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Research Article

DECODING OF NON-TRAUMATIC ABDOMINAL PAIN: MULTIDETECTOR COMPUTED TOMOGRAPHY SCAN VERSUS ULTRASOUND: A RETROSPECTIVE CROSS-SECTIONAL STUDY

SANTOSH KUMAR PANDA[1], MADHURI PANIGRAHI[2]*

[1]Department of Radiodiagnosis, Dharanidhar Medical College, Keonjhar, Odisha, India. [2]Department of Physiology, S.C.B. Medical College, Cuttack, Odisha, India.
*Corresponding author: Madhuri Panigrahi; Email: santosh160@gmail.com

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ABSTRACT

Objectives: Abdominal pain is one of the common presentations in outpatient and causality of hospitals. Ultrasound (USG) and computed tomography (CT) scans are commonly used to assess the cause of abdominal pain. The primary objective was to determine which modality (CT scan/USG) to prefer for evaluation of abdominal pain. The secondary objective was to determine whether to consider for USG scan, even if a multi-detector CT (MDCT) has already been done. Furthermore, we wanted to estimate various causes of abdominal pain.

Methods: All patients with any duration and any kind of abdominal pain were included in the study. A total of 200 cases were taken for analysis. All CT scans in this study were performed using a 128-slice MDCT scanner. USG report findings and CT scan findings were compared. Final diagnosis at the time of discharge from the hospital was noted for each case. Both CT scan and USG report findings were compared with the final diagnosis at the time of discharge from the hospital. Following variables were analyzed: – (1) Age distribution, (2) gender distribution, (3) patients found CT positive, (4) patients found USG positive, (5) correlation between CT positive and USG positive, (6) whether main cause of pain detected by CT scan, and (7) whether main cause of pain detected by USG study.

Results: Out of the 200 patients, 53% were males and 47% were females. The mean age was 44.42 years. The most common age group was the 5th decade. There was a nearly equal percentage of detection of principal etiology of pain by CT and USG among male and female patients. USG was more diagnostic in the 5th decade and later age groups compared to the younger age groups. A CT scan was diagnostic in almost all age groups except the 2nd decade. Pancreatitis (19%) and cholecystitis (15.5%) were the most common causes of abdominal pain. CT scan showed positive findings in 88.5% of cases, whereas USG showed positive findings in 76.5% of cases. In 85% of cases, there was either partial or full correlation of findings between CT and USG. In 15% cases, no correlation of findings was seen. In 84% of cases, the principal etiology of pain was detected by CT scan. In 61.5% cases, USG could detect the principal cause of pain. In 75% of cases where USG showed positive findings, the CT scan also showed positive findings. Again, in 10% of cases where USG was negative, CT was also negative. Furthermore, 13.5% of USG negative cases were positive in CT, and 1.5% of CT negative cases were USG positive. Out of 177 patients having positive findings in CT, 94.91% patients were true positives. Out of 153 patients having positive findings in CT, 80.39% patients were true positives. In 26% of cases, where USG was not able to detect the cause of pain, CT could detect it. In comparison, only in 3.5% of cases where CT was not able to detect the cause of pain, USG could detect it.

Conclusion: CT scan is more sensitive and specific for abdominal pain evaluation. If a CT scan has already been done, and satisfactory information related to the clinical diagnosis is found in the CT scan, then it is less likely to get additional information in a USG done subsequently.

Keywords: Abdominal pain, Ultrasound, Computed tomography scan.

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INTRODUCTION

Abdominal pain is one of the common presentations in outpatient and causality of hospitals [1]. Causes of abdominal pain can vary according to different locations of the abdomen [2]. Multi-detector computed tomography (MDCT) plays a vital role in the evaluation of abdominal pain to arrive at an accurate diagnosis and plan the appropriate treatment [3]. Ionizing radiation is the major limitation of MDCT, whereas one of the major drawbacks of ultrasonography is that it is observer-dependent. In addition to it, various patient categories, such as obesity, may affect the evaluation of ultrasonography [4]. Hence, choosing between MDCT and ultrasound (USG) is critical in the imaging evaluation of abdominal pain.

Objectives

- Primary
  To determine which modality (CT scan/USG) to prefer for evaluation of abdominal pain.
- Secondary
  (a) To determine whether to consider for USG scan, even if an MDCT is already done

  (b) To estimate various causes of abdominal pain.

METHODS

It was a hospital-based retrospective analytical study conducted in the Departments of Radiodiagnosis, Emergency, Surgery, Medicine, and Gynecology, S.C.B. Medical College, from December 2023 to March 2024. It was a purposive sampling method where the patients who were referred for CT scan of abdomen were considered for study initially.

Inclusion criteria

All patients with any duration and any kind of abdominal pain were included in the study.

Exclusion criteria
Those with (1) no history of abdominal pain, (2) those with abnormal renal function parameters, (3) pregnant women, and (4) those not willing to take part in the study were excluded from the study.

A total of 200 cases were taken for analysis. All CT scans in this study were performed using a 128-slice MDCT scanner in the Department of Radiodiagnosis, S.C.B. Medical College.

The CT examinations were performed using a 128-slice MDCT machine (GE) with the following parameters: 120 kVp and 100 mAs. Scans of the abdomen and pelvis were conducted from the xiphoid process to the pubic symphysis, plain and contrast study was carried out as per advice with the administration of 1.5 mL/kg (80 mL in average) of non-ionic contrast material (iohexol 350, omnipaque 350). The contrast material was injected into the cubital vein at the volar aspect of the elbow using an 18-gauge cannula, at a flow rate of 4 mL/s.

History was taken, and previous reports, including the USG report, were collected. Then USG report findings and CT scan findings were compared. After that, the final diagnosis at the time of discharge from the hospital was noted for each case. Later, both CT scan and USG report findings were compared with the final diagnosis at the time of discharge from the hospital. Data were collected by electronic, telephonic, or other methods, such as collecting data from the inpatient department, whichever was feasible.

Statistical analysis
The obtained data were analyzed using the software Statistical Package for the Social Sciences (version 20). Frequency and descriptive analyses were used to describe the data. Furthermore, a paired samples t-test was used to differentiate between two numerical data sets. Any difference or correlation was considered significant if $p<0.05$.

The following variables were analyzed: -

(1) Age distribution, (2) gender distribution, (3) patients found CT positive (any positive finding related to disease), (4) patients found USG positive (any positive finding related to disease), (5) correlation between CT positive and USG positive ([findings whether, (a) no matching [NO)], (b) few matching [PARTIAL], (c) almost matching [YES]), (6) whether main cause of pain detected by CT scan, and (7) whether main cause of pain detected by USG study.

RESULTS

This study comprised 200 patients.

Among a total of 200 patients, 106 (53%) were males and 94 (47%) were females (Table 1).

The mean age was 44.42±18.23 with a range of 4–90 years (Table 2).

The most common age group was the 5th decade (22.5%) (Table 3).

Table 1: Gender distribution of study patients

Gender of patients	Number of patients (n=200)	Percentage
Female	94	47.0
Male	106	53.0
Total	200	100.0

Pancreatitis (19%) and cholecystitis (15.5%) were the most common causes of abdominal pain (Table 4).

The following were the causes of abdominal pain as detected by CT scan and USG examination:-

- Pancreatitis (38/200) – It is the most common cause of pain in our study. All were detected in CT scan; however, 11/38 cases were not detected in USG
- Pancreatic pseudocyst (2/200) – All were detected in CT scan and USG
- Carcinoma pancreas (2/200) – Both were detected in CT scan; however, one case was not detected in USG
- Cholelithiasis-cholecystitis (31/200) – All were detected in USG study; however, 6/31 cases were not detected in CT scan
- Hilar cholangio-carcinoma (1/200) – It was detected in a CT scan and USG
- Intestinal obstruction (8/200) – All were detected in CT scan; however, 3/8 cases were not detected in USG
- Abdominal tuberculosis (7/200) – All except one were detected in CT scan, and 2/7 cases were not detected in USG
- Enteritis and gastroenteritis (8/200) – 3/8 cases were detected in CT scan; however, no case was detected in USG
- Inflammatory bowel disease (1/200) – It was detected in a CT scan but not in a USG
- Diverticulitis (1/200) – It was detected in a CT scan but not in a USG
- Appendicitis (5/200) – All were detected in CT scan; however, 3/5 cases were not detected in USG
- Pyelonephritis (3/200) – All were detected in CT scan; however, 1/3 cases were not detected in USG
- Ureteric calculus (6/200) – All were detected in CT scan; however, 5/6 cases were not detected in USG
- Renal calculus (11/200)- All were detected in CT scan; however, 9/11 cases were not detected in USG
- Renal carcinoma (2/200) – Both were detected in CT scan, as well as in USG
- Ovarian cyst with torsion (1/200) – It was detected in a CT scan, but not in USG
- Mucocele appendix (1/200) – It was detected in a CT scan, but not in USG
- Carcinoma LIVER (1/200) – It was detected in a CT scan, as well as in USG
- Hepatic abscess (8/200) – All were detected in CT scan, as well as in USG
- Peritoneal abscess (5/200) – All were detected in CT scan; however, 1/5 cases were not detected in USG
- Intestinal perforation (2/200) – It was detected in a CT scan, but not in USG
- Hepatic hydatid (1/200) – It was detected both in CT scan and in USG
- Splenic abscess (3/200) – All were detected in CT scan, as well as in USG
- Carcinoma colon (3/200) – All were detected in CT scan, but none in USG
- Carcinoma ovary (2/200) – All were detected in CT scan, as well as in USG. However, infiltration into adjacent structures was not detected in USG
- Cystitis (8/200) – All, except one (7/8) case, were detected in CT scan, as well as in USG
- Carcinoma urinary bladder (1/200) – It was detected in a CT scan, as well as in USG
- All cases of APD (13/200) and Colitis (3/200) were not detected in CT scan, as well as in USG.

Table 2: Age distribution of study patients

Total number of patients (n=200)	Minimum age in years	Maximum age in years	Mean age in years	Std. deviation	Skewness	Skewness
Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
200	4	90	44.42	18.229	−0.008	0.172

Table 3: Age group of study patients

Age group (in years)	Number of patients (n=200)	Percentage	Cumulative percentage
1–10	5	2.5	2.5
11–20	16	8.0	10.5
21–30	35	17.5	28.0
31–40	23	11.5	39.5
41–50	45	22.5	62.0
51–60	38	19.0	81.0
61–70	25	12.5	93.5
71–80	11	5.5	99.0
81–90	2	1.0	100.0
Total	200	100.0	

Table 4: Principal cause of pain in the study

S. No.	Principal etiology of pain	Number of patients (n=200)	Percentage
1	Abdominal TB	7	3.5
2	APD	13	6.5
3	Appendicitis	5	2.5
4	CA colon	3	1.5
5	CA GB	3	1.5
6	CA liver	1	0.5
7	CA ovary with hemorrhage	1	0.5
8	CA ovary with infiltration	1	0.5
9	CA Pancreas	2	1.0
10	CA stomach	1	0.5
11	CA UB	1	0.5
12	CBD stricture	1	0.5
13	Cholecystitis	31	15.5
14	Choledochal cyst	1	0.5
15	Choledocholithiasis	2	1.0
16	Colitis	3	1.5
17	Diverticulitis	1	0.5
18	Enteritis	4	2.0
19	Gastroenteritis	4	2.0
20	Gross ascites	2	1.0
21	Hepatic abscess	6	3.0
22	Hepatitis	3	1.5
23	Hilar cholangio CA	1	0.5
24	Hydatid disease	1	0.5
25	IBD	1	0.5
26	Intestinal obstruction	8	4.0
27	Intestinal perforation	2	1.0
28	Large cyst in the abdomen	1	0.5
29	Large gastric gist	1	0.5
30	Large ovarian cyst	1	0.5
31	Large ovarian cyst	1	0.5
32	Liver abscess	2	1.0
33	Mucocele appendix	1	0.5
34	Ovarian cyst	1	0.5
35	Ovarian cyst torsion	1	0.5
36	Pancreatic pseudocyst	1	0.5
37	Pancreatitis	38	19.0
38	Peritoneal abscess	5	2.5
39	Peritonitis	1	0.5
40	Pseudocyst	1	0.5
41	PV Thrombosis	1	0.5
42	Pyelonephritis	3	1.5
43	Renal calculus	11	5.5
44	Renal tumor	2	1.0
45	Retroperitoneal sarcoma	1	0.5
46	Splenic abscess	3	1.5
47	Ureteric calculus	6	3.0
48	Ureteric inflammation	1	0.5
49	UTI	8	4.0
	Total	200	100.0

TB: Tuberculosis, IBD: Inflammatory bowel disease, UTI: Urinary tract infection

From Table 5, the percentage of detection in females is (58×100÷94=) 61.7% and in males it is (65×100÷106=) 61.3%.

From Table 6, the percentage of detection in females is (79×100÷94=) 84.04% and in males it is (89×100÷106=) 83.96%.

From Tables 5 and 6, it appears that the percentage of detection of principal etiology by CT and USG among male and female patients is similar.

From Table 7, the percentage of detection by USG in age groups from the 1st to 9th decade is 60%, 37.5%, 51.4%, 47.8%, 71.1%, 68.4%, 68%, 72.7%, and 100%, respectively.

USG was more diagnostic in the 5th decade and later age groups as compared to the young age.

From Table 8, the percentage of detection by CT in age groups from the 1st to the 9th decade is 80%, 62.5%, 82.8%, 73.9%, 93.3%, 89.5%, 84%, 81.8%, and 100%, respectively.

A CT scan was diagnostic in almost all age groups except the 2nd decade.

A CT scan showed positive findings in 88.5% of cases.

USG showed positive findings in 76.5% of cases.

In 85% of cases, there was either partial or full correlation of findings between CT and USG. In 15% cases, no correlation of findings was seen.

In 84% of cases, principal etiology of pain was detected by CT scan.

In 61.5% cases, USG could detect the principal cause of pain.

From Table 9, the positive predictive value (PPV) of CT=168×100÷177=94.91%.

Out of 177 patients having positive findings in CT, 168 (94.91%) patients were true positives.

From Table 10, the PPV of USG=123×100÷153=80.39%.

Out of 153 patients having positive findings in CT, 123 (80.39%) patients were true positives.

In 75% of cases, where USG showed positive findings CT scan was also positive. Again, in 10% of cases where USG was negative, CT was also negative. Furthermore, 13.5% of USG negative cases were positive in CT, and 1.5% of CT negative cases were USG positive.

In 26% of cases, where USG was not able to detect the cause of pain, CT could detect it. In comparison, only in 3.5% of cases where CT was not able to detect the cause of pain, USG could detect it.

DISCUSSION

Out of 200 patients, 106 were males (53%) and 94 were females (47%) (Table 1), which is similar to the various studies conducted worldwide showing a slight male preponderance [5-7].

The most common age group was found to be the 4th decade, accounting for 22.5% and the mean age was 44.4 years (Tables 2 and 3). Similar results were found by studies conducted by Laal and Mardanloo [8] and Chaurasia *et al*. [5].

The two most common principal etiologies of abdominal pain are pancreatitis and cholecystitis among our study cases (Table 4).

A study by Chaurasia *et al*. showed that USG had detected the cause of pain more in females, and in the case of males, CT had detected more [5]. Contrary to it, our study did not show any such difference, and both CT and USG had similar detection percentages in males and females (Tables 5 and 6).

In our study, we found that USG was more diagnostic in the 5th decade

Table 5: Principal etiology detected in USG×sex cross-tabulation

Cross-tabulation of principal etiology detected in USG with gender distribution.	Yes/No	Number of female patients (n=94)	Number of male patients (n=106)	Total
Principal etiology detected in USG	No	36	41	77
Principal etiology detected in USG	Yes	58	65	123
Total		94	106	200

USG: Ultrasound

Table 6: Principal etiology detected in CT×sex cross-tabulation

Cross-tabulation of principal etiology detected in CT with Gender distribution	Yes/No	Number of female patients (n=94)	Number of male patients (n=106)	Total
Principal etiology detected in CT	No	15	17	32
Principal etiology detected in CT	Yes	79	89	168
Total		94	106	200

CT: Computed tomography

Table 7: Principal etiology-detected-in-USG×age group cross-tabulation

Cross-tabulation of principal etiology detected in USG with age distribution	Age group (in years)									Total (n=200)
	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	
Principal etiology detected in USG-No (in numbers)	2	10	17	12	13	12	8	3	0	77
Principal etiology detected in USG-Yes (in numbers)	3	6	18	11	32	26	17	8	2	123
Total	5	16	35	23	45	38	25	11	2	200

USG: Ultrasound

Table 8: Principal etiology-detected-in-CT scan×age group cross-tabulation

Cross-tabulation of principal etiology detected in CT with age distribution	Age group (in years)									Total (n=200)
	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	
Principal etiology detected in CT-No	1	6	6	6	3	4	4	2	0	32
Principal etiology detected in CT-Yes	4	10	29	17	42	34	21	9	2	168
Total	5	16	35	23	45	38	25	11	2	200

USG: Ultrasound, CT: Computed tomography

Table 9: Percentage distribution of cases found to have positive findings in CT scan

CT positive (Yes/No)	Number of patients (n=200)	Percentage
No	23	11.5
Yes	177	88.5
Total	200	100.0

CT: Computed tomography

Table 10: Percentage distribution of cases found to have positive findings in ultrasound

USG positive (Yes/No)	Number of patients (n=200)	Percentage
No	47	23.5
Yes	153	76.5
Total	200	100.0

USG: Ultrasound

Table 11: Percentage distribution of correlation of findings in CT and ultrasound

CT-USG-correlated (Yes/No/Partial)	Number of patients (n=200)	Percent	Cumulative percentage
No	30	15.0	15.0
Partial	53	26.5	41.5
Yes	117	58.5	100.0
Total	200	100.0	

USG: Ultrasound, CT: Computed tomography

and later age groups as compared to young age, whereas CT scan was diagnostic in almost all age groups except the 2nd decade (Tables 7 and 8). A study by Chaurasia *et al*. showed that USG was more diagnostic in the 3rd and 4th decade, whereas CT was more diagnostic in the 5th and 6th decade [5].

CT scan was more sensitive (CT positive – 88.5%) in the detection of any positive finding in the abdomen as compared to USG (USG positive – 76.5%) (Tables 11 and 12). In 85% of cases, there was either partial or full correlation of findings between CT and USG (Table 13). CT was also more specific, as 84% of the principal cause of pain was detected in CT as compared to 61.5% in USG (Tables 14 and 15).

A study conducted by van Randen *et al*. mentioned that the sensitivity of CT in detecting appendicitis and diverticulitis was much higher than that of USG. However, for cholecystitis, the sensitivity of both was the same [9]. Similarly, contrast-enhanced computed tomography abdomen showed a diagnostic accuracy of 84.02% as compared to USG showed a diagnostic accuracy of 74.71% in a study conducted by Chaurasia *et al*. [6]. A study by Mohi *et al*. also found that a CT scan has more diagnostic accuracy than ultrasonography. In their study, the accuracy of USG was 84%, sensitivity: 89.13%, and specificity: 75% whereas CT had an accuracy of 90%, sensitivity: 97.83%, and specificity: 100% [10].

Our study shows a PPV for CT of 94.91 and for USG it is 80.39 (Tables 9 and 10). Similarly, a Study by Mohi *et al*. found that USG had a PPV: 97%, compared to CT had a PPV: 100% [10].

From the CT positive and USG positive cross-tabulation, it was found

Table 12: Percentage of cases detected in CT scan

Principal etiology detected in CT scan (Yes/No)	Number of patients (n=200)	Percentage
No	32	16.0
Yes	168	84.0
Total	200	100.0

CT: Computed tomography

Table 13: Percentage of cases detected in ultrasound

Principal etiology detected in USG (Yes/No)	Number of patients (n=200)	Percentage
No	77	38.5
Yes	123	61.5
Total	200	100.0

USG: Ultrasound

Table 14: CT positive×principal etiology detected in CT cross-tabulation

Cross-tabulation of CT-positive with principal etiology detected in CT	Principal etiology detected in CT-No	Principal etiology detected in CT-Yes	Total (n=200)
CT positive-No	23	0	23
CT positive-Yes	9	168	177
Total	32	168	200

CT: Computed tomography

Table 15: USG positive×principal etiology detected in USG cross-tabulation

Cross-tabulation of USG positive with principal etiology detected in USG	Principal etiology detected in USG-No	Principal etiology detected in USG-Yes	Total (n=200)
USG positive-No	47	0	47
USG positive-Yes	30	123	153
Total	77	123	200

USG: Ultrasound

Table 16: USG positive×CT positive cross-tabulation

Cross-tabulation of USG positive with CT positive cases	CT positive-No (%)	CT positive-Yes (%)	Total (n=200)
USG-positive-No	20 (10)	27 (13.5)	47
USG-positive-Yes	3 (1.5)	150 (75)	153
Total	23 (11.5)	177 (88)	200

CT: Computed tomography, USG: Ultrasound

Table 17: Principal etiology detected in CT×principal etiology detected in USG cross-tabulation

Cross-tabulation of principal etiology detected in CT with principal etiology detected in USG	Principal etiology detected in USG-No (%)	Principal etiology detected in USG-Yes	Total (n=200)
Principal etiology detected in CT-No	25 (12.5)	7 (3.5%)	32
Principal etiology detected in CT-Yes	52 (26)	116 (58%)	168
Total	77 (38.5)	123 (61.5%)	200

CT: Computed tomography, USG: Ultrasound

that 13.5% of USG negative cases had positive findings in the CT scan. However, only 1.5% of CT-negative cases were found to have positive findings in USG (Table 16).

Again, in 26% of cases where USG was not able to detect the cause of pain, CT could detect it. In comparison, only in 3.5% of cases where CT was not able to detect the cause of pain, USG could detect it (Table 17).

These suggest the dominance of CT over USG.

Again, from the cross-table of CT positive and USG positive, it was found that both were negative in 10% and both were positive in 75% cases, which signifies that if CT is negative, USG is more likely to be negative (Table 16).

The most common cause of pain in our study is pancreatitis (38/200 cases) (Table 4). The high incidence may be attributed to selectively choosing patients who were referred for a CT scan. It may happen that more patients clinically suspected of pancreatitis were suggested for a CT scan for confirmation of diagnosis or assessment of severity. Contrary to our study, a study by Sharan *et al*. found pancreatitis as the 4th common cause of pain [4] and the 8th common cause in the study conducted by van Randen *et al*. [9]. In our study, all cases of pancreatitis were detected in CT scan; however, 11/38 cases were not detected in USG. Similarly, in a study conducted by Balamurugan *et al*., all cases of pancreatitis were detected by CT [3]. A study by Sharan *et al*. found that only three of the eight acute pancreatitis patients were found on ultrasonography; however, on CT scan, five instances of pancreatitis were identified [4].

Appendicitis, which is a common cause of abdominal pain, in our study, all were detected in CT scan; however, 3/5 cases were not detected in USG. A study by Bharathi and Tippani found that CT plays a more precise role in diagnosing appendicitis, especially in cases where USG results are negative [11].

A study by Dr. Balamurugan *et al*. found that compared to USG, CT was better in achieving a specific diagnosis. They mention that in their study, CT could pick up eight cases of appendicitis that were not picked up in USG. Similarly, CT could pick three cases of bowel perforation, 10 cases of small bowel obstruction, three cases of bowel ischemia, one case of aortic aneurysm, 10 cases of intraabdominal abscess, seven cases of pyelonephritis, five cases of acute pancreatitis which were not clearly depicted in USG and CT helped in providing the appropriate treatment [3].

Similarly, in our study, intestinal obstruction was detected in CT scan; however, three out of eight cases were not detected in USG. Intestinal perforation was detected in the CT scan, but not in USG. All cases of pyelonephritis were detected in CT scan; however, one out of three cases was not detected in USG. Peritoneal abscesses were detected in CT scan; however, one out of five cases was not detected in USG.

Abdominal pain can be treated surgically or medically, according to the cause, after evaluation. Some causes of pain, which may not be easily diagnosed and could be due to neuropathic pain, for which newer treatment options may be considered [12,13]. Treatment using drugs should be monitored to avoid complications [14,15].

Limitation

- Interobserver variation
- Less study population.

CONCLUSION

- A CT scan is more sensitive and specific for abdominal pain evaluation
- If a CT scan is already done, and satisfactory information related to the clinical diagnosis is found in the CT scan, then it is less likely to get additional information in a USG done subsequently.

ETHICAL CLEARANCE

It was applied for ethical clearance from the institute, but was waived for the retrospective nature of the study, as well as for that the data are anonymous and collected without intervention.

AUTHORS CONTRIBUTION

Both authors contributed equally to the conduct of the study and the preparation of the manuscript.

CONFLICTS OF INTERESTS

Authors have nothing to declare.

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