ORIGINAL ARTICLE

USEFULNESS OF PLAIN RADIOGRAPH & ULTRASOUND COMPARING WITH ADVANCE IMAGING IN NON-TRAUMATIC ACUTE ABDOMINAL EMERGENCIES IN A LIMITED RESOURCE PRIVATE SET UP

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ABSTRACT

OBJECTIVES: To find out the usefulness of plain radiograph and ultrasound comparing with advance imaging in non-traumatic acute abdominal emergencies in a limited resource private set up. **STUDY DESIGN:** Cross sectional study. **STUDY PLACE AND DURATION:** Emergency department (ER) in collaboration of department of Radiology, Sir Syed Hospital Karachi, a private tertiary care center. Six months from 1st August 2017 to 31st January 2018. **PATIENTS AND METHODS:** Total 204 patients presenting in ER department with non-traumatic acute abdominal pain were enrolled in the study referred to the Radiology department for imaging were recorded on proforma. SPSS version 20.0 was used for data analysis. Patients demographic data, precipitating symptoms and diagnostic findings were presented as percentages. **RESULTS:** Plain x-ray as first line imaging along with clinical examination to reach preliminary diagnosis was found useful in patients suspected to be bowel obstruction 97.9% followed by gastroenteritis 88.2%, hernia 80%, peritonitis 75%, acute pancreatitis 55.6%, acute cholecystitis 50%, renal calculus 44.4%, ureteral calculus 36.4% and acute appendicitis 26.3%, but could not suspect about gynecological issues. Plain x-ray provided useful suspicions who confirmed later for 151 (74.02%) patients, ultrasound for 189 (92.65%) and CT for 201 (98.5%). **CONCLUSION:** Abdominal radiography & ultrasonography along with precipitating factors and pathology lab findings still useful as a first imaging examination to evaluate abdominal pain in the emergency department (ED) and reduces rate of unnecessary hospitalization.

Keywords: Acute, abdominal pain, diagnosis, radiography, ultrasonography

Introduction

Non-traumatic abdominal pain is a common acute emergency rooting variety of causes from less severe to life threatening conditions.[1,2] The most important aspect is to initiate appropriate management after conventional investigations and necessary imaging techniques to identify leading cause of non-traumatic abdominal pain.[3-5] Precipitating factors including vomiting, nausea, constipation, choking, dysphagia, jaundice, gastrointestinal hemorrhage may be potentially more severe and challenging to establish an accurate diagnosis.[6-7]

Plain radiograph is the conventional imaging procedure in the patients with suspected intestinal obstruction.[8-10] Clinical bedside ultrasonography (US) is actually the first-line imaging in acute epigastric pain patients presenting to the hospital emergency department (ED) because it is rapid, noninvasive, relatively inexpensive and focused, repeatable and reliable.[11,12] Plain X rays may be first choice screening modality in the diagnosis of acute abdominal emergencies;

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however ultrasound examination is cheaper, non-invasive, quick, reliable and highly accurate modality in diagnosing the exact cause of pain and its origin in a patient presenting with an acute abdomen and thus helps the physician or surgeon to plan the timely management.[13,14] With efficient clinical judgement and using ultrasonography and X-ray abdomen as basic diagnostic investigations, one can do early diagnosis with 97% to 99% accuracy and thus can avoid unnecessary operation.[12]

Although, selection of appropriate imaging modality consists of clinician's proficiency, institutional resource capacity, skilled operators and cost effectiveness. Subsequent use of superior imaging modalities like CT & MRI as per the set standards and guideline is still debatable to avoid overusing for making accurate diagnosis.[1,8,15]

In limited resource set ups or remote areas in developing countries like Pakistan, availability and affordability of MRI & CT scans creates unnecessarily burden on poor patients which may delay the process.[17,18] This study was designed to find out the usefulness of radiograph comparing ultrasonography and advanced imaging techniques in non-traumatic acute abdominal emergencies in a limited resource private set up in order to reach accurate diagnosis in most of the common acute abdomen cases by using conventional non-invasive and cost effective diagnostic modalities and avoid unnecessary costly imaging and hospital admissions.

Patients and Methods

Total 204 patients of either gender, aged between 15-80 years who presented with non-traumatic acute abdominal pain since past 24 hours in the emergency department of Sir Syed Hospital, Karachi were referred to its department of Radiology for plain x-ray as first line imaging followed by ultrasound scan were included in the study after taking informed consent and approval from ethical committee. Pain score was measured on a 10 points visual analogue scale (VAS). The patients with chronic diseases of abdomen, liver, prostate & urology, pancreas, peptic ulcer, splenomegaly, pregnancy, postmenopausal woman on hormone therapy and malignancy were ruled out from the study. The consultant radiologist was unaware of precipitating factors and clinical suspicion. Later, the patients were referred for ultrasound due to insufficient information of x-ray findings for further investigations and assenting scans. Likewise, ultrasonography was performed by the consultant radiologist with same patient details at USG machine model no: US scanner GE logiq alpha 100 with 3.5 MHz transducer as per case need with reports given in emergency itself. The reports of radiographs and ultrasonography were not conveyed to the respective radiologist. For image review, abdominal radiography consisting of at least three exposures and low-dose CT consisting of the CT scanogram and 5-mm thick axial slices were used. Suspected cases CT scan of special investigations like intravenous urography, contrast studies of gastrointestinal tract, CT scan of abdomen were conducted /obtained whenever advised by the concerned physician and imaging findings were documented.

Final diagnosis was made on the basis of clinical evaluation, laboratory findings, radiography, ultrasonography, therapeutic response, operative findings and histopathological report. The preliminary diagnosis based on plain x-ray along with clinical examination and in addition to ultrasound findings were separately compared with the final diagnosis to evaluate usefulness of x-ray and ultrasound. Patient's demographic details, precipitating symptoms and diagnostic findings were recorded on proforma. SPSS version 20.0 was used for data analysis. All continuous response variables like age and pain score were presented as Mean ± SD. The categorical variables including precipitating factors, pain severity and diagnostic spectrum of x-ray & ultrasound are presented into frequencies and percentages. Positive predictive value of x-ray and ultrasound were calculated following the confirmatory final diagnosis.

Results

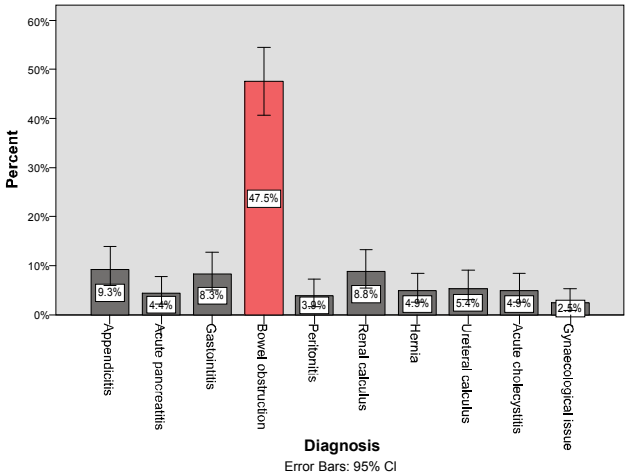
Among 204 patients who presented in ER department with chief complaint of non-traumatic abdominal pain, 120 (58.8%) were males and 84 (41.2%) females. Mean age was 26.76 ± 7.67 years. Among the patients with non-traumatic abdominal pain, presence of multiple symptoms was reported, however constipation

was the commonest precipitating factor reported by 104 (51.0%) patients, followed by fever in 51 (25.0%), headache in 44 (21.6%) and vomiting in 35 (17.2%) as detailed in (Tab. 1).

Presenting symptoms	Number of patients	Percentage
Constipation	104	51.0
Fever	51	25.0
Headache	44	21.6
Vomiting	35	17.2
Urine blockade	29	14.2
Backache	22	10.8
Pain move right iliac-fossa	21	10.3
Vertigo/ Drowsiness	12	5.9

Table 1: Precipitating symptoms with onset of non-traumatic abdominal pain.

Time length of precipitating factors was quite variant among the patients ranging from 1 hour to 4 days, thus average time length was 16.7 ± 10.2 hours. Average pain score following 1-10 points scale measurement at the time of presentation was 7.35 ± 3.44. Most of the patients were seen with moderate pain score i.e. 107 (52.5%) followed by severe pain in 79 (38.7%) and only 18 (8.8%) reported mild pain. Final diagnoses reveals bowel obstruction as the commonest diagnosis (47.5%) followed by acute appendicitis 9.3%, renal calculus 8.8%, gastroenteritis 8.3%, ureteral calculus 5.4%, acute cholecystitis 4.9%, hernia 4.9%, acute pancreatitis 4.4%, peritonitis 3.9% and gynecological issues related to acute pelvic inflammatory disease and complications of ovarian cyst in 2.5% (Graph 1).



Graph 1: Final Diagnoses of non-traumatic acute abdomen.

Plain x-ray as first line imaging along with clinical examination to reach preliminary diagnosis was found useful in patients suspected to be bowel obstruction 97.9% followed by gastroenteritis 88.2%, hernia 80%, peritonitis 75%, acute pancreatitis 55.6%, acute cholecystitis 50%, renal calculus 44.4%, ureteral calculus 36.4% and acute appendicitis 26.3%, but could not suspect about gynecological issues. Ultrasonography findings as superior modality along with clinical examination was found useful in 100% patients suspected to be bowel obstruction, renal calculus and ureteral calculus followed by gastro-enteritis 94.1%, acute cholecystitis 90%, peritonitis 87.5%, hernia 80%, acute appendicitis 78.9%, acute pancreatitis 66.7% and gynecological issues 40% (Tab. 2).

Diagnosis	Correct identification			
	Total	Radiograph	Ultrasound	CT Imaging
Appendicitis	19	5 (26.3)	15 (78.9)	17 (89.5)
Pancreatitis	9	5 (55.6)	6 (66.7)	9 (100)
Gastro enteritis	17	15 (88.2)	16 (94.1)	17 (100)
Bowel obstruction	97	95 (97.9)	97 (100)	97 (100)
Peritonitis	8	6 (75)	7 (87.5)	8 (100)
Renal calculus	18	8 (44.4)	18 (100)	18 (100)
Hernia	10	8 (80)	8 (80)	10 (100)
Ureteral calculus	11	4 (36.4)	11 (100)	11 (100)
Acute cholecystitis	10	5 (50)	9 (90)	10 (100)
Gynecological issue*	5	0 (0)	2 (40)	4 (80)

*Gynecological issues related to acute pelvic inflammatory disease and complications of ovarian cyst.

Table 2: Comparison of Plain Radiography & advance imaging findings

Out of 204 patients, 27 (13.2%) were discharged after prescribing the treatment, 91 (44.6%) were admitted in ER for further investigations, 52 (25.5%) were hospitalized for treatment, 25 (12.2%) were referred as per patients consent and 9 (4.4%) refused for treatment and discharged. Thus, this data reveals 56.8% patients who were rolled out from hospitalization on the basis of radiographic & ultrasonographic findings. Out of 204 cases, plain x-ray provided useful suspicions who confirmed later for 151 (74.02%) patients that yielded a positive predictive value 74.02%. Ultrasonography as superior modality after plain radiograph along with clinical suspicion provided usefulness in 189 (92.65%) that yielded positive

predictive value 92.65%. However, highest diagnostic yield of CT imaging was 201/ 204 (98.5%) in comparison of final diagnoses.

Discussion

Following standard protocol, imaging is generally practiced in patients presenting with acute abdominal pain, however its diagnostic yield particularly in limited resource set ups of developing countries like ours had not previously exhibited in a large prospective study.

Out of 204 cases, plain x-ray provided useful suspicions who confirmed later for 151 (74.02%) patients that yielded a positive predictive value 74.02%. The bowel obstruction was the commonest diagnosis with positive predictive value 97.9% which was quite higher than the recent study in which intestinal obstruction from plain X-ray abdomen in 80% patients.[11]

Stroman L et al[19] reported, 63% possible obstruction, 20% renal colic and 27% other suspected diagnoses, confirmed or suggestive diagnoses were supported by plain abdominal x-ray, admissions (21%), possible obstruction (22%) and possible renal colic (22%). In our study, ultrasonography as superior modality after plain radiograph along with clinical suspicion provided usefulness in 189 (92.65%) that yielded positive predictive value 92.65%.

Raman S et al[20] claimed overuse of ultrasound imaging instead similar findings achieved from abdominal x-ray with pathology lab findings. They concluded ultrasound is less useful in patients who are less than 25 years of age, especially when the symptoms and signs are non-specific and the laboratory results are normal.

In a recent study, acute abdomen was most common in age group between 20-40 years with male predominance. Acute appendicitis was the most common cause of surgical condition, followed by peritonitis and then intestinal obstruction. The diagnostic accuracy rates in male and female patients were 93% and 80% respectively. Ultrasonography had highest sensitivity rate (97.8%) and plain X -ray abdomen had highest specificity rate (88.4%). In our study most of the patients were of younger age group (Mean = 26.76 years). Since, younger age groups has usually less likely exposure of co-morbids or complex diagnoses so plain x-ray and ultrasound imaging may provide more accurate diagnosis.

Gathwal CK et al[13] reported most common diagnoses including acute appendicitis, kidney, ureteral & bladder (KUB) calculus disease and acute cholecystitis seen in 22.86%, 17.14% and 15% cases respectively. Their data reveals that ultrasound supersedes provisional clinical diagnosis and radiographic evaluation in diagnosing acute abdominal conditions with sensitivity, positive predictive value, false positive rate, false negative rate and diagnostic accuracy as 90.71, 100, 0 ,9.28 and 90.71 percent respectively. Bhangu A et al[22] reported that abdominal x-ray was done in 30% who underwent appendicectomy, 57% in acute gallstone disease and 78% with acute pancreatitis. When they used, ultrasound confirmed the diagnosis in 84% and CT scanning in 97%.

Sharma P et al[23] also reported overall sensitivity and specificity of ultrasound 78.7% and 84.6% respectively. In a recent systematic review,[24] the overall sensitivity for abdominal radiography varied between 30% and 77% and specificity varied between 75% and 88%. In our study, we could not calculate sensitivity and specificity due to patient's follow up in a private set up as well as variety of non-traumatic acute abdomen for that variant gold standard criteria were required for confirmation of particular diagnosis based on either interventional outcome, per operative findings, CT or MRI. However, we reported overall as well as specific positive predictive value overall for each etiological factor of non-traumatic acute abdominal pain.

A different approach of radiographic screening was seen that 300 (52%) out of 573 consecutive patients underwent abdominal radiography. Findings were normal in 88% non-specific in 7.3%, and abnormal in 4.7%. For those with normal results, no further imaging was ordered for 43%, 57% were advised follow-up imaging, and 65% showed abnormal findings.[25]

Our study exhibits 25.5% hospitalization and 56.8% were ruled out from hospitalization on the basis of radiographic & ultrasonographic findings. Gulen et al[26] reported 11.1% hospitalization and 86.9% were discharged, however this study was done is fully equipped larger university hospital. While in our set up, plain x-ray and ultrasonography was included

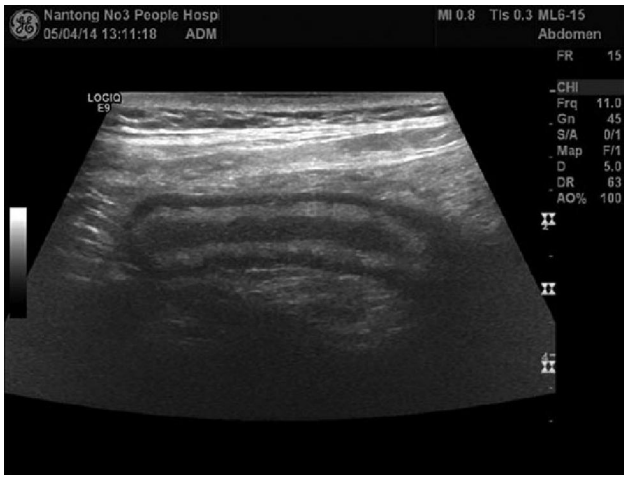


Figure 1: Ultrasound image showing dilated appendix.

Figure 2: X-ray abdomen showing appendicular lump displacing bowel loops.

apart from clinical assessment which is affordable and relatively available across the country.

Limitation of the presented study was that we used the approach which allowed extent of agreement of imaging strategies with clinical diagnoses but no direct evaluation of the effects of imaging on patient's management and outcome. In our study, management after completion of the diagnostic protocol was always based on the result of all diagnostic tests. Thus, findings of our study demonstrates that abdominal radiography & ultrasonography along with precipitating factors and pathology lab findings still useful as a first imaging examination to evaluate abdominal pain in the emergency department and reduces rate of unnecessary hospitalization. In this context, our study may be the foundation stone for future researchers to conduct multicenter study to reduce judgmental bias and accuracy of diagnosis inrelation to the patient's.

Conflict of Interest: None

Figure 3: CT coronal image showing dilated appendix.

References

1. Lameris W, van Randen A, van Es HW, van Heesewijk JP, van Ramshorst B, Bouma WH et al. Imaging strategies for detection of urgent conditions in patients with acute abdominal pain: diagnostic accuracy study. Brit Med J 2009; **339:** 2431.

2. Kulla M, Kraus S, Walcher F, Somasundaram R, Wrede CE, Lampl L et al. Patients with Acute, Non-Traumatic Abdominal Pain in German Emergency Departments: A Prospective Monocentric

Observation Study. Zentralbl Chir 2016; **141(06):** 666-76.

3. Gangadhar K, Kielar A, Dighe MK, O'Malley R, Wang C, Gross JA et al. Multimodality approach for imaging of non-traumatic acute abdominal emergencies. Abdom Radiol (NY). Jan 2016; **41(1):** 136-48.

4. Mazzei MA, Guerrini S, Squitieri NC, Cagini L, Macarini L, Coppoline F et al. The role of US examination in the management of acute abdomen. Critical Ultrasound Journal 2013 5(Suppl 1):S6.

5. Kariman H, Shojaee M, Sabzghabaei A, Khatamian R, Derakhshanfar H, Hatamabadi H. Evaluation of the Alvarado score in acuteabdominal pain. Ulus Travma Acil Cerrahi Derg 2014; **20:** 86-90.

6. Gans SL, Pols MA, Stoker J, Boermeester MA. Guidelines for the diagnostic pathway in patients with acute abdominal pain. Digest Surg 2015; **32:** 23-31.

7. Durand G, Bounes V, Lauque D. Chronicization of non-traumatic acute abdominal pain in emergency department: Incidence and predictive factors. Ann Fr Med Urgence 2015; **5(3):** 159-65.

8. Gans SL, Stoker J, Boermeester MA. Plain abdominal radiography in acute abdominal pain; past, present, and future. Inter J Gen Med. 2012; **5:** 525-33.

9. Van Randen A, Laméris W, Luitse JS, Gorzeman M, Hesselink EJ, Dolmans DE et al. The role of plain radiographs in patients with acute abdominal pain at the ED. Am J Emerg Med 2011; **29:** 582-9.

10. Paolillo C, Spallino I, Cervellin G, Catena F. Is there still a role for abdominal plain X-ray in acute abdomen? Emerg Care J 2015: 5528.

11. Shah H, Parikh C, Raychaudhuri C. Role of Radiology in Evaluation of Non-Traumatic Acute Abdomen. IAIM, 2017; **4(3):** 1-9.

12. Kellow ZS, MacInnes M, Kurzencwyg D. The role of abdominal radiography in the evaluation of the nontrauma emergency patient. Radiology 2008; **248:** 887-93.

13. Gathwal CK, Gathwal MB, Garg S, Kumari Y, Singh K. A comparative study between abdominal plain radiography and ultrasonography in non-traumatic acute abdominal emergencies in tertiary care hospital. Int J Res Med Sci 2017; **5:** 113-23.

14. The 2007 recommendations of the international commission on radiological protection. ICRP publication 103. Ann ICRP 2007; **37:** 1-332.

15. Barksdale AN, Hackman JL, Gaddis M, Gratton MC. Diagnosis and disposition are changed when board-certified emergency physicians use CT for non-traumatic abdominal pain. Am J Emerg Med. Nov 2015; **33(11):** 1646-50.

16 Dubuisson V , Voiglio EJ, Grenier N, Le Bras Y, Thoma M, Launay-Savary MV. Imaging of non-traumatic abdominal emergencies in adults. J Visc Surg 2015, **152(6):** S57-64.

17. Smith JT, Mbchb M, Parachemant C. The role of imaging in the management of adults with nontraumatic acute abdominal pain. 2009; **21:** 1-19.

18. Jain R, Gupta V. A prospective study of various available diagnostic and treatment modalities and intraoperative findings of non-traumatic acute abdominal cases in a tertiary care hospital of Central India. J. Evolution Med Dent Sci 2016; **5(92):** 6829-34.

19. Stroman L, Abdulmajed MI, McDonald C, Chandran P. The role of plain abdominal X-ray in acute surgical setting: a retrospective analysis. Int J Surg 2012; **10(8):** S46.

20. Raman S, Somasekar K, Winter R, Lewis M. Are we overusing ultrasound in non-traumatic acute abdominal pain? Postgraduate Medical Journal. 2004; **80(941):** 177-79.

21. Momin RS, Azhar MA, Hussain S. Clinical and Radiological Diagnosis in Acute Abdominal Emergencies. J. Evolution Med. Dent. Sci. 2015; **4(65):** 11308-15.

22. Bhangu A, Richardson C, Winter H, Bleetman A. Value of initial radiological investigations in patients admitted to hospital with appendicitis, acute gallbladder disease or acute pancreatitis. Emerg Med J 2010; **27:** 754-7.

23. Sharma P, Sidharth, Singh BP, Singh D, Gupta. A Comparative Study between Plain Radiography and Ultrasound Abdomen in Non-Traumatic Surgical Acute Abdominal Conditions NJR. 2012; **2(3).**

24. Alshamari M, Norrman E, Geijer M, Jansson K, Geijer H. Diagnostic accuracy of low-dose CT compared with abdominal radiography in non-traumatic acute abdominal pain: prospective study and systematic review. Eur Radiol 2016; **26:** 1766-74.

25. Zeina AR, Shapira-Rootman M, Mahamid A, Ashkar J, Abu-Mouch S, Nachtigal A. Role of Plain Abdominal Radiographs in the Evaluation of Patients with Non-Traumatic Abdominal Pain. Isr Med Assoc J. Nov 2015; **17(11):** 678-81.

26. Gulen B, Oktay C, Akpinar G, Sonmez E. The Utility of a Standardized Evaluation Form for Complaints in Patients with Acute Abdominal and Flank Pain. Eurasian J Emerg Med 2016; **15:** 20-3.