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Original Research Article

Diagnostic accuracy of ultrasound in common acute abdominal conditions

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ABSTRACT

Background: Ultrasound evaluation is cheap, easily available, even at rural level, and can predict need for surgical intervention in majority of conditions. It involves no exposure to radiation, can diagnose easily, can be repeated any number of times for follow up. Disadvantages are that it is user dependent and distended bowel containing air prevents satisfactory evaluation of abdomen. The objective was to study diagnostic accuracy of ultrasound in common acute abdominal conditions.
Methods: All patients presenting to the emergency Department of General Surgery, Narayana general hospital, Nellore with abdominal pain of acute onset and who were diagnosed to be suffering from acute appendicitis, acute perforation peritonitis, acute intestinal obstruction, acute pancreatitis, acute calculous cholecystitis were included in the present study.
Results: Diagnostic accuracy of USG for acute appendicitis was little bit low with sensitivity of 71.8% and specificity of 59.1% for operative findings and similar for CT findings. For acute perforation peritonitis it was still very low with sensitivity of 42.9% and specificity of 66.7% for operative findings and similar for CT findings. It was very good for acute intestinal obstruction with sensitivity of 90.9% and specificity of 83.3%, but here it was low compared to CT findings. It was also pretty good for diagnosing acute calculus cholecystitis in comparison with operative as well as CT findings.
Conclusions: USG can be used as a diagnostic tool for diagnosis of acute intestinal obstruction and acute calculus cholecystitis but doubtful role in the diagnosis of acute appendicitis and acute perforation peritonitis and acute pancreatitis.

Keywords: Diagnostic accuracy, Ultrasound, Sensitivity, Specificity, Appendicitis, Pancreatitis

INTRODUCTION

Acute abdomen, commonly diagnosed as acute pain in the abdomen usually requires urgent surgical intervention. There are conditions which present with abdominal pain of sudden onset that do not require immediate surgical intervention, like acute exacerbation of chronic duodenal ulcer, etc.[1]

Sonography is a valuable imaging tool in patients who may have specific gastrointestinal disease, such as acute appendicitis or acute diverticulitis.[2]

The abdominal ultrasound evaluation should include visible gas and fluid (to determine their luminal or extraluminal location), the peri enteric soft tissues, and the GI tract itself. Extraluminal gas may be intraperitoneal or retroperitoneal, and its presence should suggest either hollow viscus perforation or infection with gas-forming organisms.[3]

Occlusion of the GI tract lumen producing obstruction may be either mechanical, where an actual physical impediment to the progression of the luminal content

exists, or functional, where paralysis of the intestinal musculature impedes progression (paralytic ileus).[4]

Acute cholecystitis accounts for 3-10% of all patients with abdominal pain and is the most common cause of acute abdominal pain in the right upper quadrant, especially in the elderly patients.[5]

With the modern imaging techniques, not only the diagnosis can be clinched but also the need for surgical intervention can be accurately assessed. The available imaging modalities are USG, CT and MRI.

Ultrasound evaluation is cheap, easily available, even at the rural level, and can predict the need for surgical intervention in majority of conditions. It involves no exposure to radiation, can diagnose easily, can be repeated any number of times for follow up. The disadvantages are that it is user dependent and distended bowel containing air prevents satisfactory evaluation of abdomen. Present study was undertaken to determine the accuracy of ultrasound in the diagnosis of common acute abdominal conditions and to compare the ultrasound diagnosis with intra operative findings and other diagnostic modalities.

METHODS

All patients presenting to the emergency department of general surgery, Narayana general hospital, Nellore from October 2014 to October 2016, with abdominal pain of acute onset and who were diagnosed to be suffering from acute appendicitis, acute perforation peritonitis, acute intestinal obstruction, acute pancreatitis, acute calculous cholecystitis were included in the present study.

The significant findings like free air under the diaphragm, gall stones, thickening of gall bladder wall, inflamed appendix, distended bowel prompt surgical intervention.

All patients presenting to the general surgery department of Narayana general hospital with the complaint of acute pain in the abdomen formed the subjects of the study.

All the patients were physically examined and vitals were noted. Physical examination findings like abdominal tenderness, guarding, rigidity, presence or absence of bowel sounds, abdominal lump, ascites was noted.

Where necessary the patients were further evaluated with other modes of imaging like plain X-ray of the abdomen, Computed tomography of the abdomen with and without contrast etc.

A subset of patients in whom CT was not done were taken up for surgery and intra op findings were correlated to ultrasound findings

A subset of patients who underwent CT scan, their results were correlated to ultrasound findings.

Sensitivity, specificity, positive predictive value, negative predictive value is thereby calculated and the efficiency of ultrasound is estimated.

Inclusion criteria

Inclusion criteria were acute appendicitis, acute perforation peritonitis, acute intestinal obstruction, acute pancreatitis and acute calculous cholecystitis.

Exclusion criteria

Exclusion criteria were chronic abdominal conditions; traumatic conditions; acute obstetric and gynaecological conditions; age less than 10 yrs. and more than 70 yrs; patients in whom ultrasound could not be done; patients with a past history of abdominal surgery; patients who weren't willing for admission.

Statistical analysis

The data was entered in the microsoft excel worksheet and analysis was done using proportions. Sensitivity, specificity, positive predictive value, negative predictive value was calculated for determining the diagnostic accuracy of USG.

RESULTS

Table 1 shows distribution of study subjects as per clinical diagnosis. In the present study, a total of 309 cases were studied out of which 134 (43.36%) cases were clinically diagnosed as acute appendicitis. Amongst 134 patients, 72 patients were male and 62 patients were female. 57 (18.44%) cases were clinically diagnosed as acute perforation peritonitis. Amongst 57 patients, 44 patients were male and 13 patients were female. 42 (13.59%) cases were clinically diagnosed as acute intestinal obstruction. Amongst 42 patients, 31 patients were male and 11 patients were female. 40 (12.94%) cases were clinically diagnosed as acute calculous cholecystitis. Amongst 40 patients, 13 patients were male and 27 patients were female. 36 (26.86%) cases were clinically diagnosed as acute pancreatitis. Amongst 36 patients, 25 patients were male and 11 patients were female.

Table 2 shows diagnostic accuracy of USG vs. operative findings and CT findings for acute appendicitis. First subset of 88 patients were taken up for surgery and the intra op findings and ultrasound findings were correlated. Comparing ultrasound findings with intra operative findings yielded a sensitivity 71.8%, specificity 59.09%, positive predictive value 85% and negative predictive value 46.42%. Second subset of patients were taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 73.52%, specificity 58.33%, positive predictive value 83.33% and negative predictive value 43.75%.

Table 1: Distribution of study subjects as per clinical diagnosis.

Clinical diagnosis	Male	Female	Total	Total (%)
Acute appendicitis	72	62	134	43.4
Acute perforation peritonitis	44	13	57	18.4
Acute intestinal obstruction	31	11	42	13.6
Acute calculous cholecystitis	13	27	40	12.9
Acute pancreatitis	25	11	36	11.7

Table 2: Diagnostic accuracy of USG versus operative findings and CT findings for acute appendicitis.

USG findings	Operative findings		CT findings	
	Positive	Negative	Positive	Negative
Positive	51	9	25	5
Negative	13	15	7	9
Sensitivity (%)	71.8		73.6	
Specificity (%)	59.1		58.3	
Positive predictive value (%)	15		83.3	
Negative predictive value (%)	46.4		43.8	

Table 3: Diagnostic accuracy of USG versus operative findings and CT findings for acute perforation peritonitis.

USG findings	Operative findings		CT findings	
	Positive	Negative	Positive	Negative
Positive	12	3	9	2
Negative	6	16	3	6
Sensitivity (%)	42.9		60	
Specificity (%)	66.7		60	
Positive predictive value (%)	80		81.9	
Negative predictive value (%)	27		3	

Table 3 shows diagnostic accuracy of USG vs. operative findings and CT findings for acute perforation peritonitis. All patients underwent preliminary ultrasound examination. First subset of patients was taken up for surgery and the intra op findings and ultrasound findings were correlated. Comparing ultrasound findings with intra operative findings yielded a sensitivity 42.85%, specificity 66.66%, positive predictive value 80% and negative predictive value 27.27%. Second subset of patients was taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 60%, specificity 60%, positive predictive value 81.81% and negative predictive value 33.33%.

Table 4: Diagnostic accuracy of USG vs. operative findings and CT findings for acute intestinal obstruction.

USG findings	Operative findings		CT findings	
	Positive	Negative	Positive	Negative
Positive	20	1	9	1
Negative	4	2	5	2
Sensitivity (%)	90.7		81.8	
Specificity (%)	83.3		66.7	
Positive predictive value (%)	95.2		90	
Negative predictive value (%)	71.4		50	

Table 4 shows diagnostic accuracy of USG vs. operative findings and CT findings for acute intestinal obstruction. All patients underwent preliminary ultrasound examination. First subset of patients was taken up for surgery and the intra op findings and ultrasound findings were correlated. Comparing ultrasound findings with intra operative findings yielded a sensitivity 90.9%, specificity 83.33%, positive predictive value 95.23% and negative predictive value 71.42%. Second subset of patients was taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 81.81%, specificity 66.66%, positive predictive value 90% and negative predictive value 50%.

Table 5 shows diagnostic accuracy of USG vs. operative findings and CT findings for acute calculus cholecystitis. First subset of patients was taken up for surgery and the intra op findings and ultrasound findings were correlated. Comparing ultrasound findings with intra operative findings yielded a sensitivity 95%, specificity 75%, positive predictive value 95.65% and negative predictive value 75%. Second subset of patients was taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 91.66%, specificity 100%, positive predictive value 100% and negative predictive value 50%.

Table 5: Diagnostic accuracy of USG vs. operative findings and CT findings for acute calculus cholecystitis.

USG findings	Operative findings		CT findings	
	Positive	Negative	Positive	Negative
Positive	22	1	11	0
Negative	3	1	3	1
Sensitivity (%)	95		91.7	
Specificity (%)	75		100	
Positive predictive value (%)	95.7		100	
Negative predictive value (%)	75		50	

Table 6: Diagnostic accuracy of USG vs. CT findings for acute appendicitis.

USG findings	CT findings	
	Positive	Negative
Positive	27	1
Negative	2	6
Sensitivity (%)	81.8	
Specificity (%)	66.7	
Positive predictive value (%)	96.4	
Negative predictive value (%)	25	

Table 6 shows diagnostic accuracy of USG vs. CT findings for acute appendicitis. All patients underwent preliminary ultrasound examination. Then patients were taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 81.81%, specificity 66.66%, positive predictive value 96.42% and negative predictive value 25%.

DISCUSSION

In the present study, a total of 309 cases were studied out of which 134 (43.36%) cases were clinically diagnosed as acute appendicitis. First subset of 88 patients was taken up for surgery and the intra op findings and ultrasound findings were correlated. Comparing ultrasound findings with intra operative findings yielded a sensitivity 71.8%, specificity 59.09%, positive predictive value 85% and negative predictive value 46.42%. Second subset of patients was taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 73.52%, specificity 58.33%, positive predictive value 83.33% and negative predictive value 43.75%.

In a study conducted by AyoolaAshaolu et al, which comprised of 150 patients who presented with non-traumatic abdominal pain, include 66 patients of acute appendicitis, yielded a sensitivity of 83.3% and specificity of 100%.[6]

In a study done by Pintado-Garrido et al, the sensitivity and specificity were 83.7% and 97.4% respectively.[7]

The study done by Prasad et al, yielded a sensitivity and specificity of 66.6% and 100% respectively.[8]

In the present study, a total of 309 cases were studies out of which 57 (18.44%) cases were clinically diagnosed as acute perforation peritonitis. First subset of patients was taken up for surgery and the intra op findings and ultrasound findings were correlated. Comparing ultrasound findings with intra operative findings yielded a sensitivity 42.85%, specificity 66.66%, positive predictive value 80% and negative predictive value 27.27%. Second subset of patients was taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 60%, specificity 60%, positive predictive value 81.81% and negative predictive value 33.33%.

In a study conducted by AyoolaAshaolu et al, which comprised of 150 patients who presented with non-traumatic abdominal pain, include 66 patients of acute appendicitis, yielded a sensitivity of 83.3% and specificity of 100%.[6]

In a study by Stoker et al, sensitivity of 92% and a specificity of 53% have been reported for the detection of perforation with US.[9]

Chen et al, studied 132 patients and ultrasonography demonstrated a sensitivity of 93%, a specificity of 64%, a positive predictive value of 97%, a negative predictive value of 44%.[10]

In the present study, a total of 309 cases were studies out of which 42 (13.59%) cases were clinically diagnosed as acute intestinal obstruction. First subset of patients was taken up for surgery and the intra op findings and ultrasound findings were correlated. Comparing ultrasound findings with intra operative findings yielded a sensitivity 90.9%, specificity 83.33%, positive predictive value 95.23% and negative predictive value 71.42%. Second subset of patients was taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 81.81%, specificity 66.66%, positive predictive value 90% and negative predictive value 50%.

In a study conducted by AyoolaAshaolu et al, which comprised of 150 patients who presented with non-traumatic abdominal pain, include 13 patients of intestinal obstruction, yielded a sensitivity of 100% and specificity of 97%.[6]

According to Schmutz et al, evaluated with sonography 123 patients of small bowel obstruction and yielded a sensitivity of 95% and specificity of 82.1%.[11]

In the present study, a total of 309 cases were studied out of which 40 (12.94%) cases were clinically diagnosed as acute calculous cholecystitis. First subset of patients was taken up for surgery and the intra op findings and ultrasound findings were correlated. Comparing ultrasound findings with intra operative findings yielded a sensitivity 95%, specificity 75%, positive predictive value 95.65% and negative predictive value 75%. Second subset of patients was taken up for abdominal CT scan and its findings were correlated with ultrasound findings. Comparing ultrasound findings with CT findings yielded a sensitivity 91.66%, specificity 100%, positive predictive value 100% and negative predictive value 50%.

In one study by Ralls et al, sonographic findings in 497 patients with suspected acute cholecystitis were analysed prospectively.[12]

In the present study, a total of 309 cases were studies out of which 36 (26.86%) cases were clinically diagnosed as acute pancreatitis.

Comparing ultrasound findings with CT findings yielded a sensitivity 81.81%, specificity 66.66%, positive predictive value 96.42% and negative predictive value 25%.

CONCLUSION

Diagnostic accuracy of USG for acute appendicitis was little bit low with sensitivity of 71.8% and specificity of 59.1% for operative findings and similar for CT findings. For acute perforation peritonitis it was still very low with sensitivity of 42.9% and specificity of 66.7% for operative findings and similar for CT findings. It was very good for acute intestinal obstruction with sensitivity of 90.9% and specificity of 83.3%, but here it was low compared to CT findings. It was also pretty good for diagnosing acute calculus cholecystitis in comparison with operative as well as CT findings. USG can be used as a diagnostic tool for diagnosis of acute intestinal obstruction and acute calculus cholecystitis but doubtful role in the diagnosis of acute appendicitis and acute perforation peritonitis and acute pancreatitis.

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