https://doi.org/10.22502/jlmc.v7i2.293

Original Research Article

Role of Ultrasound Scan in Non-Traumatic Acute Abdomen Presenting in Surgery Department of a Tertiary Care Centre

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ABSTRACT

Introduction: An acute abdomen is defined as a clinical condition characterized by severe abdominal pain developing suddenly over several hours or less. Ultrasonography (USG) helps the managing surgeons arrive at early diagnosis and rule out alternative diseases, thus reducing negative laparotomy rate. This study analyzed the diagnostic yield of USG in patients with non-traumatic acute abdomen presenting to Surgery Department via Emergency Department/outpatient department of a tertiary hospital. **Methods**: This cross-sectional observational study included 110 patients with non-traumatic acute abdominal pain who were sent for USG examination. The percentage concordance of USG diagnosis with the final diagnosis at discharge was determined in terms of sensitivity, specificity, positive and negative predictive values for acute abdomen. **Results:** Of 110 patients, correct clinical diagnosis was made in 83 patients (75%) while USG made a correct diagnosis in 101 patients (91%). Hence, with the help of USG, accuracy of diagnosing cause of acute abdomen increased by 16 %. The sensitivity and specificity of USG in diagnosis of acute appendicitis were 87.7% and 98.3% respectively. **Conclusion**: USG is easily available and non-invasive modality without radiation exposure and requiring minimal patient preparation. USG should therefore be an important routine diagnostic investigation in patients presenting with acute abdomen.

Keywords: Acute abdomen, Sensitivity, Specificity, Ultrasonography

INTRODUCTION:

An acute abdomen is defined as a clinical condition characterized by severe abdominal pain that develops suddenly over several hours or less.[1] It is one of the most common clinical conditions that brings the patient to Emergency Department (ED). About 4–5% of the patients present to ED with acute abdominal pain which includes acute appendicitis, pancreatitis, ureteric colic, diverticulitis, cholecystitis, bowel obstruction and sometimes non-specific causes that may not be ascertained clinically. The causes vary from benign self-limiting diseases to life threatening conditions. Perforated viscus and bowel ischemia are rare but serious causes of acute abdomen with high chances of mortality if not addressed in time. However, it is often difficult to pin the exact cause of abdominal pain based upon only history, clinical examination and laboratory findings. To minimize the misdiagnosis and negative laparotomies in acute abdomen, imaging plays an important role.[2,3]

Ultrasonography (USG) is commonly used in the diagnostic work-up of patients with acute abdomen that can delineate alimentary tract along with its peristalsis and blood flow. Furthermore, maximal point of tenderness can be correlated with its help. It is easily available, non-invasive, cost

Submitted: 15 July, 2019
Accepted: 21 November, 2019
Published: 29 December, 2019

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How to cite this article:
Acharya S, Tiwari A, Sharma R, Paudel S. Role of Ultrasound Scan in Non-Traumatic Acute Abdomen Presenting in Surgery Department of a Tertiary Care Centre. Journal of Lumbini Medical College. 2019;7(2):56-60. DOI: http://doi.org/10.22502/jlmc.v7i2.293. Epub: 2019 December 29.

effective, portable, with no known side effects. It also requires minimal patient preparation and does not have radiation exposure. However, operator variability may co-exist.[4]

This study was conducted with the aim to determine the role of USG in the diagnosis of non-traumatic acute abdomen in terms of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

METHODS:

This observational cross-sectional study was carried out in the Department of Radiodiagnosis, Lumbini Medical College and Teaching Hospital (LMCTH), Nepal over a period of seven months from 1st June, 2018 to 31st December, 2018. A total of 110 patients were seen during this period. Ethical approval from Institutional Review Committee of the institute was obtained prior to enrollment of the patients.

Hospital records (patient's file sent to radiology department for USG) were reviewed from 110 patients who were sent from ED or surgery Out-Patient Department (OPD) with provisional diagnosis of acute abdomen. Patients with traumatic acute abdomen and females with suspected gynecological or obstetrical cause of acute abdomen were excluded. All the observations during the study of each patient were recorded in an individual case proforma containing all the information regarding admission details, demographic parameters, clinical features, examination findings and provisional diagnosis. Investigation reports including blood hemoglobin level, leucocyte count and other relevant reports were noted.

All the USG scans were performed by the radiologist using Acuson NX3 USG machine (Siemens, Germany) with both curvilinear (2-5 MHz) and linear (4-12 MHZ) array probes. Grey scale imaging was done in all cases of acute abdomen and any detected lesions were additionally evaluated with color Doppler.

The patients were admitted in the surgery ward. Other relevant investigations like Computed Tomography (CT) scans and intra-operative findings were recorded at the time of discharge. Final diagnosis was based on clinical findings, laboratory values, CT findings, intra-operative findings, clinical follow-up with histopathological report. Eventually, USG diagnosis was compared with the final (standard) diagnosis and clinical diagnosis.

The data collected in proforma were entered into Statistical Package for Social Sciences (SPSS™) version 16 and used for the statistical analysis. Data relating to qualitative variables were presented in frequency and percentages, and that to quantitative variables were expressed in means with standard deviation (SD). The diagnostic yield of USG was determined in terms of sensitivity, specificity, PPV and NPV.

RESULTS:

Among 110 patients enrolled into the study, there were 64 males (58%) and 46 females (42%). The mean age of presentation was 35 years (SD=1.79).

Table 1. Distribution of sites of pain in acute abdomen (N=110).

Sites of pain	Frequency n (%)
Right iliac fossa pain	28 (25.5)
Periumbilical pain	20 (18.2)
Epigastric pain	17 (15.5)
Diffuse pain	16 (14.5)
Right hypochondrial pain	12 (10.9)
Right lumbar pain	5 (4.5)
Central abdominal pain	4 (3.6)
Bilateral hypochondriac pain	4 (3.6)
Left iliac fossa pain	2 (1.8)
Left lumbar pain	2 (1.8)

Right iliac fossa was the most common site of pain accounting for 25.5% (n=28), followed by periumbilical region constituting 18.20% (n=20) of the patients (Table 1).

A majority of the patients (31%) presented to our hospital within the first day of acute abdomen. The mean day of presentation of pain abdomen was 4.9 days (SD=2).

Table 2 presents the frequency distribution of causes of acute abdomen according to USG findings.

The most common cause of acute abdomen was appendicitis (n=44, 40%) followed by NSAP (n=22, 20%).

Table 2. Causes of acute abdomen based on USG findings (N=110).

USG findings	Frequency n (%)
Appendicitis	44 (40)
NSAP	22 (20)
Calculous cholecystitis	12 (10.9)
Urinary calculus	10 (9)
Malignancy (Small bowel Lymphoma)	1 (0.9)
Pancreatitis	5 (4.5)
Hernia	4 (3.6)
Liver abscess	2 (1.8)
Intestinal Obstruction	2 (1.8)
Miscellaneous	8 (7.2)

*NSAP: non-specific abdominal pain

Table 3 presents the frequency of causes of acute abdomen shown by various methods. The most common cause of acute abdomen either diagnosed clinically or by USG or as per final diagnosis was acute appendicitis followed by NSAP.

Table 3. Frequency comparison of causes of acute abdomen by different modalities (N=110).

	Clinical diagnosis	USG diagnosis	Final diagnosis
Appendicitis	41	44	49
NSAP	39	22	13
Calculous cholecystitis	10	12	12
Ureteric colic	8	10	10
Miscellaneous	2	8	8
Pancreatitis	4	5	6
Hernia	4	4	4
Liver Abscess	1	2	3
Malignancy (Lymphoma)	-	1	2
Intestinal obstruction	1	-	3
Total	110	110	110

Out of 110 patients, definite correct clinical diagnosis was made in 83 patients (75%) and USG made a correct diagnosis in 101 patients (91%). Hence with the help of USG, accuracy of diagnosing cause of acute abdomen increased by 16%. Among total 49 cases of acute appendicitis, 43 were correctly diagnosed and were proved by histopathology and one was over diagnosed by USG, which turned out to be normal appendix in histopathology. Six cases were diagnosed by CT which were retro-caecal appendicitis. Of the six cases of pancreatitis, five were diagnosed by USG and one by CT. Among 22 cases of NSAP in USG, further investigations gave final correct diagnosis. Table 4 shows sensitivity and specificity of USG in diagnosing different causes of acute abdomen.

Table 4. Sensitivity and specificity of USG in diagnosing different cause of acute abdomen.

Causes of acute abdomen	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Appendicitis	87.7 (75.23 - 95.37)	98.36 (91.2 - 99.96)	97.73 (85.59 - 99.67)	90.9 (82.52 - 95.4)
Cholecystitis	100 (73.5-100)	100 (96.3-100)	100	100
Ureteric colic	100 (69.15-100)	100 (96.38-100)	100	100
Pancreatitis	83.3 (35.8-99.5)	100 (96.5-100)	100	99.1 (94.56-99.84)

DISCUSSION:

Acute abdomen is a commonly encountered clinical condition in ED. This study compared clinical and USG findings with the final diagnosis based upon the laboratory values, CECT abdomen and intraoperative findings, and follow-up of patients with histopathological reports in relevant cases.

Prasad et al.[5] observed the most common cause for pain abdomen as acute appendicitis (24.3%) followed by nonspecific pain abdomen (18.9%) with correct clinical diagnosis in 70.9% of the cases. USG diagnosed correctly in 78.4% of acute abdominal pain that increased diagnostic accuracy by 8%.

Similarly, Alleman et al.[6] also saw diagnostic accuracy increased by 13% with USG in comparison to clinical diagnosis which is almost comparable to our findings.

KC et al. found the sensitivity, specificity, PPV and NPV of USG in diagnosis of acute appendicitis as 95.12%, 88.88%, 97.5% and 80% respectively.[7] Similarly, Tauro et al. mentioned the sensitivity, specificity, PPV, NPV of USG in diagnosis of acute appendicitis as 91.37%, 88.09%, 91.37% and 88.09% respectively.[8] A different diagnostic accuracy of 24.4 % was observed in the study done by Garba et al. for the diagnosis of acute appendicitis.[9] This could be attributed to observer's error and possibly low resolution of the USG machine and inappropriate probes with unsuitable frequencies, and poor clinical history to guide the operator particularly in cases of self-referral by patients.[10] In our study, most of the procedures were performed by the first author with a high resolution USG machine that reduced the observer's error which led to the high diagnostic accuracy.

USG is the preferred imaging modality for the diagnosis of acute cholecystitis and is the first method used when the clinical presentation is suggestive of biliary pathology.[11] Prasad et al. showed the sensitivity and specificity of USG in diagnosing acute cholecystitis as 92.3% and 100% respectively.[5] Similarly, a study from Philadelphia found 97% sensitivity and 95% specificity in their study that corresponds to our findings.[12]

The sensitivity and specificity of USG in diagnosing acute pancreatitis was 89.6% and 87.5% respectively in a study by Pandey et al.[13] while Galarraga et al. reported as 100% and 85% respectively that almost corroborates our findings. [14]

The sensitivity and specificity were both 100 % in a study conducted by Ashaolu et al. for cases of renal colic.[15] Prasad et al. showed that the sensitivity and specificity of USG in diagnosing ureteric colic were 84.6% and 98.4% respectively. [5]

Our study had 12 false negative cases (six cases of retrocaecal appendicitis, one case of pancreatitis, one case of liver abscess, one case of malignancy (Lymphoma of small intestine), three cases of intestinal obstruction) and showed them as no abnormalities and classified them as NSAP. All the missed cases were diagnosed by CECT abdomen. USG has poor sensitivity in detecting retrocaecal appendicitis and pancreatitis as they are difficult to visualize due to obscuration by overlying gas shadow from caecum and transverse colon forming poor acoustic window. It may miss early abscess with subtle echogenic changes especially in the left lobe of liver. Also, it is not specific in diagnosing intestinal obstruction as nonspecific findings like dilated, prominent bowel loops and abnormal peristalsis are the common findings in intestinal obstruction, which can also be noted in other abdominal pathologies.[5]

Poor performance of USG in the cases with perforated viscus was observed. The latter often results in massive intraperitoneal free air. Intraperitoneal free air in turn leads to scattering of the USG waves at the interface of the soft tissue and the air which is accompanied by reverberation of the waves between the transducer and the air.[16] This, typically, results in a high-amplitude linear echo (increased echogenicity of a peritoneal stripe) accompanied by posterior artifactual reverberation echoes with characteristic comet-tail appearance. This may explain why diagnostic accuracy of USG could be low. Maneuvers that can help improve USG sensitivity in cases with perforated viscus include positional change and the use of linear-array of transducers.[16,17] However, the indirect evidence of peritonitis such as free fluid and decreased peristalsis can be detected by USG. X-ray abdomen is found to be superior to USG in detecting pneumoperitonium. For few miscellaneous conditions such as abdominal aorta aneurysm, mesenteric lymphadenitis, and intra-abdominal cyst the number of cases were very less to comment in our study.

CONCLUSION:

Ultrasonography is an outstanding imaging modality and has high sensitivity, specificity, and diagnostic accuracy in acute abdomen which has helped the managing surgeons in arriving at early diagnosis. Hence, it can be an important routine diagnostic investigation in patients presenting with acute pain abdomen in ED /OPD.

Conflict of Interest: The authors declare that no competing interests exist.

Financial disclosure: No funds were available.

REFERENCES:

1. Diethelem AG. The acute abdomen. In: Sabiston DC jr. (ed.) Sabiston Text book of surgery. Philadelphia: Saunders;1986. p.790-809.
2. Stoker J, Randen AV, Lameris W, Boermeester MA. Imaging patients with acute abdominal pain. Radiology. 2009;253(1):31-46. PMID: 19789254. DOI: https://doi.org/10.1148/radiol.2531090302
3. Cope ZS, Silen W. Cope's early diagnosis of the acute abdomen. 18thed. New York Oxford Oxford University Press;1991.
4. Puylaert JB, Rutgers PH, Lalisang RI, de Vries VC, Van der Werf SD, Dorr JP, et al. A prospective study of ultrasonography in the diagnosis of appendicitis. N Engl J Med. 1987;317(11):666–9. PMID: 3306375. DOI: https://doi.org/10.1056/NEJM198709103171103
5. Prasad H, Rodrigues G, Shenoy R. Role of ultrasonography in nontraumatic acute abdomen. The Internet Journal of Radiology. 2007;5(2):1-2. Available from: https://print.ispub.com/api/0/ispub-article/4681
6. Allemann F, Cassina P, Rothlin M, Largiader F. Ultrasound scans done by surgeons for patients with acute abdominal pain: a prospective study. Eur J Surg. 1999;165(10):966–70. PMID: 10574106. DOI: https://doi.org/10.1080/110241599750008099
7. KC S, De A, Pathak M, Sathian B. Diagnostic Role of Ultrasonography in Acute Appendicitis: A Study at a Tertiary Care Hospital. American Journal of Public Health Research. 2015;3(5A):23–8. Available from: http://pubs.sciepub.com/ajphr/3/5A/6/ajphr-3-5A-6.pdf
8. Tauro LF, Premananda TS, Aithala PS, George C, Suresh HB, Acharya D. Ultrasonography is still a useful diagnostic tool in acute appendicitis. Journal of Clinical and Diagnostic Research. 2009;3(5):1731-36. Available from: https://www.jcdr.net/articles/PDF/567/475.pdf
9. Garba ES, Chom ND. Ultrasound in the diagnosis of appendicitis: A plea for caution. Niger Journal of Surgical Research. 2006;8(3-4):132–4. DOI: http://dx.doi.org/10.4314/njsr.v8i3-4.54874
10. Puylaert JB. Ultrasonography of the acute abdomen: gastrointestinal conditions. Radiol Clin North Am. 2003;41(6):1227–42. PMID: 14661668. DOI: https://doi.org/10.1016/s0033-8389(03)00120-9
11. Pinto A, Reginelli A, Cagini L, Coppolino F, Stabile Ianora AA, Bracale R, et al. Accuracy of ultrasonography in the diagnosis of acute calculous cholecystitis: review of the literature. Crit Ultrasound J. 2013;5(Suppl 1):S11. PMID: 23902680. DOI: https://doi.org/10.1186/2036-7902-5-S1-S11
12. Shea JA, Berlin JA, Escarce JJ, Clarke JR, Kinosian BP, Cabana MD, et al. Revised estimates of diagnostic test sensitivity and specificity in suspected biliary tract disease. Arch Intern Med. 1994;154(22):2573–81. PMID: 7979854
13. Pandey L, Milicevic M, Grbic R, Bulajic M, Krstic R, Golubovic G, et al. The value of ultrasound in staging the severity of acute pancreatitis. Acta Chir Iugosl. 1997-1998;44–45(1–1):63–7. PMID: 10951817
14. Galarraga D, Garcia N, Barrios S, Hinestrosa H, Quiroz E. Acute pancreatitis: the value of ultrasonography in its prognosis. G E N. 1992;46(2):93–101. PMID: 1340822
15. Ashaolu BA, Asaleye MC, Adetiloye AV, Alatise IO. Spectrum of disease and diagnostic value of ultrasound in adult patients with non traumatic acute abdomen in a Nigerian tertiary health facility. Niger J Surg. 2015;21(1):6-12. PMID: 25838758. DOI: https://dx.doi.org/10.4103/1117-6806.152731
16. Hefny AF, Abu-Zidan FM. Sonographic diagnosis of intraperitoneal free air. Journal of Emergencies Trauma, and Shock. 2011;4(4):511–3. Available from: http://www.onlinejets.org/text.asp?2011/4/4/511/86649
17. Chadha D, Kedar RP, Malde HM. Sonographic detection of pneumoperitoneum: an experimental and clinical study. Australas Radiol. 1993;37(2):182–5. PMID: 8512509. DOI: https://doi.org/10.1111/j.1440-1673.1993.tb00046.x