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Original Article

Radiology Section

Diagnostic Value of Peritoneal Nodules Detected on CECT Abdomen in Management of Ascites of Unknown Origin- A Retrospective Study

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ABSTRACT

Introduction: The aetiology of ascites can be established in a majority of patients with routine clinical examination and conventional laboratory and imaging investigations; but in a minority, the cause may remain undetected even after these examinations. This ascites is termed as ascites of unknown origin. The Contrast Enhanced Computed Tomography (CECT) abdomen of these patients sometimes shows peritoneal nodules which can be useful to establish diagnosis.

Aim: To evaluate the diagnostic value of peritoneal nodules detected on CECT abdomen in the management of ascites of unknown origin.

Materials and Methods: This retrospective study was conducted in Katuri Medical College and Hospital, Guntur, Andhra Pradesh, India on the data retrieved from the medical records of the patients between January 2019 to January 2021. These patients had already been vainly investigated with basic clinical, laboratory and diagnostic ultrasound examinations for the aetiology of ascites. All the patients who were diagnosed to have peritoneal nodules on CECT abdomen and later underwent laparoscopic tissue diagnosis of these peritoneal nodules were included in the study. The sizes of the peritoneal nodules and the distribution of the pathology were collected from CECT abdomen reports and compared them with the histopathology findings. Statistical analysis and plotting of the Receiver Operating Characteristic (ROC) curve were done using Statistical Package for the Social Sciences (SPSS) version 25.0.

Results: Fifty-two patients of ascites of unknown origin with peritoneal nodules were included in the study. Of the total, 36 (69.2%) patients were males and 16 (30.8%) were females. Mean age of the patients was 48 years (22 to 74 years). Tissue diagnosis of the peritoneal nodules revealed that majority of the patients had carcinomatosis peritonei (88.5%) while a minority had tuberculosis (11.5%). A nodule size of more than 5 mm as a sign of malignancy on CECT abdomen had a sensitivity of 93% and a specificity of 83%. Based on the tissue diagnosis of the peritoneal nodules these patients were treated with antituberculosis drugs for tuberculous abdomen and chemotherapy for carcinomatosis peritonei.

Conclusion: Detection of peritoneal nodules on CECT abdomen can be helpful in guiding the clinician for further management of ascites of unknown origin.

Keywords: Abdominal tuberculosis, Contrast enhanced computed tomography, Diagnostic laparoscopy, Peritoneal nodule size, Peritoneal thickening

INTRODUCTION

Ascites is a clinical presentation of a diverse group of diseases such as abdominal tuberculosis, pyogenic peritonitis, primary and secondary malignancies of the peritoneum, congestive cardiac failure, cirrhosis of liver, nephrotic syndrome and so on. Routine clinical examination, laboratory investigations (biochemical and cytological examination of blood, urine and peritoneal fluid) and imaging examinations (diagnostic sonography and CECT abdomen) usually discover the causes of ascites. But rarely the aetiology of ascites cannot be detected even after these investigations. This diagnostically challenging clinical condition is termed as ascites of unknown origin [1].

Diagnostic sonography and CECT abdomen in patients with ascites of unknown origin reveal not only the ascites but also findings like omental thickening and caking, lymph nodes, septations in ascites, peritoneal thickening and nodules. These findings may sometimes point towards the diagnosis such as tuberculous abdomen and carcinomatosis peritonei [1-3]. Diagnostic sonography is particularly useful to detect thin septations in ascites and differentiate between clear ascitic fluid and fluid with internal echoes that usually reflects exudative fluid [4]. Haemorrhagic ascites is seen as high density peritoneal collection on computed tomography. However, fluid with high protein content displays a similar appearance [5].

Thorough evaluation of the peritoneal cavity with high resolution probe on diagnostic sonography can demonstrate peritoneal nodules as reliably as CECT abdomen, but to detect these minute details there are several limiting factors for diagnostic sonography like obesity and bowel gas. CECT abdomen is useful in these situations to detect peritoneal thickening and nodules. However, lesions less than 5 mm cannot be visualised on both diagnostic sonography and CECT [6].

The two major causes of peritoneal thickening and nodules are abdominal tuberculosis and carcinomatosis peritonei [7]. Institution of early treatment is of utmost importance in abdominal tuberculosis. But the peritoneal fluid culture for tuberculosis bacilli takes six weeks time [8]. Similarly, though a morbid procedure and requires good experience to perform, Hyperthermic Intraperitoneal Chemotherapy (HIPEC) can prolong the life of a patient with carcinomatosis peritonei [9]. So, an accurate diagnosis of the aetiology of peritoneal nodules and thereby the ascites is necessary for both groups of patients with ascites of unknown origin for early diagnosis and proper management [10].

The laparoscopy guided tissue sampling of the peritoneal nodules is the only method available till date to establish the aetiology of the peritoneal nodules. But this method is invasive and the patient's general condition must be reasonably good to receive general anaesthesia. The non invasive diagnostic modalities like diagnostic ultrasonography and CECT abdomen have till been used only to find out the peritoneal pathology and assist in guided tissue sampling, but did not make any attempts to establish the aetiology of the ascites based on the characteristics of peritoneal pathology on imaging itself [11,12]. So, this study aimed to evaluate the diagnostic value of peritoneal nodules detected on CECT abdomen in the management of ascites of unknown origin.

MATERIALS AND METHODS

This was a retrospective study conducted at Katuri Medical College and Hospital, Guntur, Andhra Pradesh, India after taking the approval from Institutional Review Board (IEC/006/2021). The data was collected from the medical records of patients between January 2019 to January 2021.

The patients included in this study had been vainly investigated for the cause of ascites on routine clinical examination, laboratory and imaging investigations but found to have only peritoneal thickening, nodules on CECT abdomen and later underwent tissue diagnosis of the nodules through laparoscopy. Sample size required for the study was 61 for 90% sensitivity and 50 for 92% sensitivity.

Inclusion criteria: Patients with ascites of unknown origin, who showed peritoneal nodules on CECT abdomen and later underwent tissue diagnosis through laparoscopy were included in the study.

Exclusion criteria: The patients who showed peritoneal pathology on CECT abdomen but did not undergo laparoscopic tissue diagnosis and the patients who underwent tissue sampling but the eventual histopathology report came as inclusive were excluded from the study.

In the study institution, triple phase CECT abdomen is conducted with GE 16 Multidetector Computed Tomography (MDCT) and Nemoto CT Pressure injector with Iohexol i.v. contrast. Patients are usually given 750 to 1000 mL of plain water orally 30 minutes before performing CECT abdomen. Triple phase CECT abdomen is performed at 20 seconds, 35 seconds and 70 seconds after administration of 100 mL i.v. contrast. Retro-reconstructed and multiplanar images are studied on the work station for documenting, apart from other findings, the characteristics of peritoneal pathology, sizes of the nodules and the distribution of pathology.

Likewise, the diagnostic laparoscopy procedures are usually performed with Stryker 5 mm laparoscopy under standard general anaesthesia with endotracheal tube intubation and intermittent positive pressure ventilation. Before conducting tissue sampling of the peritoneal pathology, surgeons visually diagnose tuberculosis when the peritoneal nodules are small (less than 5 mm) and uniform in size and carcinomatosis peritonei when the peritoneal nodules are more than one cm and variable in size. For present study, the study variables sizes of peritoneal nodules and distribution of peritoneal pathology were collected from patients' medical records and compared with histopathology findings.

STATISTICAL ANALYSIS

SPSS software version 25.0 was used for Statistical analysis and plotting of ROC curve to measure sensitivity and specificity.

RESULTS

The eventual tissue diagnosis after laparoscopic guided tissue sampling is demonstrated in [Table/Fig-1]. Mean age of the patients was 48 years (22 to 74 years); and 36 male and 16 female patients were included in this study. Of the 52 patients, 46 cases were found to have carcinomatosis peritonei (88.5%) and six cases have tuberculosis abdomen (11.5%). Carcinomatosis peritonei developed from adenocarcinoma in 39 cases (84.78%), epithelial ovarian carcinoma in six cases (13.04%) and peritoneal mesothelioma in one case (2.17%). The patient with mesothelioma had a history of asbestos exposure in a quarry for over 20 years. Out of the six cases of tuberculosis abdomen proved on tissue diagnosis, only two cases yielded positive results on culture of ascites fluid.

Varibles	N	Tuberculosis	Carcinomatosis peritonei		
			Epithelial ovarian carcinoma	Adenocarcinoma	Mesothelioma
Gender					
Male	36	4	0	31	1
Female	16	2	6	8	0
Color of the fluid					
Clear	19	3	1	14	1
Turbid	27	1	4	22	0
Haemorrhagic	6	2	1	3	0
CECT findings					
Lymph nodes	12	4	2	6	0
Omental cake	5	2	1	2	0
Septations	4	3	1	0	0
Peritoneal nodules alone	40	5	2	33	0
Peritoneal nodules and thickening	12	1	4	6	1

[Table/Fig-1]: Comprehensive table showing demographic, CECT abdomen, laparoscopic and histopathology findings.

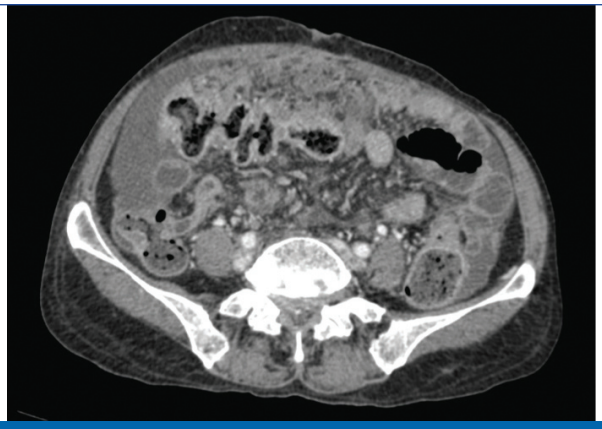
The present study also evaluated the diagnostic value of peritoneal pathology on the basis of peritoneal nodules alone and peritoneal nodules along with thickening and distribution of nodules in the upper and lower abdomen with the bifurcation of aorta as the arbitrary demarcation between upper and lower abdomen [Table/Fig-2].

Distribution of peritoneal nodules and thickening				
Peritoneal pathology	Laparoscopic tissue diagnosis	Upper abdomen	Lower abdomen	Diffuse
Peritoneal nodules alone	Tuberculosis	4	1	0
	Epithelial ovarian carcinoma	0	1	1
	Adenocarcinoma	23	1	9
	Mesothelioma	0	0	0
Peritoneal nodules and thickening	Tuberculosis	1	0	0
	Epithelial ovarian carcinoma	0	3	1
	Adenocarcinoma	4	0	2
	Mesothelioma	0	0	1

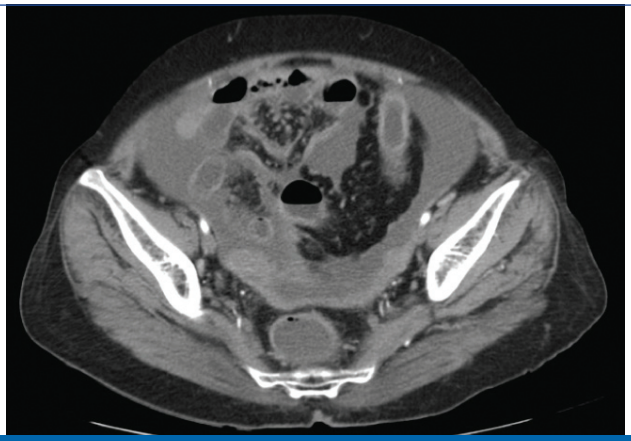
[Table/Fig-2]: Comparison of distribution of peritoneal pathology with the histopathology findings.

Among the carcinomatosis peritonei cases, adenocarcinoma cases showed predominantly peritoneal nodules alone (33 out of 39 cases i.e., 84.6%) with upper abdominal distribution of nodules (27 out of 39 cases i.e., 70%) [Table/Fig-3] whereas, epithelial ovarian carcinoma cases showed peritoneal nodules along with thickening (four out of six cases i.e., 66.6%) and lower abdominal distribution (four out of six i.e., 66.6%) [Table/Fig-4,5].

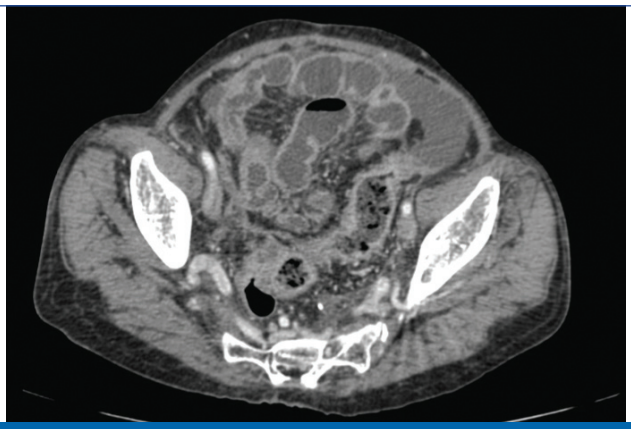
Nodules more than one cm in size on CECT abdomen showed a sensitivity of 73% and a specificity of 100% for carcinomatosis peritonei, and nodules less than five mm showed a sensitivity of 83% and a specificity of 93% for tuberculosis. If authors consider all nodules more than five mm as carcinomatosis peritonei the sensitivity would be 93% but specificity is 83% as demonstrated in ROC curve in [Table/Fig-6]. Comparison of the sizes of peritoneal nodules with the histopathology findings is shown in [Table/Fig-7]. Based on the tissue diagnosis of the peritoneal nodules these patients were treated with antituberculosis drugs for tuberculous abdomen and chemotherapy for carcinomatosis peritonei.



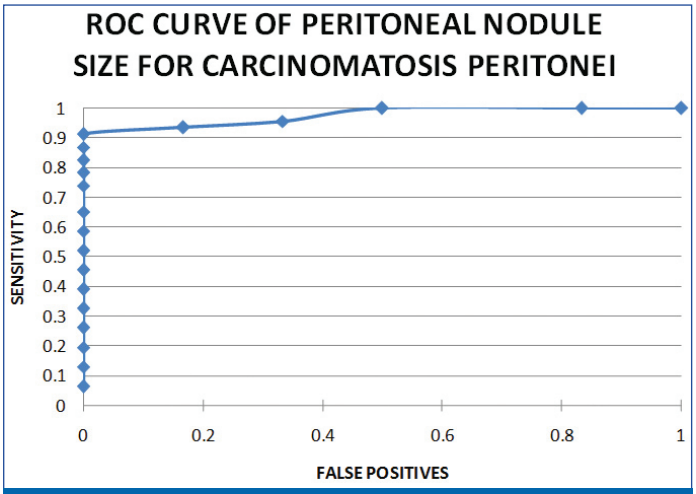
[Table/Fig-3]: Carcinomatosis peritonei in a 56-year-old male with adenocarcinoma. Axial CECT Abdomen image demonstrates omental caking, visceral peritoneal implants over transverse colon and parietal peritoneal implants in the left paracolic gutter.



[Table/Fig-4]: Axial CECT Abdomen image of a 42-year-old woman with epithelial ovarian cancer shows peritoneal nodules and thickening of pelvic peritoneum.



[Table/Fig-5]: Peritoneal implants in a 60-year-old woman with epithelial ovarian cancer. Axial CECT Abdomen image shows peritoneal implants on sigmoid colon.



[Table/Fig-6]: ROC curve of peritoneal nodule size and carcinomatosis peritonei.

Peritoneal nodule size	Tuberculosis abdomen	Carcinomatosis peritonei
<5 mm	5	3
6 to 10 mm	1	9
>10 mm	0	34

[Table/Fig-7]: Comparison of the sizes peritoneal nodules with the histopathology findings.

DISCUSSION

Diagnostic sonography and CECT abdomen in ascites of unknown origin cases sometimes reveal useful findings to diagnose the aetiology of ascites. One such finding is peritoneal thickening and nodules caused by tuberculosis abdomen and carcinomatosis peritonei. Of the 52 patients with peritoneal thickening and nodules included in the study, only six patients were found to have tuberculosis abdomen. Though tuberculosis is endemic in India, only 11.5% of patients had tuberculosis abdomen. One possible reason is that tuberculous peritoneal nodules are usually less than five mm and cannot always be depicted on CECT abdomen [6]. The present study also revealed that a peritoneal nodule of size less than five mm as the criteria for tuberculous nodule had reliable sensitivity and specificity. This finding adds further sensitivity and specificity for peritoneal thickening and nodules detected on CECT abdomen for the prediction of carcinomatosis peritonei as the CECT can readily depict the nodule size more than five mm.

Carcinomatosis peritonei results from the dissemination of primary tumor to peritoneum in four routes, haematogenous route, contiguous spread, lymphatic spread and peritoneal surface spread [13,14,15,16]. This study also demonstrated that the most common cause of ascites of unknown origin with peritoneal pathology on CECT abdomen was adenocarcinoma (75% of total cases and 84.78% of carcinomatosis peritonei cases). Though peritoneal deposits are common in epithelial ovarian carcinomas, the present study demonstrated only six cases (11.5% of total cases and 13% of carcinomatosis peritonei cases). One possible reason is epithelial ovarian carcinomas are readily depicted on imaging investigations. So, only occult epithelial ovarian carcinomas with peritoneal deposits would present with ascites of unknown origin.

To the best of our knowledge this is the first study that tried to demonstrate the diagnostic value of peritoneal thickening and nodules in ascites of unknown origin. Therefore, the results of the present study are compared with earlier series of studies that evaluated ascites of unknown origin in general. Han CM et al., in a retrospective study demonstrated that 31 cases out of 176 had tuberculosis abdomen (17.6%) and 99 cases had carcinomatosis peritonei (56.2%). Out of these 99 cases 79 were adenocarcinomatous deposits (80%) [1]. Rana SS et al., evaluated the usefulness of endoscopic ultrasound guided Fine Needle Aspiration (FNA) of peritoneal nodules in 12 patients with ascites of unknown origin. Histopathology revealed that six patients had carcinomatosis peritonei and four out of these six cases were adenocarcinomatous deposits (66.6%). Though four cases out of the 12 were due to inflammatory aetiology only two cases were found to have tuberculosis (16.6%) [2].

Incidence of adenocarcinoma in the present study correlated with the above two studies. However, both the studies did not report any ovarian malignancies and the present study did not report any pseudomyxoma peritonei and lymphoma cases. Charoensak A et al., in a retrospective study reported that the peritoneal nodules were usually greater than one cm size in carcinomatosis peritonei cases compared to tuberculosis abdomen [3].

Limitation(s)

Only the cases that showed peritoneal pathology on CECT abdomen were followed through the histopathology findings. Authors did not know the outcome of the patients who did not show peritoneal pathology on CECT abdomen and yet underwent laparoscopic tissue diagnosis.

CONCLUSION(S)

This retrospective study demonstrates that peritoneal thickening and nodules visualised on CECT abdomen have reliable diagnostic value in guiding the clinician for further management of ascites of unknown origin.

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