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ROLE OF COMPUTED TOMOGRAPHY IN EVALUATION OF PARENCHYMAL FOCAL LESIONS OF LIVER

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ABSTRACT: BACKGROUND: Of the various pathologies that afflict the liver, liver masses form an important group. Computed tomography (CT) is the imaging modality most often used to evaluate focal liver lesions. **OBJECTIVE:** To characterize focal hepatic lesions using multi detector computed tomogram (MDCT) and determines its sensitivity and specificity in diagnosing various lesions. **MATERIALS AND METHODS:** The study was conducted on hundred patients in the Department of Radiodiagnosis and Imaging, Government Medical College, Amritsar from August 2012 to October 2014. Patients with clinical symptoms, laboratory finding referable to the hepato-biliary system, palpable right upper quadrant mass or incidentally detected liver masses with ultrasound or CT were included in the study. The MDCT findings were correlated with serology, histopathology, surgical findings or with therapeutic response in 75 out of 100 patients. Sensitivity and specificity of CT scan in diagnosing and characterizing focal hepatic lesions was then calculated. **RESULTS:** Out of 100 patients, 64(64%) patients had benign and 36(36%) had malignant lesions. On later histopathological or serological correlation, definite diagnosis was made in 75 cases. The sensitivity and specificity of multidetector CT scan for the detection and characterization of amebic abscess, pyogenic abscesses, hydatid cyst, primary hepatic malignancies and metastasis was 94.7% and 96.4%, 80% and 98.3%, 100% and 100%, 87.5% and 98.5%, 100% and 98% respectively. Thus, in the present study, sensitivity of MDCT in diagnosing focal hepatic lesions was found to be between 80-100% and specificity to be between 96.4–100%. **CONCLUSIONS:** MDCT is a highly sensitive noninvasive tool for detection and characterization of focal hepatic lesions.
KEYWORDS: Hepatic lesions, multidetector CT scan, radiology.

INTRODUCTION: Of the various pathologies that afflict the liver, liver masses form an important group. Hepatic masses are increasingly being identified due to the widespread use of imaging modalities. These include X-rays, arteriography, radionuclide scanning, ultrasound and, since the 1970s, computed tomography (CT) and magnetic resonance imaging (MRI).[1]

Liver lesions are not visible in a conventional radiograph unless calcified. Ultra sonogram (USG) is most often used as the initial mode of investigation to assess liver lesions. However, often the definitive diagnosis is not based on gray-scale information alone and a mass detected on ultrasound is generally evaluated further with contrast-enhanced CT (CECT) or MRI for definitive characterization.[2]

CT offers the advantage of characterization and provides important preoperative information. Although current literature search shows that MRI has a comparable rate in detection and classification of focal liver lesions, however, rapid availability and short scanning time has made CT an ideal imaging technique.

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Multi–detector row helical CT (MDCT) is rapidly evolving technique that significantly improves CT images for several indications including depiction of focal liver lesion. Multi–detector row helical CT scanners have the ability to scan through the entire liver in ten seconds or less and this allows acquisition of both an early and late arterial set of hepatic images.

Although histopathology is the gold standard, biopsy is always not possible as it is an invasive technique.[3]

In India, where the cost and accessibility are the prime factors in determining the modality to be used for diagnostic purposes, MDCT has become the mainstay for diagnosis of hepatic lesions. In this study, we investigated the role of CT in evaluation of parenchymal focal hepatic lesions and determine its sensitivity and specificity in diagnosing various lesions.

MATERIAL AND METHODS: The present study was conducted on hundred patients in the Department of Radiodiagnosis and Imaging, Government Medical College, Amritsar from August 2012 to October 2014 after Institute Ethics Committee approval and written informed consent. Patients with clinical symptoms, laboratory findings referable to the hepato-biliary system, palpable right upper quadrant mass or incidentally detected liver masses with ultrasound or CT were included in the study. Pregnant females, patients with trauma and/or contrast allergy were excluded from the study.

History, clinical examination and laboratory findings were recorded and each patient was subjected to multislice CT examination of the abdomen using Philips brilliance 190P, Dunlee 6-slice whole body Computed tomography scanner at 120 kvp and 200-250 mAs. Patients were given oral and intravenous contrast. Patient preparation included administration of 2000 ml of water/gastrograffin 60-90 minutes prior to the examination used as oral contrast.

For intravenous contrast, 2 milliliter/kilogram (mL/kg) (350 milligram/mL iodine) of iohexol (Omnipaque) was injected at a rate of 2–3 mL/sec. The scan delay was typically 50 seconds, with a section thickness of 5 mm and a pitch of 0.7. Reconstructions were performed at 5-mm intervals.

The axial scans along with coronal and sagittal reformatting were done as and when required. The scans were then systematically analyzed for focal hepatic lesion location, size, number, margin, density, calcification, necrosis, contrast enhancement and other associated findings. Attenuation values were obtained on plain as well as contrast enhanced scans. Role of CT was studied in detection and characterization of the lesions.

Radiological diagnosis was confirmed with aspiration and cytology, surgery followed by the histopathologic examination, serology or with therapeutic response depending on the individual case. The CT scan findings were then correlated with cytological or surgical or histopathological diagnosis. Sensitivity and specificity of CT scan in diagnosing and characterizing focal hepatic lesions was then calculated.

RESULTS: Hundred patients participated in the study. In the present study, peak incidence was observed in the age group of 41-50 years (31%). The mean age was 43.8 years. 59 cases (59%) were males and 41 cases (41%) were females. The presenting symptoms were pain abdomen (63%) followed by loss of appetite (41%), weight loss (39%), fever (32%), progressive abdominal distension (22%), jaundice (17%) and bowel symptoms such as constipation, anorexia and nausea seen in 8% of cases. On clinical examination, hepatomegaly was seen in 56% patients followed by

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abdominal tenderness (48%), fever (32%), icterus (17%). Mass per abdomen was palpable in only 7% of the patients. Anaemia and raised serum glutamic oxaloacetic transaminase (SGOT) were observed in 39 % and 34 % of the patients respectively (Table 1).

Benign hepatic lesions accounted for 64 % of the cases and 36% were malignant, based on CT findings (Table 2). In case of benign hepatic lesions (n=64), segment V was involved in 26.56% patients. Right lobe involvement was seen in 73.84% cases of benign hepatic lesions. 42.18% lesions were within 1–5 cms in size. Majority of benign lesions were well defined (87.5%) and hypodense (64.06%). Peripheral enhancement on contrast administration was noticed in 56.25% cases. Ascites was associated finding in 14.06 % of the cases (Table 3).

Whereas amongst the malignant lesions (n=36), segment VIII was most commonly involved (47.22%). Both lobes were involved in 69.44% of the malignant hepatic lesions. Majority (61.11%) were 5–10 cms in size. Ill-defined margins and hypodense lesions were the hallmark in malignant hepatic masses (77.77% cases). 50% malignant lesions enhanced heterogeneously on contrast studies. Ascites (86.11 %) and abdominal lymphadenopathy (75%) were the common associated features in an event of malignancy (Table 4).

Pyogenic liver abscess (31.25%), amebic liver abscess (20.31%), simple hepatic cyst (18.75%), hemangiomas (17.18%) and hydatid cysts (12.5%) were in decreasing order of frequency, the probable diagnosis of the benign hepatic lesions (n=64) (Table 5).

Metastases were the most common malignant hepatic lesions accounting for 72.22% (26 cases). Most commonly seen were the metastases from gall bladder, lung and colon, each accounting for 11.11% (4 cases each) of the malignant hepatic lesions. Rest was cases of primary hepatic malignancies. These included 5 cases (13.88%) of HCC, 3 cases (8.33%) of cholangiocarcinoma and one case each of fibrolamellar carcinoma (2.77%) and hepatoblastoma (2.77%) (Table 6). Radiological-histopathological correlation was done in 75 out of 100 patients (41 cases of benign lesions and 34 cases with provisional diagnosis of a malignant lesion).

Patients with provisional diagnosis of simple hepatic cysts (n=12) and hemangiomas (n=11) did not report to the department for follow up. On CT, out of the 20 cases diagnosed as amebic abscess, 18 cases were confirmed on serology testing. Indirect hemagglutination test was positive in these cases. Rest of the two cases were treated as pyogenic abscesses and showed response to antimicrobial therapy. In 13 cases with the probable diagnosis of pyogenic abscess, fine needle aspiration cytology revealed polymorphonuclear leukocytes and bacteria in 12 cases, confirming the diagnosis. One case, however, was negative for bacterial infection on cytology but revealed motile trophozoites suggesting the diagnosis of amebic abscess. On CT examination, 8 cases were diagnosed as hydatid cyst. The radiological diagnosis was confirmed in all cases based on operative findings or serology. Thus, the sensitivity and specificity of multidetector CT scan for the detection and characterization of amebic abscess, pyogenic abscesses and hydatid cyst was 94.7 % and 96.4%, 80% and 98.3%, 100% and 100%, respectively (Table 7).

Metastases accounted for 72.22% (n=26) of the total malignant hepatic lesions encountered (n=36). On histopathological correlation, 1 case out of these was later on found to be that of pyogenic abscess on aspiration cytology. The most common primaries were from gall bladder, lung and colon (11.11% each).

Rests of the malignant lesions were primary hepatic malignancies. These included 5 cases (13.88%) of HCC, 3 cases (8.33%) of cholangiocarcinoma and one case each of fibrolamellar

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carcinoma (2.77%) and hepatoblastoma (2.77%). Out of 10 cases of primary hepatic malignancies observed in our study, one case each of fibrolamellar carcinoma and hepatocellular carcinoma was lost to follow up. Amongst the rest 8 cases, provisional CT diagnosis was confirmed on histopathology. Only one was misdiagnosed on CT. It was a case of hepatocellular carcinoma which was later diagnosed as focal nodular hyperplasia on histopathology. The sensitivity and specificity of multidetector CT scan for the detection and characterization of primary hepatic malignancies and metastasis was 87.5% and 98.5%, 100% and 98% respectively (Table 7).

Thus, in the present series, CT scan had a sensitivity of 80-100% and specificity of 96.4–100% for detection and characterization of focal hepatic lesions.

DISCUSSION: Multi-detector row Computed Tomography (CT) has, in recent years, evolved as the procedure of choice for the detection and characterization of a large variety of benign and malignant liver lesions. Since, MDCT scanners are widely available in India and worldwide, it is important to understand their performance capabilities for assessment of various focal hepatic lesions. The aim of our study was to determine the role of MDCT in evaluation of focal hepatic lesions and to determine its sensitivity and specificity for the same.

In our study, provisional diagnosis of benign lesion was made in 64 cases, 36 were malignant. In a study by Hanninen et al in Germany, the incidence of malignant and non-malignant lesion was 83.3% and 16.7% cases respectively.[4] The disparity may be reflective of regional differences in the distribution of the disease. It has been previously reported that prevalence of various liver lesions has marked differences across geographic regions and ethnic groups and focal liver lesion is more likely to represent a metastatic deposit than primary malignancy in Europe and United States.[5]

In the randomized study described herein, radiological-histopathological correlation was done in 75 out of 100 patients (41 cases of benign lesions and 34 cases with provisional diagnosis of a malignant lesion). Histopathological correlation confirmed all 41 cases as benign. However, 2 cases of pyogenic abscess were misdiagnosed as amebic abscess and a case of amebic as pyogenic. For the detection and characterization of amebic and pyogenic abscesses, our study recorded a sensitivity of 94.7% and 80% respectively. According to existing literature the sensitivity of CT scan in detection and diagnosis of hepatic abscesses varies from 94–97%.[6,7] Double target sign consisting of a hypodense central area surrounded by a hyperdense ring and then by a hypodense zone, seen in some cases of pyogenic abscess, was not seen in any case of amebic abscess. Mathieu et al, in their study, described pyogenic hepatic abscesses as round to oval areas of low attenuation with well-defined margin seen in 52% and double target sign in 16% cases.[6] Otherwise, no definite distinguishing feature between amebic and pyogenic abscesses could be delineated in our study. Prior studies have acknowledged this limitation as well.[2,8]

In the present study, the hydatid cysts (n=8) appeared as sharply marginated round or oval hypodense masses with a thin rim. Wall calcifications were seen in 87.5% cases. All cases were confirmed on serology. Thus in the present study, CT showed a sensitivity of 100% in diagnosing hydatid cysts. The sensitivity of CT scan in diagnosing hydatid cyst has been reported to be 100% in a study by Tahir et al.[9]

A provisional diagnosis of malignant lesion was made in 36 cases. 34 were confirmed on histopathology. Although high sensitivity (32/33) was noted in our study, we noted 2 false positive cases.

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One case diagnosed as metastasis on CT was later on found to be pyogenic abscess and a case diagnosed as hepatocellular carcinoma (HCC) later on proved to be focal nodular hyperplasia (FNH).

In the present study, HCC was the probable diagnosis in 5 cases. On non-contrast enhanced scans, all the lesions appeared hypodense compared to normal liver parenchyma. Heterogenous enhancement was seen in late arterial and portal venous phase in all the cases and on delayed scans lesions were hypodense to the surrounding liver (washout). However, on histopathology, one case proved to be FNH. The lesion had irregular margins, showed heterogenous contrast enhancement and had no central scar. These features probably led to the misdiagnosis of HCC. The imaging characteristics of focal nodular hyperplasia are varied. Generally, on CECT, they are isodense/ hyperdense to the liver parenchyma in the arterial phase and become hypodense in the late portal venous phase. However, heterogenous enhancement can be seen sometimes. Central scar is seen in 14-43% cases.[10]

The probable diagnosis of three cases in our study was cholangiocarcinoma. The lesions were seen as ill-defined predominantly hypodense masses with areas of necrosis. 2 cases (66.67%) involved the region of hepatic duct bifurcation and 1 case (33.3%) was intrahepatic arising from the peripheral bile duct. Hepatic bile duct dilatation was evident in all the cases. The radiological diagnosis was confirmed on histopathology in all the cases. Thus, CT had a sensitivity of 100% in diagnosing cholangiocarcinomas. Assy and coworkers reported that 60% of cholangiocarcinomas occur at the hepatic duct bifurcation (Klatskin tumor), and the rest in the distal common bile duct (25%) or within the liver (15%). They also reported that CT shows marked intrahepatic duct dilatation.[11]

In this study, metastases were the most common malignant hepatic lesions accounting for 72.22% (26 cases). Most commonly seen were the metastases from gall bladder, lung and colon, each accounting for 11.11% cases (4 cases each) of the malignant hepatic lesions. In a study, it has been previously reported that hepatic metastases represent the most common hepatic malignancy and the most common primary tumors to metastasize to the liver are colon, stomach, breast and lungs.[11]

The CT appearance of majority of the lesions in our study was as multiple ill defined, hypodense lesions scattered in both the lobes of liver. All the hypodense lesions were visualized on portal venous phase in our study.

Certain metastases (e. g., pancreatic islet cell carcinomas, carcinoids, melanomas, pheochromocytomas, choriocarcinomas, and sarcomas) have a proportionately greater hepatic arterial blood supply and, as a result, may be visible only on hepatic arterial phase images. In our study, 7 metastatic lesions were hypervascular (2 cases of metastasis from kidney, 1 case each of metastasis from thyroid, pancreas and breast and 2 cases of unknown primary) and were best visualized on arterial phase images rather than on portovenous phase, as they rapidly became isodense to surrounding normal liver on portal venous phase and delayed scans. Portugaller and colleagues concluded in their study that for tumours likely to seed hypervascular metastasis, hepatic arterial phase scans should be applied in addition to the portal venous scans.[12]

In the present study, a case with provisional diagnosis of metastasis was confirmed on histopathology as a case of pyogenic abscess. This lesion was labeled as malignant because of irregular margins and patient's history of renal cell carcinoma.

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Our study showed specificity of MDCT scan to diagnose primary hepatic malignancies and metastasis to be 98.5 % and 98% respectively. Murcia et al found that CT had a specificity of 98% for diagnosing HCC and that of 93 % in diagnosing metastatic disease.

There are certain limitations in our study like small sample size especially for primary hepatic malignant lesions (n=10). Radiological diagnosis was not confirmed in 25 cases. However, mostly these were cases of simple hepatic cysts (n=12) and hemangiomas (n=11). A case each of HCC and FLC could not be followed up. In cases of multifocal lesion, only biopsy of largest and most approachable lesion was performed. Interobserver agreement for interpretation of CT images was not calculated.

`In summary, in our experience MDCT has a high sensitivity and specificity of 80-100% and 96.4–100% respectively in enabling the detection and characterization of focal hepatic lesions.

CONCLUSION: In recent decades, MDCT has become the mainstay for diagnosis of hepatic lesions because of its ease, availability, cost effectiveness, less time consumption, ability to reveal anatomy of structures, extent of the disease process and most importantly, guiding the surgeons to plan surgery accordingly.

The results of this study indicate MDCT to be highly sensitive in classifying the hepatic lesions into clinically relevant categories, making diagnosis and more so in evaluation of the site and size of lesion, detection of calcification and necrosis within the lesion, presence of regional lymphadenopathy and any other associated finding.

In India, where the cost and accessibility are the prime factors in determining the modality to be used for diagnostic purposes, MDCT imaging has promising prospects.

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	Number	% age
AGE (years) 41-50	31	31
GENDER Male Female	59 41	59 41
CLINICAL PRESENTATION - Abdominal pain - Weight loss - Loss of appetite - Fever - Abdominal distension - Jaundice - Bowel symptoms	63 41 39 32 22 17 8	63 41 39 32 22 17 8
PHYSICAL SIGNS -Hepatomegaly - Abdominal tenderness - Fever - Icterus - Mass per abdomen	56 48 32 17 7	56 48 32 17 7
LABORATORY PARAMETERS - Anaemia - Raised SGOT - Leucocytosis - Raised SGPT - Raised S. Alk. Phos. - Hyperbilirubinemia - Hbs Ag Positive	39 34 32 31 26 17 6	39 34 32 31 26 17 6
TABLE 1: PERTINENT CLINICAL FEATURES		

Category	Total	Percentage (%)
Benign Lesions	**64**	64%
Malignant Lesions	**36**	36%
TABLE 2: Categorical Distribution of focal Hepatic lesions (Total no. of cases = 100)		

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CT findings	No. of cases	Percentage (%)
Site		
- Right lobe	48	75
- Left lobe	6	9.37
- Both lobes	10	15.62
Size (cm)		
- 0 – 1	2	3.12
- 1 – 5	27	42.18
- 5 – 10	26	40.62
- > 10	9	14.06
Margins		
- Well defined	56	87.5
- Ill defined	8	12.5
Attenuation		
- Cystic	20	31.25
- Hypodense	41	64.06
- Hyperdense	2	3.12
- Isodense	1	1.56
Enhancement		
- Heterogenous	3	4.68
- Peripheral	36	56.25
- Septal	6	9.37
- No enhancement	19	29.68
Table 3: CT Characteristics of Benign Focal Hepatic Lesions (Total No. of cases=64)		

CT findings	No. of cases	Percentage (%)
Site		
- right lobe	10	27.77
- left lobe	1	2.77
- both lobes	25	69.44
Size (cm)		
- 0 – 1	-	-
- 1 – 5	13	36.11
- 5 – 10	22	61.11
- > 10	1	2.77
Margins		
- well defined	8	22.22
- ill defined	28	77.77
Attenuation		
- hypodense	28	77.77
- hyperdense	7	19.44
- isodense	1	2.77
Enhancement		
- homogenous	3	8.33
- heterogenous	18	50
- peripheral	9	25
- no enhancement	6	16.66

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Associated findings		
- ascites - abdominal lymphadenopathy - pleural effusion - cirrhosis liver - vascular thrombosis - biliary obstruction - gall bladder calculi - peritoneal deposits	31 27 9 7 5 4 3 1	86.11 75 25 19.44 13.88 11.11 8.33 2.77
TABLE 4: CT Characteristics of Malignant Focal hepatic lesions (Total no. of cases=36)		

Type of Lesions	No. of Cases	Percentage (%)
Amebic Abscesses	20	31.25
Pyogenic abscesses	13	20.31
Simple Hepatic Cyst	12	18.75
Hemangiomas	11	17.18
Hydatid Cyst	8	12.5
TABLE 5: Probable Diagnosis of Benign Hepatic Masses Studied (Total no. of cases = 64)		

Type of Lesions	No. of Cases	Percentage (%)
Metastasis - Gall Bladder Lung Colon Breast Stomach Kidney Ovary Thyroid Pancreas Unknown Primary	26 4 4 4 3 2 2 2 1 1 3	72.22 11.11 11.11 11.11 8.33 5.55 5.55 5.55 2.77 2.77 8.33
Hepatocellular carcinoma (HCC)	5	13.88
Cholangiocarcinoma	3	8.33
Fibrolamellar carcinoma	1	2.77
Hepatoblastoma	1	2.77
TABLE 6: Probable Diagnosis of Malignant Hepatic Masses Studied (Total no. of cases = 36)		

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Diagnosis	Sensitivity (TP/TP+FN)	Specificity (TN/FP+TN)
Amebic Abscesses	94.7% (18/19)	96.4% (54/56)
Pyogenic abscesses	80% (12/15)	98.3% (59/60)
Hydatid Cyst	100% (8/8)	100% (67/67)
Primary hepatic malignancy	87.5% (7/8)	98.5% (66/67)
Metastasis	100% (25/25)	98% (49/50)
TABLE 7: Performance Value of Ct in the Diagnosis of Focal Hepatic Lesions (Total no. of cases = 75)		

Fig. 1: CT scan showing a well-defined round hypodense intrahepatic lesion (10-13 HU) with no wall and no enhancement seen on contrast administration.
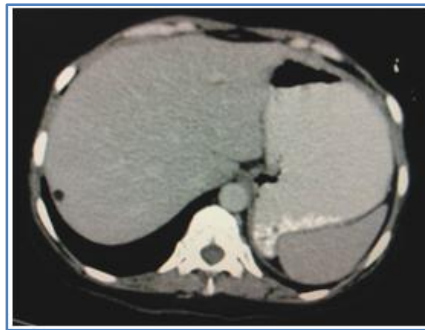
Fig. 1: SIMPLE HEPATIC CYST

Fig 2 (a, b): CT scan showing multiple well defined cystic lesions of varying sizes in both the lobes of liver. Few of them are multilocular with small round 'daughter cysts' at the periphery. Some of the cysts show wall calcifications.
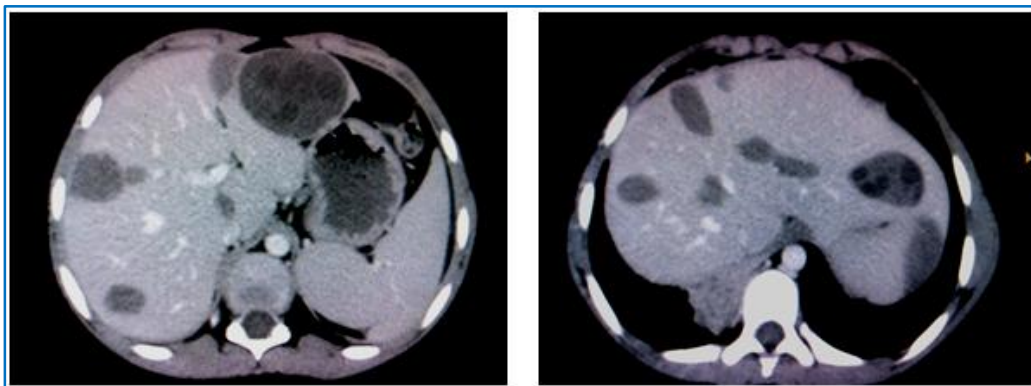

Fig. 2(a & b): HYDATID CYST

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Fig. 3: Axial CT scan image show a large oval hypoattenuating lesion (32-36 HU) with few cystic areas (14-17 HU) and perilesional oedema in the right lobe of liver.

Fig. 3: AMOEBIC ABSCESS

Fig. 4 (a, b): Multiple well defined round to oval hypodense lesions with double target sign seen in the right lobe of liver.
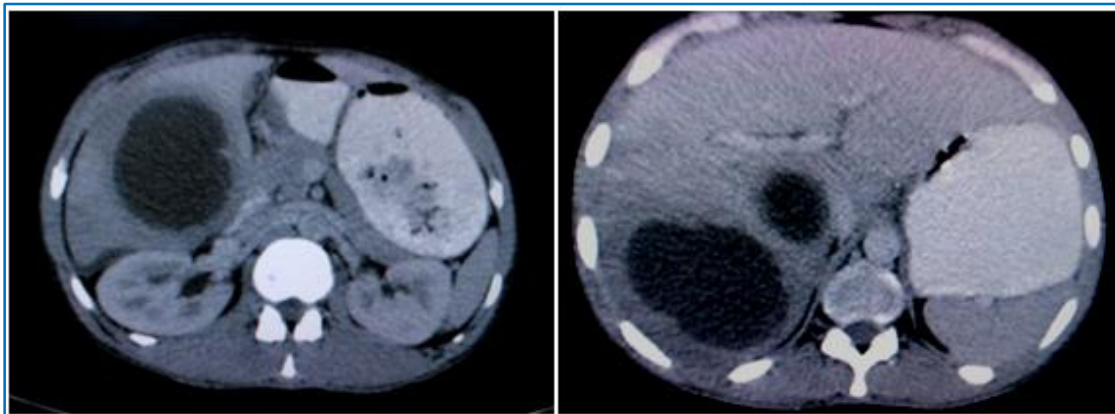

Fig. 4 (a & b): PYOGENIC LIVER ABSCESS

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Fig. 5: (a) An ill-defined hypodense lesion of 40-55 HU is seen adjacent to the gall bladder fossa region. (b) Similar hypodense lesion also seen in left lobe of liver. (c,d) GB wall is eccentrically thickened in the fundal region with multiple calcified calculi seen in the lumen. Central IHBR's are dilated.
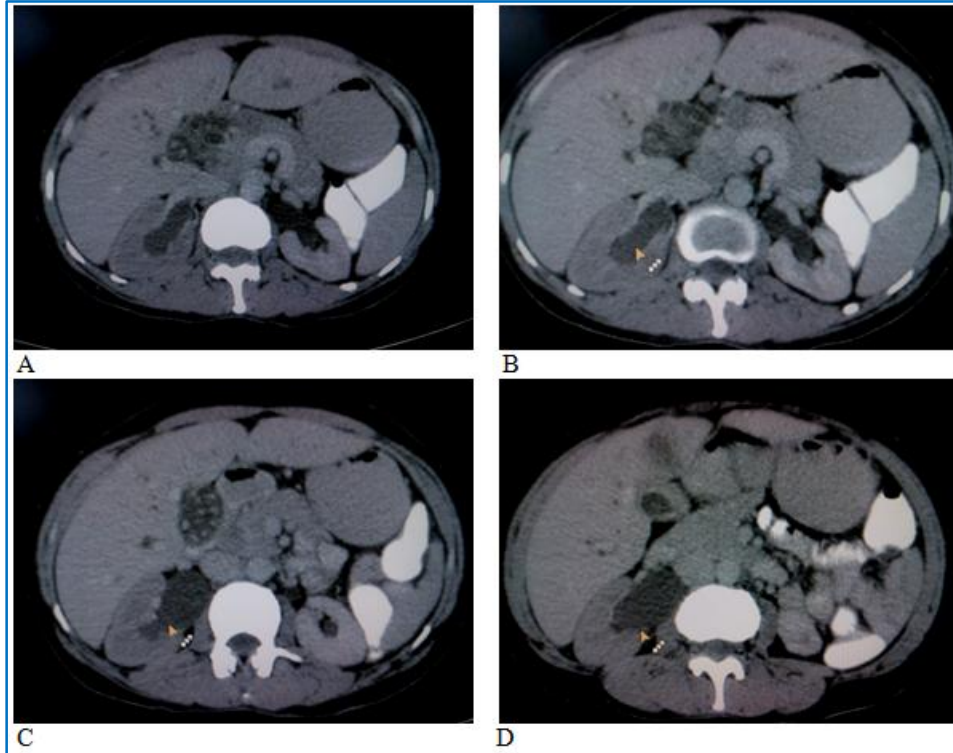

Fig. 5: METASTASIS FROM GALL BLADDER

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