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ORIGINAL ARTICLE

ROLE OF COMPUTED TOMOGRAPHY IN EVALUATION OF ASCITES

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ABSTRACT: Ascites result from variety of medical & surgical causes, and ultrasonography (US) or computed tomography (CT) of abdomen is advisable for its detection, and the different CT signs depend on amount and distribution of fluid. **OBJECTIVES:** To evaluate ascitic fluid collections, their etiologies in relation to CT scan findings, evaluating the role of CT scan to differentiate ascites from other space-occupying masses and to evaluate the role of CT scan in determining the etiology of ascites of unknown origin. **MATERIAL AND METHODS:** Hundred patients with an age range of 18-88 years had ascites, been referred for CT scan of abdomen as a further diagnostic step to confirm &identify the possible underlying cause of ascites. Abdominal CT scan had been done using 6mm slice thickness (oral diluted gastrografin 1.5-2hrs prior to examination) & two sets of CT examinations had been done with 350mg/ml IV omnipaque (in indicated patients only) or without contrast. Results: 100 patients with ascites underwent CT scan. The study showed that CT was very sensitive in detection of ascites, with sensitivity of 100% and the different signs of ascites on CT images depended on the amount of ascetic fluid producing either (early) or (late) signs. The frequency of the underlying causes of ascites was- 54% cases of neoplasm, 17% liver cirrhosis, 14% acute pancreatitis, 6% abdominal tuberculosis, 5% intestinal obstruction and 4% chronic renal failure. **DISCUSSION:** Associated organ involvement was seen in 98 cases (98%). Isolated Ascites was seen in 2 cases (2%). **CONCLUSION:** CT was very sensitive in detection of ascites, and most useful in identifying the underlying cause of it, but still some of the patients require further investigative steps.
KEYWORDS: Ascites; etiology; Computed Tomography.

INTRODUCTION: The normal peritoneal cavity contains only a small amount of serous fluid for lubrication is less than 100ml. Free fluid accumulation exceeding this amount is considered to be ascites.[1] Ascitic fluid is common in many pathological conditions, ranging from abnormal cardiogenic and metabolic states to inflammatory processes and neoplasm. It is associated with changes in the splanchnic and systemic circulation, and with renal abnormalities.[2] In many of these pathological conditions, ascites represent a late manifestation and/or complication of the disease while in others it represents one of the earliest manifestations of the pathophysiology involved. Ascites may be the primary reason for the patient's having sought medical help and its detection and evaluation is an important feature of the diagnostic workup.[3] Ascitic fluid is traditionally characterized as either transudative which is thin, low protein count and low specific gravity or exudative which is high protein count and specific gravity.[4] Causes of ascites are Portal hypertension- Cirrhosis Fulminant hepatic failure, Hepatic out flow obstruction, Congestive heart failure, Constrictive / restrictive cardiomyopathy, Budd-chiari syndrome- hepatic vein and / or inferior vena cava occlusion, Veno-occlusive diseases, Portal vein occlusion, Malignancy-Secondary carcinomatosis from ovary, stomach, colon commonly, and less commonly from pancreas, uterus and urinary bladder.

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AIMS AND OBJECTIVES:

1. Evaluate ascitic fluid collections, their etiologies in relation to CT scan findings.
2. Evaluating the role of CT scans to differentiate ascites from other space-occupying masses.
3. Evaluating the role of CT scan in determining the etiology of ascites of unknown origin.

MATERIAL AND METHOD: One hundred patients presenting with ascites were included into the study. Case selection comprised of all age groups, referred from Guru Nanak Dev Hospital Govt. Medical College, Amritsar. Exclusion criteria include patients having a history of hypersensitivity reaction to intravenous contrast agent and pregnant females.

After taking informed consent from the patient, an examination was carried out in all the patients on Philips brilliance 190P, Dunlee 6-slice whole body CT scanner after giving oral and intravenous contrast as and when required.

RESULTS: The most frequent age group was 40-59 yrs (46%) followed by above 60yr (31%), 20-39 yr (21%) group, <19 yr group (2%) of the cases. Males presented more commonly with 61 (61%) cases as compared to females with 39 (39%) cases. The male to female ratio was 1.56. Malignancy was found in 54 cases (54%) - Colorectal carcinoma was seen in 24 cases (24%), adnexal malignancies in 21 cases (21%). Gastric carcinoma in 5 cases (5%). Hepatocellular carcinoma in 4 cases (4%). Acute abdomen in 25 cases (25%), acute pancreatitis in 14 cases (14%), tuberculosis in 6 cases (6%), acute intestinal obstruction in 5 cases (5%), liver cirrhosis in 17 cases (17%), chronic renal failure in 4 cases (4%). Isolated Ascites was seen in 2 cases (2%). Ascites was seen more commonly in subdiaphragmatic location in 89 cases (89%) Sub hepatic in 86 cases (86%), Morrison's Pouch in 85 cases (85%), Paracolic gutter in 78 cases (78%), Pelvis in 64 cases (64%), Lesser sac in 11cases (11%), Interloop in 15 cases (15%). Higher attenuation fluid of 20-30 HU was seen in 79 cases (79%), lower attenuation fluid with 5-15 HU is seen in 21 cases (21%). Hemorrhagic ascites was seen in 1 case (1%). Generalized ascites was seen in 35 cases, loculated ascites in 16 cases. Septations were seen in 10 cases (Table I).

Hepatomegaly seen in 28 cases (28%), small shrunken liver in 17 cases (17%), smoothly marginated liver in 19 cases (19%), nodular marginated liver in 17 cases (17%), heterogeneous attenuation in 19 cases (19%), homogenous attenuation in 16 cases (16%), necrosis in hepatic masses in 10 cases (10%), calcification in 10 cases (10%). Retroperitoneal lymphadenopathy was seen in 2 cases (2%). Associated pleural effusion was seen in 1 cases (1%). Enlarged adnexa was seen was seen in 21 cases (21%). Unilateral involvement was seen in 14 cases (14%), bilateral involvement in 7 cases (7%), cystic appearance in 14 cases (14%), mixed cystic and solid appearances in 7 cases (7%), solid appearance in 1 case (1%), calcification in 10 cases (10%), fat attenuation in 7 cases (7%), necrosis in 5 cases (5%), liver metastasis in 6 cases (6%). Stomach wall thickness >20mm was seen in 5 cases (5%), colorectal wall thickness >20mm in 24 cases (24%) and <20mm in 11 cases (11%), necrosis in 4 cases (4%), perilesional fat stranding in 20 cases (20%), liver metastasis in 9 cases, retroperitoneal lymphadenopathy in 10 cases (10%), peritoneal carcinomatosis in 10 cases (10%), pneumoperitoneum in 5 cases (5%), transition zone in 5 cases (5%). In cases with pancreatic involvement, its enlargement was seen in 13 cases (13%), normal in 1 case (1%). heterogeneous in 14 cases (14%), necrosis in 8 cases (8%), calcification in 1 case (1%), peripancreatic inflammation in 8 cases (8%), associated pleural effusion in 1 case (1%). The most

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common early sign is presence of round central density in pelvis and ill-defined bladder top (20% cases), followed by thickening of peritoneal flank stripe (12% cases), space between peritoneal fat and gut >3mm (3%). Medial displacement of ascending and descending colon is the most common late sign (70%), followed by medial displacement of lateral liver margin (Hellemer sign) (70%), Obliteration of hepatic and splenic angles (55%) and floating centralized loops (25%), bulging flanks and gray abdomen 20% of cases each, separation of the loop in 15% cases (Table II). Clinical examination has 85% sensitivity and 100% specificity. CT scan has 100% sensitivity and 100% specificity. Thus proving CT scan to be a better modality to detect ascites than clinical examination (Table III).

DISCUSSION: The age range of the patients was between 18 to 88 years. The mean age was 51yr. The majority of patients (77%) were over 40 years of age. The maximum age preponderance was noted in the 40-59 years age group (46%), followed by age group was >60 (31%) and 20-40 (21%). This corroborates with the Ahmmad et al, in which most of the patients were also within the same age group (40-59years) with 46.6% of the cases and second most common age group was >60yr.[5] This is probably because the most common cause of ascites detected was malignancy which showed a high incidence in this age group.

61 cases (61%) were males and 39 cases (39%) were females. Males outnumbered females by a ratio of 1.56:1. This correlates well with Ahmmad et al where 60.4 % cases were males and 39.6 % were females and the male: female ratio was 1.52.[5]

AAG ratio <1.1 is seen in 79 cases (79%), in patients with malignancy, tuberculosis, acute pancreatitis and obstruction. SAAG ratio >1.1 is seen in 21 cases (21%) suggestive of transudative ascites, in patients with cirrhosis and CRF patients. Elevated CA-125 levels are seen in 17 cases (17%), seen in patients with adnexal pathologies.

Provisional clinical diagnosis was made in 86 cases. No probable clinical diagnosis was made in 14 cases (14%). On pathological follow up of the patients after CT scans, Colorectal carcinoma was confirmed in 24 cases (24%), ovarian malignancies in 21 cases (21%), gastric carcinoma in 5 cases (5%), hepatic carcinoma in 4 cases (4%), which were consistent with the possible etiology suggested on CT scan. CT scan was able to find the etiology of ascites in 14 cases in which no possible clinical diagnosis was made. Not only this, CT scan was able to demonstrate the underlying etiology in 9 cases of acute abdomen, in which acute pancreatitis was seen in 2 cases, acute obstruction with perforation in 1 case and Ileocaecal tuberculosis in 6 cases. Hence it proves the importance of CT scan not only to confirm the presence of ascites but also to find the underlying etiology also.

In this study, ascites with other organ involvement was seen in 98 cases (98%) while isolated ascites was seen in 2 cases (2%). Ascites was seen more commonly in sub diaphragmatic location in 89 cases (89%). This is probably because of the negative pressure beneath the diaphragm that pulls the fluid beneath the diaphragm. This is followed by accumulation of ascites in Sub hepatic location in 86 cases (86%), in Morrison's Pouch in 85 cases (85%), in Paracolic gutters in 78 cases (78%) in Pelvis in 64 cases (64%). Haaga et al states that in early ascites, when the fluid is free moving and small in amount, it localizes in the cul de-sac or pericolic gutters or the subhepatic space. Gravity causes the fluid to collect in the pelvis or the right subhepatic space.[6] Fluid was seen in Interloop location in 15 cases (15%), in the lesser sac in 11cases (11%).

Higher attenuation fluid of 20-30 HU were seen in 79 cases (79%) mainly in malignancy, tuberculosis, acute pancreatitis and obstruction patients. These patients also showed SAAG ratio <1. 1 suggestive of Exudative ascites. Lower attenuation fluid with 5-15 HU is seen in 21 cases (21%) of cirrhosis and renal failure patients. These patients also show SAAG ratio >1.1 suggestive of transudative fluid. This might suggest a possible relation between attenuation value and the nature of the fluid. Higher attenuation fluid is seen commonly with exudative fluid and lower attenuation seen with transudative fluid. Septations were seen in 10 cases. They were seen in tuberculous and perforated peritonitis patients.

The most common early sign was round central density in the pelvis with ill-defined bladder top, which was seen in 20% of the cases followed by thickening of peritoneal flank strip in 12 cases (12%), more than a 3mm space between peritoneal fat and gut in 3 cases (3%). The most common late sign seen in ascites was a medial displacement of ascending and descending colon seen in 71 cases (71%). It is also the most common sign seen in ascites. The next most common sign seen within this study was a medial displacement of lateral liver margin also known as Hellmer's sign seen in 70 cases (70%). Obliteration of hepatic and splenic angles and floating centralized loops were seen in 55 and 25 cases, respectively (55% and 25% respectively). Bulging flanks and gray abdomen seen in 20 cases each (20% each). They also showed that separation of the loop was the least common sign seen with about 13.6% of the cases. The probable reason why late signs were seen more commonly was because that most of the referred cases has moderate to severe ascites which was diagnosed clinically or by ultrasound, where a CT scan of the abdomen was requested to identify the underlying cause.

In our study, comparison of sensitivity and specificity of clinical examination and CT scan for detection of ascites was done. Clinical examination has 85% sensitivity and 100% specificity. CT scan has 100% sensitivity and 100% specificity. This agrees with Cattau et al where they concluded that the sensitivity & specificity of the physical examination maneuvers ranged from 50% -94% and 29% - 82%, respectively.[7] They also concluded that routine physical examination had limitations in the precise diagnosis of equivocal ascites. Thus proving CT scan to be a better modality to detect ascites than clinical examination.

CONCLUSIONS: We assessed and evaluated ascites patients and found that CT is useful in finding the underlying cause of ascites and associated features in multiple ways, including the adjacent vital structures involved, other complications like para-aortic lymphadenopathy, pleural effusion and predicting the outcome.

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CT FINDINGS	NO. OF CASES	PERCENTAGE
1. Location		
- Sub diaphragmatic	89	89
- Sub hepatic	86	86
- Morrison's Pouch	85	85
- Paracolic gutter	78	78
- Pelvis	64	64
- Interloop	15	15
- Lesser sac	11	11
2. Attenuation		
- 20-30 HU	79	79
- 5-19 HU	21	21
- Hemorrhagic	1	1
3. Generalized	35	35
4. Loculated	16	16
5. Septations	10	10

TABLE 1: Showing CT findings in ascites (n=100)

CT SIGNS	NO. OF CASES	PERCENTAGE
Early Signs:		
- Round central density in the pelvis + ill-defined bladder top	20	20
-Thickening of the peritoneal flank stripe	12	12
- Space between peritoneal fat and gut > 3mm	3	3
Late signs:		
-Hellmer sign (medial displacement of lateral liver margin)	70	70
- Obliteration of hepatic and splenic angles	55	55
-Floating centralized loops	25	25
-Bulging flanks	20	20
-Gray abdomen	20	20

TABLE 2: Showing diagnostic signs of ascites on CT (n=100)

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No. of Ascites patients detected clinically			No. of Ascites patients detected on CT Scan		
No. of cases	**Sensitivity**	**Specificity**	**No. of cases**	**Sensitivity**	**Specificity**
85	85%	100%	100	100%	100%

TABLE 3: Showing comparison of sensitivity and specificity of clinical examination and CT scan for ascites detection (n=100)

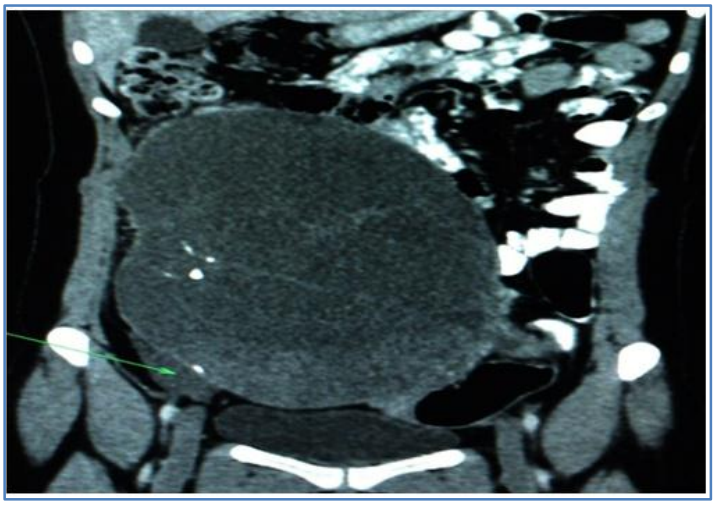

Fig. 1: Ovarian Carcinoma. Right adnexal mass associated with ascites (arrow)

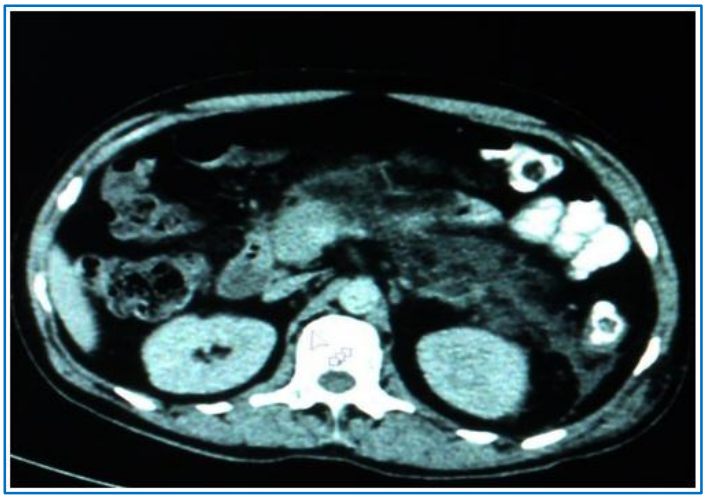

Fig. 2: Acute Pancreatitis. Enlarged and heterogeneous pancreas with Peripancreatic fluid collection

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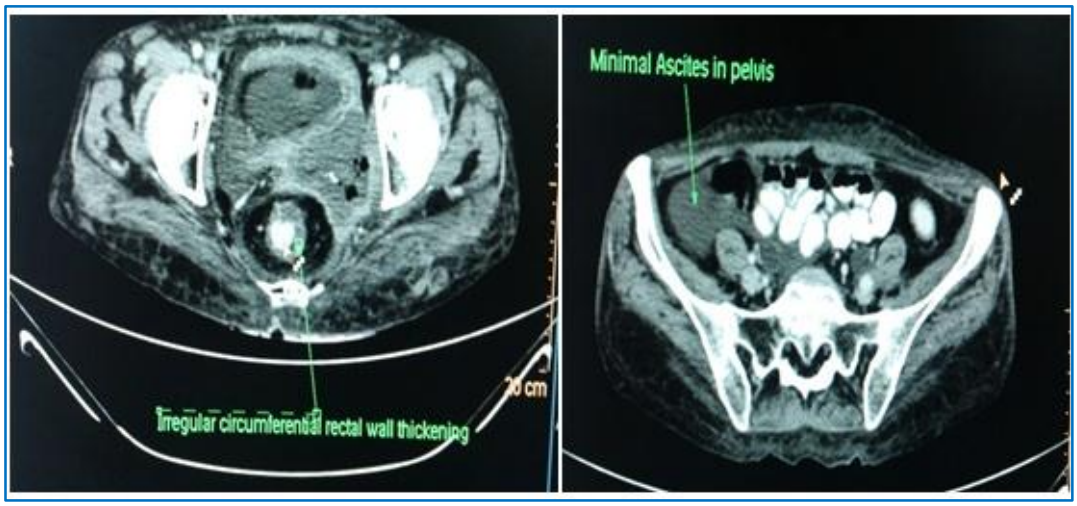

Fig. 3a & 3b: Colon Carcinoma. Irregular wall thickening of the rectum. Minimal ascites is seen in the pelvis

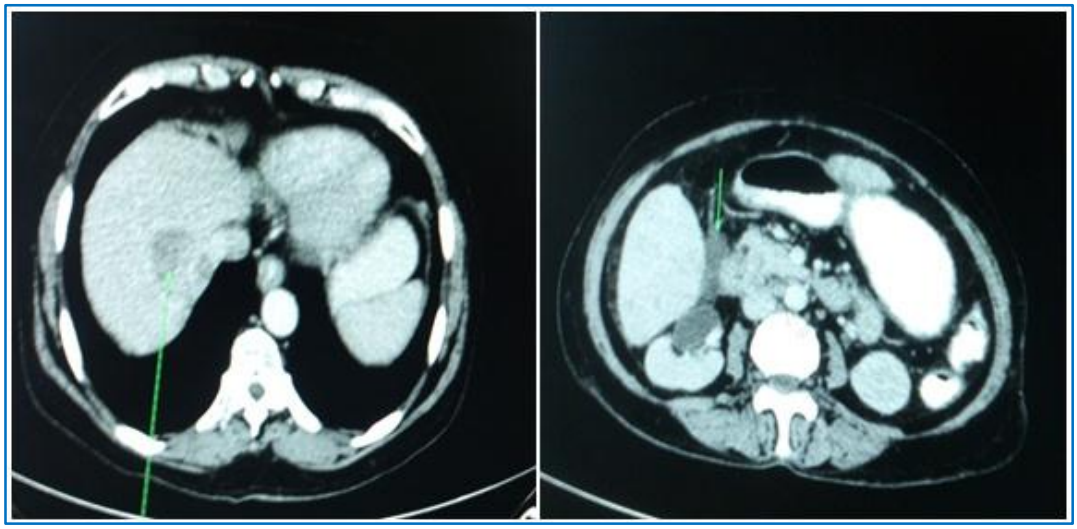

Fig. 4a & 4b: Hepatocellular carcinoma. Hypodense lesion suggestive of HCC in liver (arrow). Ascites in subhepatic location associated with the HCC in precious Figure, marked with arrow

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