperechoic with strongly distal acoustic shadowing



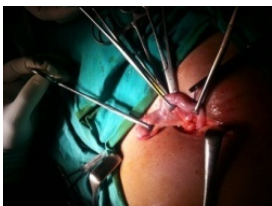
**Fig. 1:** Cholecystitis: US findings. Multiple gallstones associated with gallbladder wall thickened



**Fig. 4:** Ultrasound of intestinal obstruction. A longitudinal segment of a severely fluid-distended small intestine adjacent to normal bowel seen in transverse sections, suggesting obstruction.



**Fig. 5:** Surgical image of newborn with small intestinal atresia type I. shows dilated proximal segment and decompressed distal segment. No mesenteric gap is present. Bowel length is normal.



**Fig. 6:** Surgical image of acute appendicitis



**Fig. 7:** Surgical image of gangrenous appendicitis



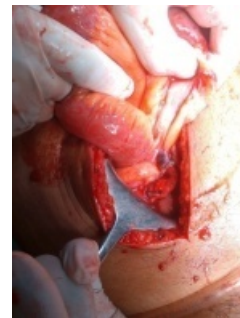
**Fig. 8:** Surgical image of perforated acute appendicitis



**Fig. 9:** Surgical image of perforated peptic ulcer



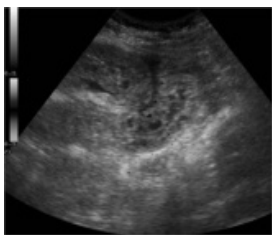
**Fig. 10:** Surgical image of annular pancreas



**Fig. 11:** Surgical image of small bowel obstruction



**Fig. 12:** The sonographic appearance of free intraperitoneal air



**Fig. 13:** Intraperitoneal free fluid and reduced intestinal peristalsis at sonographic examination are considered indirect signs of gastroduodenal perforation.

## DISCUSSION

The accurate clinical assessment of acute abdominal pain remains one of the more challenging areas of medicine. The variety of conditions that require emergent medical management, and often surgical management, vary widely in clinical presentation and physical examination<sup>13</sup>. Diagnosis of many acute abdominal conditions relies on a good history and physical examination and the appropriate use of radiological investigations<sup>14</sup>. There is no single radiological test that is uniformly effective in identifying the cause of acute abdominal pain. Various factors, including age, sex and the suspected clinical diagnosis determine the choice of radiological investigation. Ultrasound is being used increasingly in the assessment of acute non-traumatic abdominal pain as it is non-invasive and does not carry the risk of radiation<sup>15</sup>.

There were more males than females in this study, which is in agreement with the studies done by Prasad *et al.*,<sup>16</sup> and Memon *et al.*,<sup>17</sup> where more males were found probably due to the few cases of gynecological emergencies and exclusion of gynecological emergencies noted, respectively, in their studies. Acute appendicitis was the most common cause of acute abdomen in this study. This is consistent with findings from other studies carried out by Memon *et al.*,<sup>17</sup> and Pintado-Garrido *et al.*,<sup>18</sup> There were more males than females who presented with acute appendicitis which is in concordance with the study done by Memon *et al.*,<sup>17</sup>.

In present study the sensitivity and specificity of ultrasonography in diagnosing inflammation were 79.54% and 88.3%, respectively. This agrees with a study done by Prasad *et al.*,<sup>16</sup> who reported sensitivity and specificity of 66.6% and 100%. However, in a study done by Pintado-

Garrido *et al.*,<sup>18</sup> reported the sensitivity and specificity (83.7% and 97.4%) were almost similar to the values noted in this study.

Intestinal obstruction was the second common cause of non traumatic acute abdomen in this study diagnosed by US. Of the 60 patients sonographically diagnosed to have intestinal obstruction; 49 patients were confirmed by surgery. The sensitivity and specificity of US in detecting intestinal obstruction is high, 81.67% and 91.0%, respectively. In recent years, intestinal sonography has gained in acceptance for assessment bowel obstruction owing to technologically advanced equipment that improved resolution capability with good cross-sectional imaging of the gut wall and display of the transmural aspects of inflammation. In addition, the possibility of assessing intestinal morphology and motility during real-time US observation with no discomfort for the patient makes it a suitable diagnostic procedure in the case of an acute setting such as intestinal obstruction<sup>20</sup>.

Similar to the findings of this study previous report had recorded high diagnostic accuracy for transabdominal ultrasonography in patients with intestinal obstruction<sup>21</sup>.

In present study sensitivity of US in diagnosis was 81.0% and specificity of ultrasound was 83.0%, which is slightly lower than Gupta K *et al.*,<sup>22</sup>.

There are a few studies, which have looked at the various parameters we analyzed. Allemann *et al.*,<sup>23</sup> reported that in USG done by surgeons for patients with non traumatic abdominal pain, it was the correct diagnostic rate to 348 patients from 414 patients (84.0%). In the same study, USG was found to have sensitivity and specificity of 94% and 99% in diagnosing biliary tract disease. Mishra *et al.*,<sup>24</sup> in their study of imaging for acute abdomen had 13 cases of appendicitis. USG was diagnostic in 11 with sensitivity and specificity of 91.6% and 97%. Zoller *et al.*,<sup>25</sup> in their meta analysis demonstrated that USG has a sensitivity of 85% and a specificity of 96% in diagnosing acute appendicitis. Manfredi *et al.*,<sup>26</sup> concluded that USG in acute pancreatitis is a good screening test in patients with suspected biliary pancreatitis and a mild clinical course, but contrast enhanced CT is preferred for patients with other types of pancreatitis.

## CONCLUSION

This study group of patients with non traumatic acute abdomen requiring prompt diagnosis, ultrasonography is an outstanding imaging modality which has helped the managing physicians and surgeons in arriving at early diagnosis. It has also been shown in this study to have high sensitivity, specificity, and diagnostic accuracy. We recommend that ultrasonography should be the first investigation of choice for patients with non traumatic acute abdomen.

### List of abbreviations

CT: computed tomography; IO: Intestinal obstruction; PPV: positive predictive value; SPSS: Statistical; package for social sciences; US: ultrasound; USS: ultrasound scan

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