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Multimodality Imaging In The Evaluation Of Obstructive Jaundice

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Abstract

Background

Obstructive Jaundice has been documented as one of the leading causes of increased morbidity. Imaging plays an imperative role in its diagnosis and management. The main goals of imaging in obstructive jaundice is to confirm the presence of obstruction, its location, extent and its probable cause.

Ultrasonography (USG) and Helical Computed Tomography (CT) are preliminary modalities of investigation in cases of surgical jaundice.

Magnetic Resonance Cholangiopancreatography (MRCP) is emerging as an exhilarating tool for noninvasive evaluation of patients with obstructive jaundice.

Material And Methods:

This study on "ROLE OF IMAGING IN OBSTRUCTIVE JAUNDICE." has been carried out in the Department of Radiodiagnosis, Sri Lakshmi Narayana institute of medical science. A total no of 72 patients suffering from various diseases of biliary tract and pancreas of all age groups were included in this study.

Most of the patients were diagnosed clinically with obstructive jaundice.

All the patients underwent USG abdomen and most instances a diagnosis was made on USG prior to helical CT and MR assessment.

The study protocol was approved by the ethical committee. All the patients gave informed consent to participate. Patients were omitted if considered unsuitable for MRI-MRCP and Helical CT examination, due to claustrophobia or renal insufficiency preventing the use of contrast in CECT.

Conclusion

Among the benign cause of obstructive jaundice, CBD calculi was the most common finding constituting about 50% of benign causes and it was detected as an isolated finding or in association with other pathology.

In conclusion in this prospectively collected data of patients, MRI combined with MRCP shows similar sensitivity as that of Helical CT in delineating the cause of obstructive jaundice as malignant, but it is superior to Helical CT in diagnosing benign causes of obstructive jaundice.

This difference was mainly explained by the MRCP's superiority in imaging malignant/benign biliary and/or pancreatic duct strictures and bile duct calculi. MRCP alone is more accurate than Helical CT in delineating the cause of obstructive jaundice.

MRI with MRCP has a greater diagnostic accuracy of 94.4% for diagnosing the cause of obstructive jaundice than helical CT which has an accuracy of 91.6% and USG with diagnostic accuracy of 66.67%.

Keywords: Magnetic resonance imaging, MRCP, Obstructive jaundice, Benign & malignant

Introduction

Obstructive Jaundice has been documented as one of the leading causes of increased morbidity. Imaging plays an imperative role in its diagnosis and management. The main goals of imaging in obstructive jaundice are to confirm the presence of obstruction, its location, extent, and its probable cause. It should also attempt to obtain a map of biliary tree that will assist the surgeon in determining the best approach to each individual case. Among these Ultrasonography (USG) and Helical Computed Tomography (CT) are preliminary modalities of investigation. Recently Magnetic Resonance Imaging with Magnetic Resonance Cholangiopancreatography (MRI with MRCP) is emerging as an exciting tool for noninvasive evaluation of patients with obstructive jaundice.

Magnetic Resonance Cholangiopancreatography is a fairly new MR imaging technique that has revolutionized the imaging of biliary and pancreatic ducts and has emerged as an accurate, noninvasive means of visualization of the biliary tree and pancreatic duct without injection of contrast media. [1]

Magnetic Resonance Cholangiopancreatography with its inherent high contrast resolution, rapidity, multiplanar capability and virtually artifact free display of anatomy and pathology is proving to be imaging modality of choice in these patients.[2,3,4]

In patients with malignant obstruction or stenosis of biliary-enteric anastomosis, this noninvasive imaging technique demonstrates the site and extent of the stenosis, the degree of proximal dilatation, the presence and size of biliary stones, and associated findings.[3,5]

The principle of MRCP is based on use of heavily T2 weighted fast spin echo sequences. On these images, the fluid of the biliary and pancreatic ducts gives the cholangiogram and pancreatogram.[2,3,6,7,8]

Magnetic Resonance Cholangiopancreatography (MRCP) has few added advantages as follows:

1. Non-invasive imaging modality
2. No ionizing radiation
3. No contrast media
4. Multiplanar imaging capability
5. No post procedure complications
6. It can be performed in critically ill patients.
7. It can show biliary tract proximal as well as distal to the level of obstruction.

Material And Methods

A total no of 72 patients suffering from various diseases of biliary tract and pancreas of all age groups were included in this study.

Most of the patients were diagnosed clinically with obstructive jaundice.

All the patients underwent USG abdomen and most instances a diagnosis was made on USG prior to helical CT and MR assessment.

The study protocol was approved by the ethical committee. All the patients gave informed consent to participate. Patients were omitted if considered unsuitable for MRI-MRCP and Helical CT examination, due to claustrophobia or renal insufficiency preventing the use of contrast in CECT.

Patient preparation for USG:

All the patients were instructed to come with empty stomach (NPO) on the day of procedure.

Patient preparation for Helical CT:

All the patients were instructed to come with empty stomach on the day of procedure.

All patient's renal functional status were noted before undergoing contrast CT.

All patient's clinical history were elicited to rule out previous contrast reactions/allergies.

Patient preparation for MRI with MRCP.

All the patients were instructed to fast for 6 hours prior to examination.

All the metallic possessions removed prior to the examination.

In few uncooperative and critically ill patients, respiratory triggering was used.

Patients were asked to drink pineapple juice one hour prior to scan.

Equipment

1. SONOSCAPE S22 Ultrasound equipment
2. Siemens SOMATOM SCOPE 16 x 2 Multi-slice CT

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3. Siemens MAGNETOM ESSENZA 1.5 Tesla MRI Scanner

Results:

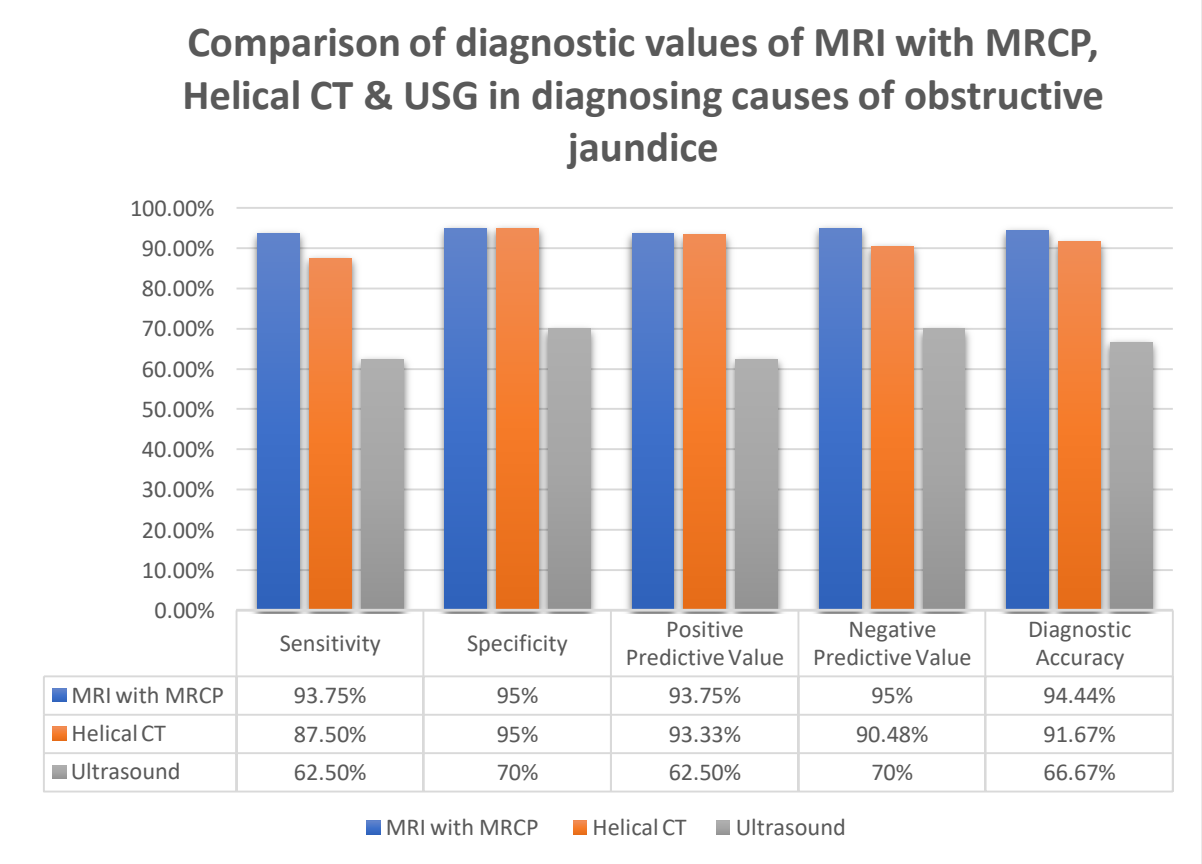
Our study was conducted to determine the MR-MRCP efficiency in the evaluation of patients with obstructive jaundice Vs Helical CT /USG. This study comprised 72 patients. The youngest patient of our study was 5 months old and the oldest was 85 years. The mean age of patients with benign lesions was 38 years and that with malignant lesions was 46.5 years.

On CT, 30 patients had benign cause of obstructive jaundice, out of which, 2 case (6.6%) turned out to be malignant. Of 42 cases characterized as malignant by CT, 4 cases (9.5%) turned out to be benign.

Out of 32 cases characterized benign by MRI with MRCP, only 2 case (6.2%) turned out malignant, which was characterized benign on CT as well. Out of 40 cases characterized as malignant by MR with MRCP, 2 case (5%) turned out to be benign.

For calculation of statistics SPSS 17, software was used to analyze the data and open epi software was used to calculate sensitivity, specificity, NPV, PPV and diagnostic accuracy. p-value was calculated by chi-square test, p-value less than 0.05 was considered as statistically significant

It is inferred that for diagnosing the causes of obstructive jaundice the Sensitivity, Specificity, PPV, NPV, Accuracy was 62.5%, 70%, 62.5%, 70%, 66.67% for Ultrasound, 87.5%, 95%, 93.33%, 90.48%, 91.67% for CT and 93.75%, 95%. 93.75%, 95%, 94.44% for MRI respectively.



	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Diagnostic Accuracy
MRI with MRCP	93.75%	95%	93.75%	95%	94.44%
Helical CT	87.50%	95%	93.33%	90.48%	91.67%
Ultrasound	62.50%	70%	62.50%	70%	66.67%

Discussion

Diagnosing patients with suspected biliary or pancreatic pathologies in their early stage is of utmost importance in patient care and management. Knowledge of the advantages and disadvantages of each technique are needed to determine the appropriate work up of patients with these pathologies.

With the introduction of MR Cholangiopancreatography in addition with conventional MRI, diagnosing biliary and pancreatic

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ductal pathologies invasive procedure like ERCP can be avoided solely for the purpose of diagnosis.

In our study we have evaluated 72 patients suffering from various causes of obstructive jaundice.

Obstructive jaundice is the commonest presentation in patients with biliary obstruction. In detection of cause and site of pathology, imaging plays a crucial role. For optimal management of disease, it becomes, important to characterize & do staging of the malignant tumour.

In our study, following were identified as the common etiological factors in manifestation of obstructive jaundice.

Benign Lesions

In imaging of benign lesions(n=32) MR with MRCP diagnosed CBD & GB calculi in all 16 patients with such a final diagnosis and CT also showed the same in all and both the modalities showing 100% accuracy in detecting CBD and GB calculi. MR with MRCP showed calculus region as an area of signal void, and CT showed it as hyperdense lesion.

Cholelithiasis: (Case-1,2)

On CT, cholesterol stones are hypodense, calcified stones appear hyperdense, stones that are isodense to bile are unnoticeable by CT. On MRI stones appear as T1/T2 hypointense foci, cross sectional T2 weighted images are more sensitive than T1 weighted images. CT shows a radio opaque filling defect, 'TARGET SIGN' can be usually noted. Other signs on CT include abrupt termination of CBD. Rim of amplified density around a lower density and accompanying inflammation of CBD wall displays thickening and enhancement. Hypo intense structure encircled by hyper intense bile can be seen on MRCP.

Mirizzi syndrome (Case-3)

It is an unusual entity in which obstruction is seen as a result of extrinsic compression of the CHD from an impacted stone in the cystic duct or GB neck. Dilated bile ducts is usually noted on USG and computed tomography. Diameter of CHD decreases brusquely at/below the level of stone at neck / cystic duct.

Cholangitis: (Case-4)

Cholangitis is a relatively broad term used for inflammation of the bile ducts. Imaging is helpful in diagnosis of various types like- Primary sclerosing cholangitis, eosinophilic, chemotherapy induced cholangitis.

Entire biliary tree is involved in Primary sclerosing cholangitis with multiple segmental stricture (usually short segment) with intervening normal calibre ducts causing beaded appearance of bile ducts with associated dilatation, diverticula and mural irregularities.

Primary biliary cholangitis shows periportal hyperintensity (cuffing), regional lymphadenopathy and splenomegaly.

CT is helpful in identifying contour abnormalities, lobar atrophy or hypertrophy of caudate lobe.

Biliary strictures: (Case-5)

Stricture disease was diagnosed in 8 patients, MR with MRCP clearly displayed benign nature of stricture in all eight cases approaching 100% accuracy. MRCP clearly showed the length of the stricture segment accurately and differentiated stricture as malignant and benign. [9]

On MRCP strictures appear as high-grade ductal narrowing with markedly dilated proximal duct.

It is important to distinguish the benign biliary strictures from malignant strictures.

Benign strictures feature smooth and tapered margins. Variety of diseases such as chronic pancreatitis, autoimmune cholangitis etc can cause benign biliary strictures.

Malignant strictures feature irregular, shouldered margins with thickened (>1.5 mm) and enhancement of duct walls. Malignant bile duct strictures are usually due to cholangiocarcinoma pancreatic adenocarcinoma

Choledochal cyst: (Case-6)

Theses are another common benign, congenital anomaly featuring abnormal, disproportionate, cystic dilatation of the biliary duct. It is the diagnosis of exclusion (rule out tumour/inflammation etc.). Todani classification is used to classify choledochal cysts based on extra or intra hepatic ductal involvement.

Malignant Lesions

Periampullary carcinoma: (Case-7)

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In imaging of malignant lesions (n=40), 16 cases of periampullary growth were diagnosed with histopathological correlation. Among these 14 patients were diagnosed to have periampullary growth in MR with MRCP, and Helical CT. Conventional MRI sections played a major role in arriving at the final diagnosis. In four of these cases MRCP demonstrated "double duct" sign which helped more in arriving final diagnosis. [10]

Periampullary is referred as any tumour arising within 2cm of ampulla of vater.

Pancreatic ductal carcinoma involving head/uncinate process (case-8,9), few types of cholangiocarcinoma and tumours arising from ampulla itself fall under periampullary tumours.

Cholangiocarcinoma: (Case-10)

In 8 patients with extrahepatic cholangiocarcinoma MR with MRCP diagnosed all eight cases with a 100% accuracy with the help of conventional MRI, while CT clearly showed growth in 4 cases and with suspicion in remaining 4 cases, thus approaching 100% accuracy for MR with MRCP compared to 88-90% accuracy in CT.

Cholangiocarcinoma is classified into extrahepatic (perihilar and distal) and intrahepatic (Klatskin- hilar cholangiocarcinoma).

Perihilar cholangiocarcinoma is the most common type and is further classified based on anatomic extent using Bismuth-Corlette classification.

Mass forming cholangiocarcinoma appear as homogenously hypodense lesions with gradual centripetal enhancement and distal biliary dilatation. Capsular retraction and hepatic atrophy may be present.

Periductal type shows ductal wall thickening with altered calibre whereas intraductal shows ductal dilatation with or without mass.

MRI shows similar finding with peripheral hyperintensity on diffusion weighted images distinguishing it from hepatocellular carcinoma.

GB carcinoma:

Among eight patients with GB Carcinoma MR with MRCP diagnosed all eight cases with 100% accuracy, while CT showed positive finding in six cases, with accuracy of 75% and two cases were diagnosed as malignant hilar obstruction. On imaging, they can appear as a focal intraluminal mass, or a large herterogenous mass with necrotic areas and patchy contrast enhancement with focal or diffuse irregular wall thickening and complete replacement of gallbladder and adjacent invasion in advanced cases. Conventional MRI added a lot of value once again in arriving at final diagnosis.

ERCP is considered the standard of reference for imaging patients with obstructive jaundice, as it provides high resolution images of biliary tree and pancreatic duct. A great advantage of ERCP is its ability to accomplish therapeutic interventional procedures, including stone removal, stricture dilatation, and stent placement which can relieve obstruction. It requires a highly skilled and experienced endoscopist. Technical limitations can lead to botched examination.

Conclusion

Based upon our study following conclusions can be drawn.

1. MR with MRCP is an accurate, non-invasive means of assessing patients with obstructive jaundice.
2. It is very useful in children and in critically ill patients.
3. It fares better than Helical CT and USG in showing the distal CBD as well as pancreatic duct.
4. The inherent multiplanar capability of MRI with MRCP makes MR superior to other modalities in characterizing the lesion.

The diagnostic accuracy of MRI with MRCP is steep & has the potential to replace or limit the use of invasive procedures like diagnostic ERCP, which should be used only in cases where intervention is being contemplated.

In conclusion in this prospectively collected data of patients, MRI combined with MRCP is equivalent to Helical CT in delineating the cause of obstructive jaundice as malignant, but it is superior to Helical CT in diagnosing benign causes of obstructive jaundice. This difference was mainly explained by the MRCP in imaging malignant/benign biliary and/or pancreatic duct strictures and to bile duct calculi. MRCP alone is more accurate than Helical CT in delineating the cause of obstructive jaundice. Dynamic contrast

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enhanced MRI did not add significant value as compared to cross sectional MRI combined with MRCP without contrast. From the above table it can be inferred that for diagnosing the cause of obstructive jaundice MRI with MRCP has a greater diagnostic accuracy of 94.4% than helical CT which has an accuracy of 91.6% and USG with diagnostic accuracy of 66%. Above findings are in concordance with findings drawn by Singh A. [11]

The sensitivity of MRI with MRCP is greater than that of helical CT and USG in diagnosing the cause of obstructive jaundice. Thus, this modality should replace the more invasive procedures like PTC & ERCP in diagnosis of obstructive jaundice where therapeutic intervention is not contemplated/intended.

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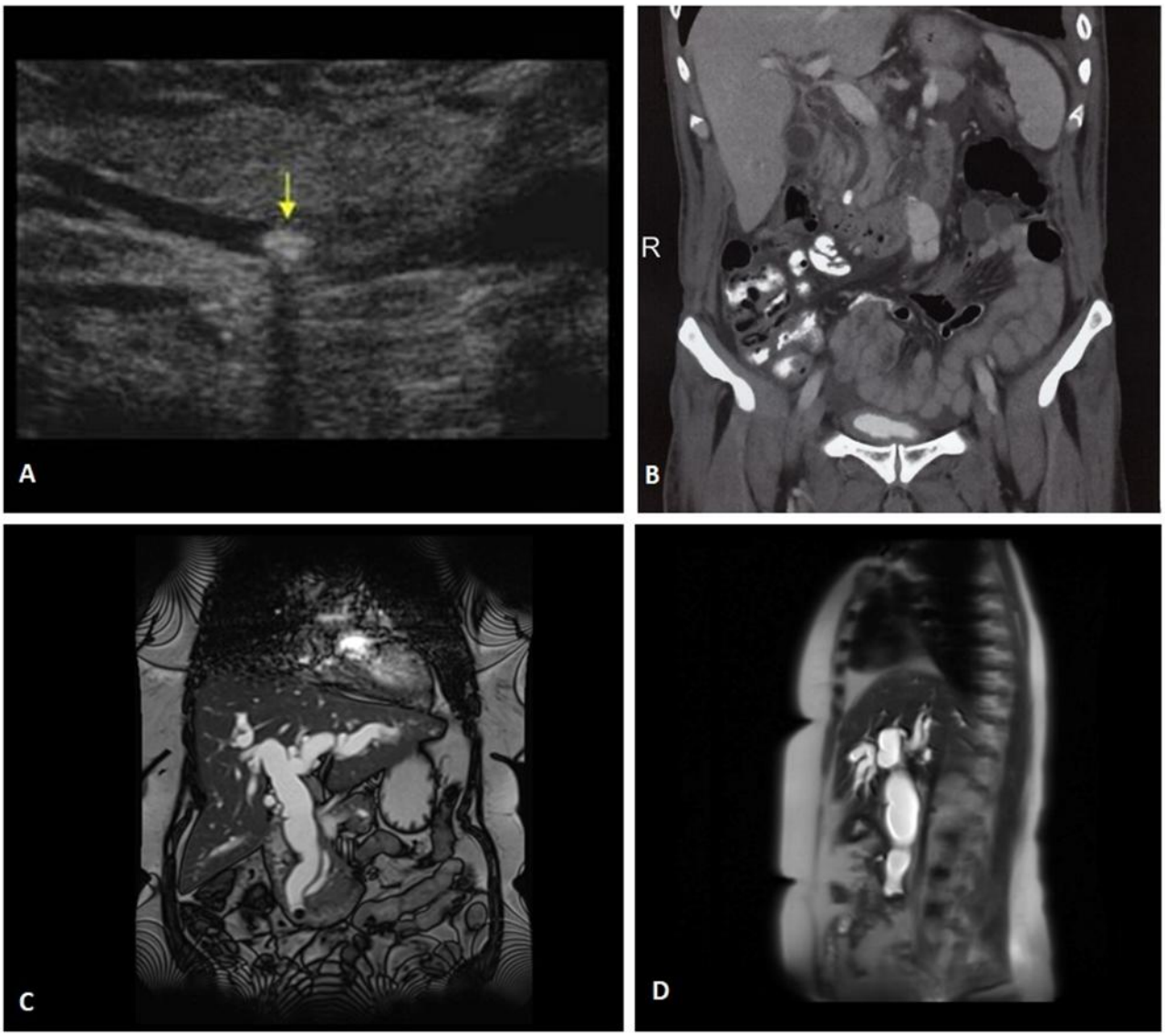
CASE 1: CHOLEDOCHOLITHIASIS



(A)Transabdominal USG axial, (B) NCCT abdomen coronal (C) TRUFI coronal & (D) T2 sagittal sequences show grossly dilated CBD, CHD, and intrahepatic biliary radicles. A Calculus is noted in distal CBD.

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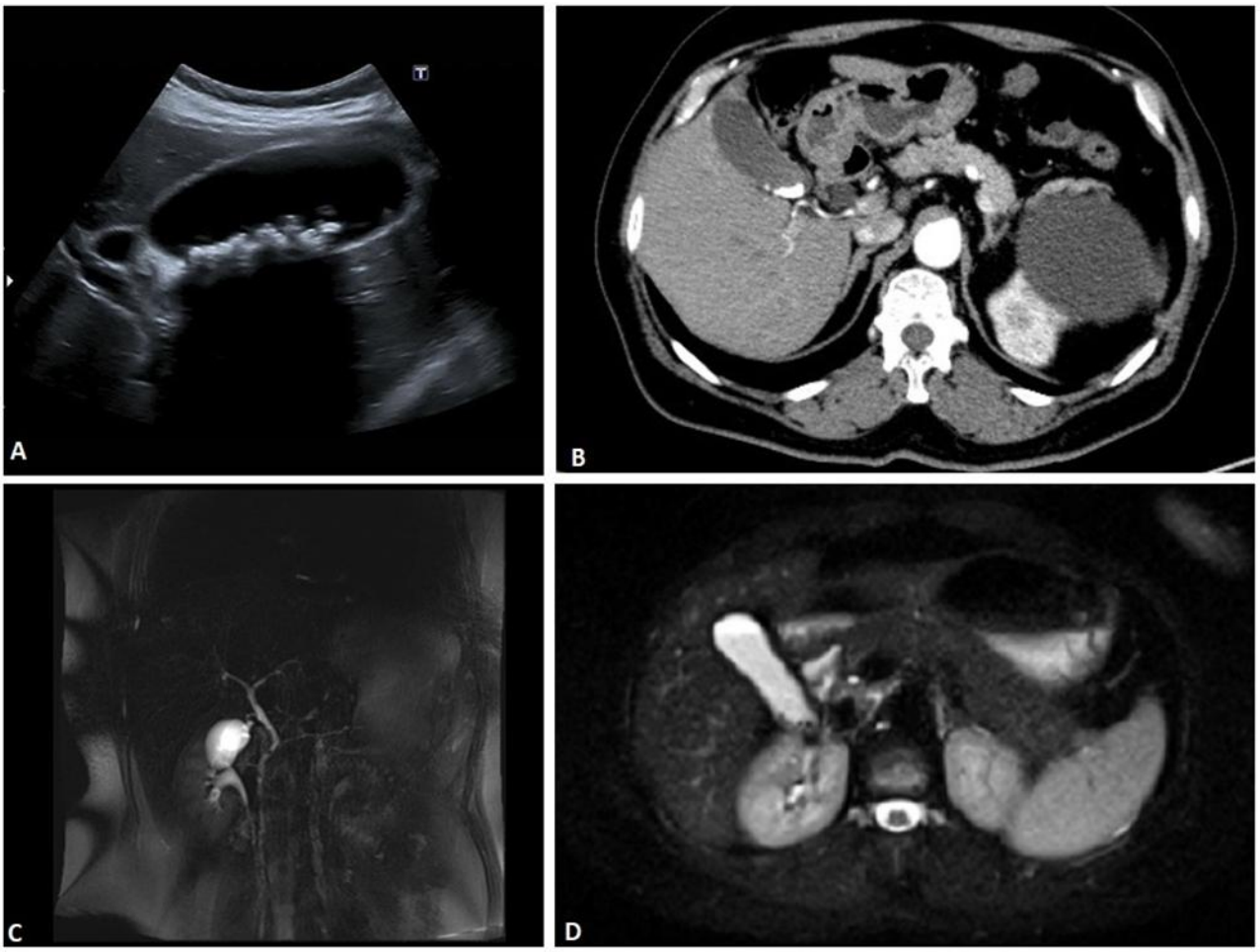
CASE 2: CHOLELITHIASIS WITH CHOLEDOCHOLITHIAIS



(A) Transabdominal USG axial (B) NCCT abdomen axial (C) HASTE coronal and (D) T2 FS axial in a 22-year-old female patient show multiple tiny calculi in the neck & body of gall bladder with a small mid-CBD calculus seen on HASTE coronal.

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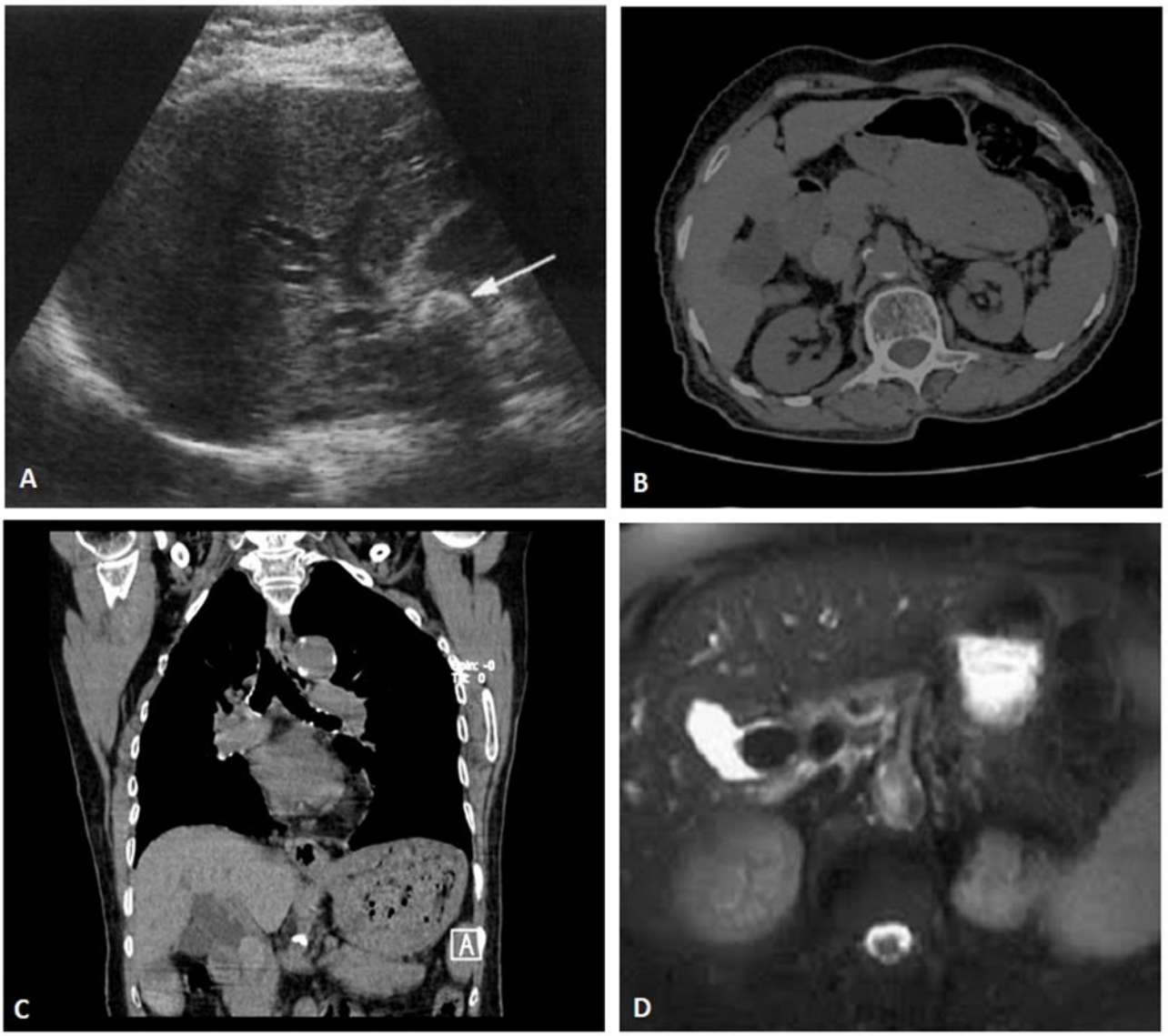
CASE 3: MIRIZZI'S SYNDROME



(A) Transabdominal USG axial, (B) NCCT abdomen axial (C) coronal sections & (D) T2 axial sections showing overdistended gall bladder with calculi in the dependent portion of gall bladder body. A large calculus is seen at the junction of cystic duct and CHD causing compression of CHD and intrahepatic biliary radicle dilatation

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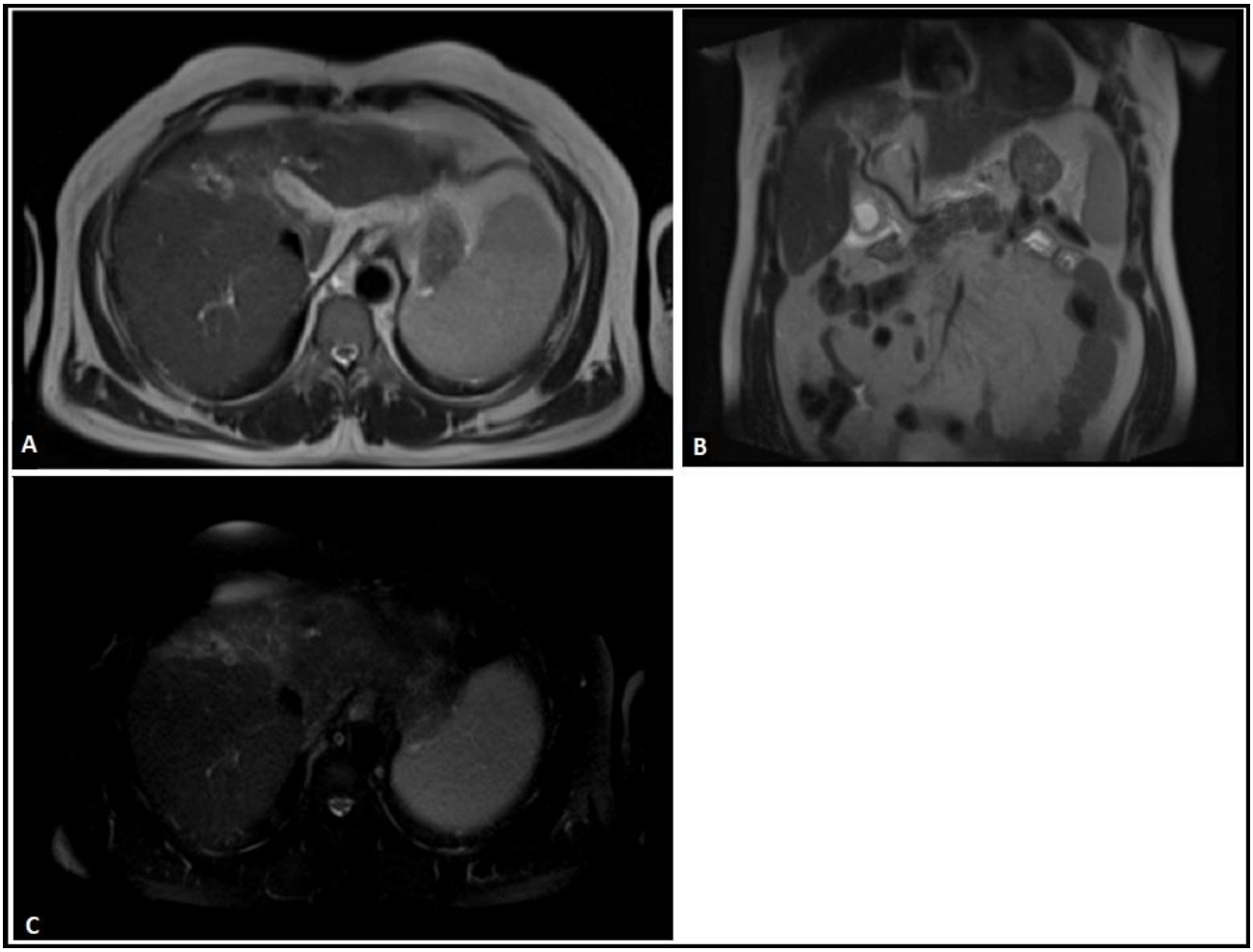
CASE 4: CHOLANGITIS

CASE 4: CHOLANGITIS



(A)T2 axial (B) T2 coronal (C) STIR axial images of 53-year-old male showing focal T2/STIR hyperintensities in segment IV in a branching pattern, suggestive of cholangitis

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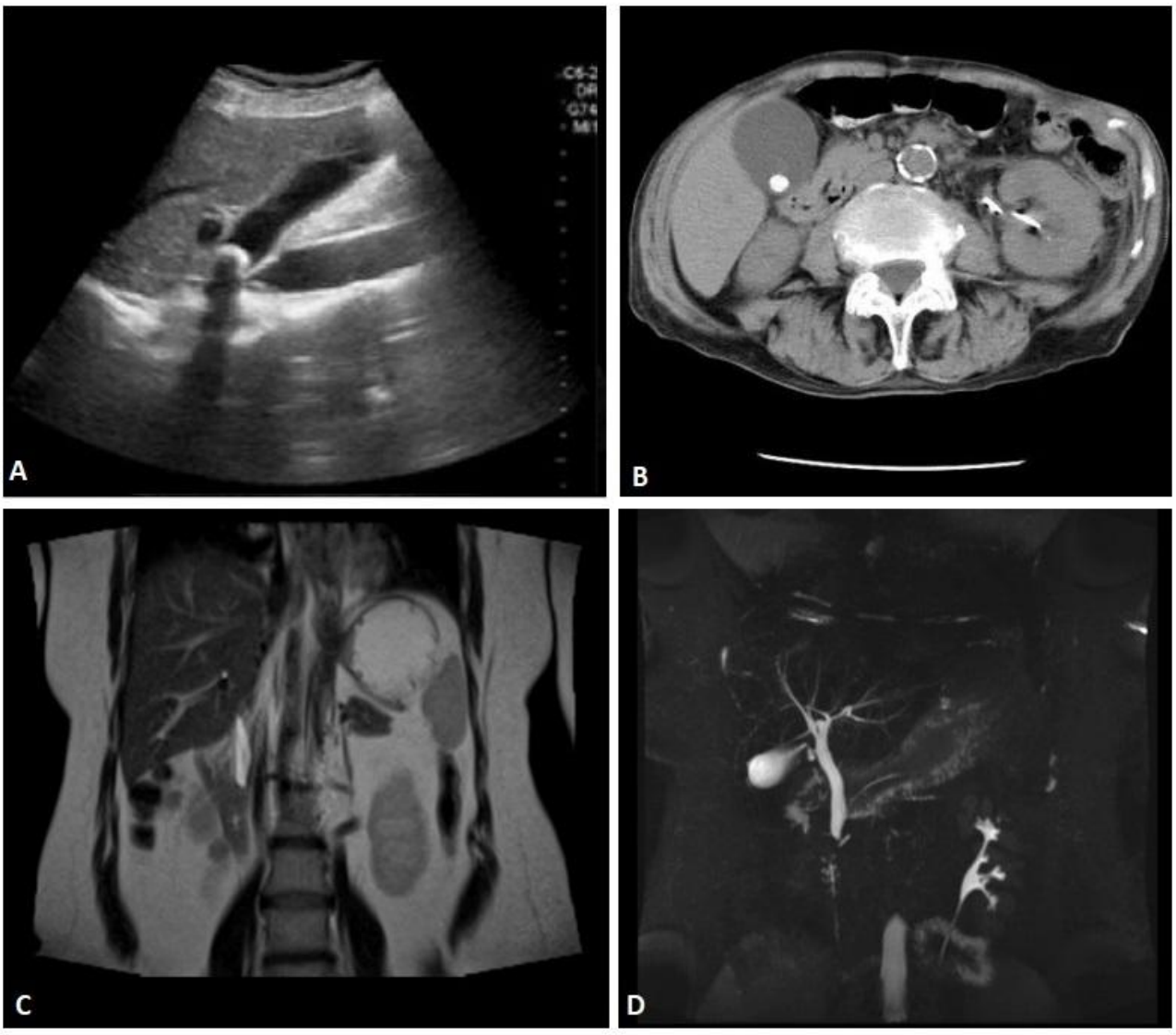
CASE 5: BENIGN STRICTURE WITH CHOLELITHIASIS



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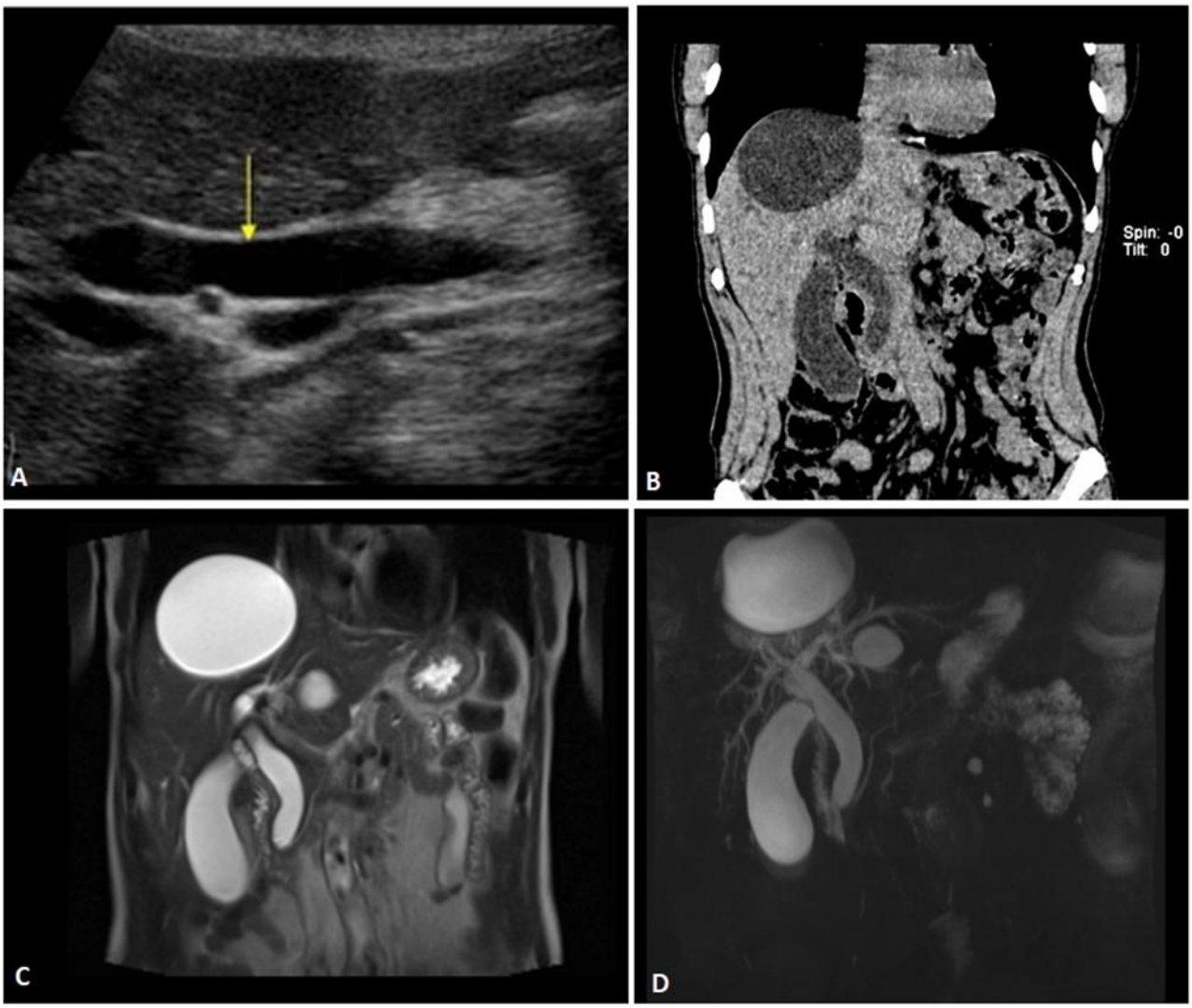
CASE 6: CHOLEDOCHAL CYST



(A) Transabdominal USG axial (B) NCCT Coronal section

(C)T2 coronal (D) HASTE sequences of a 36-year-old male show a large intra-hepatic biliary cyst measuring ~9.0cm in diameter seen in the segment VIII. Common bile duct shows fusiform dilatation with smooth tapering at distal end - suggestive of Type-I choledochal cyst.

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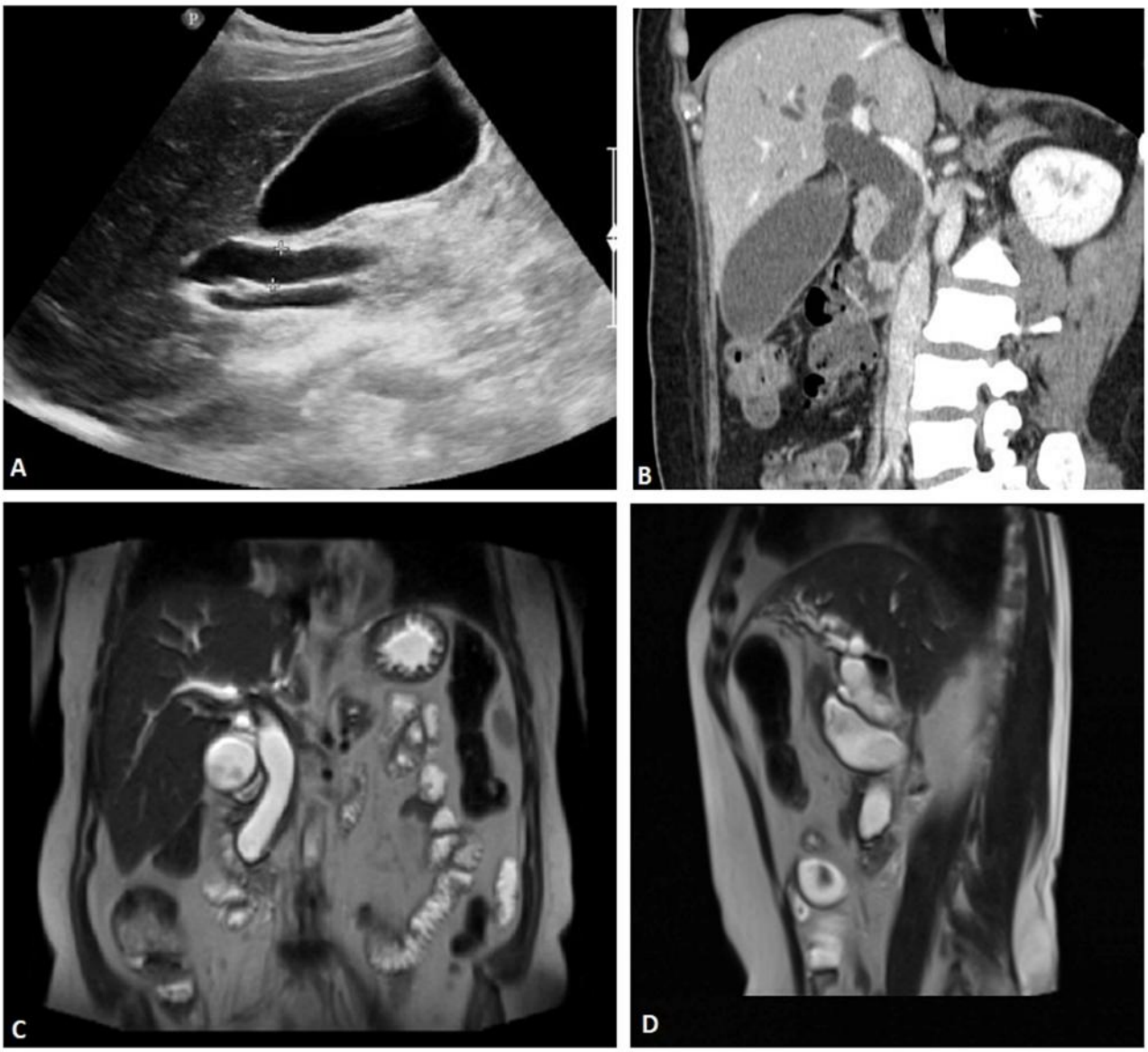
MALIGNANT ETIOLOGIES

CASE 7: PERIAMPULLARY CARCINOMA



(A) Transabdominal USG axial (B) NCCT thorax and abdomen coronal, (C) T2 coronal and (D)T2 Sagittal images show dilated CBD with abrupt tapering and few hypointense areas at its distal end. Histopathology revealed presence of early periampullary carcinoma

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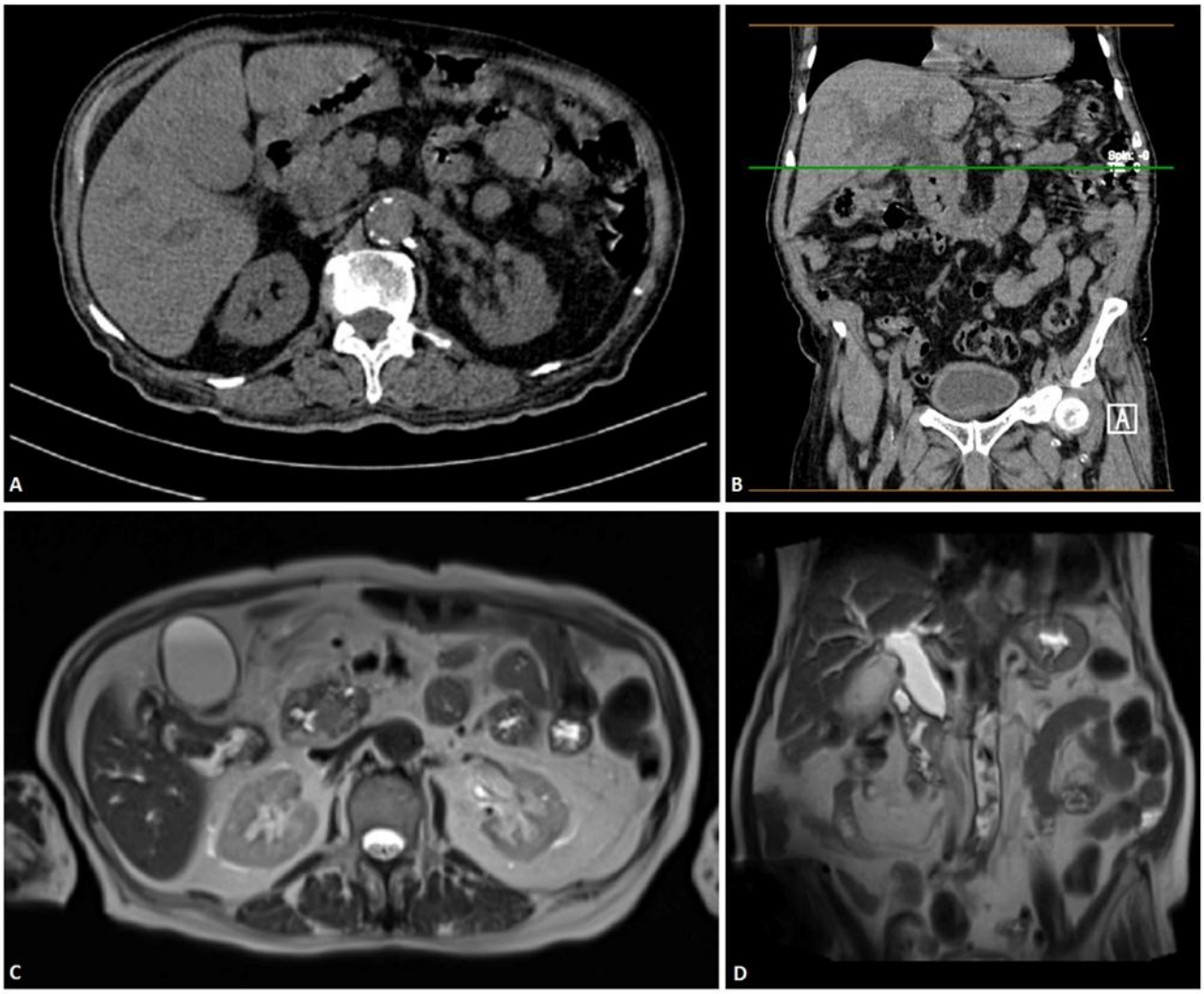
CASE 8: CARCINOMA HEAD OF PANCREAS



NCCT abdomen (A)axial and (B)Coronal sections and (C)T2 axial and (D)T2 coronal sequences in an 85-year-old male show abnormal signal involving the head of pancreas. There is complete narrowing and abrupt termination of CBD at the level of lesion with gross dilatation of biliary system

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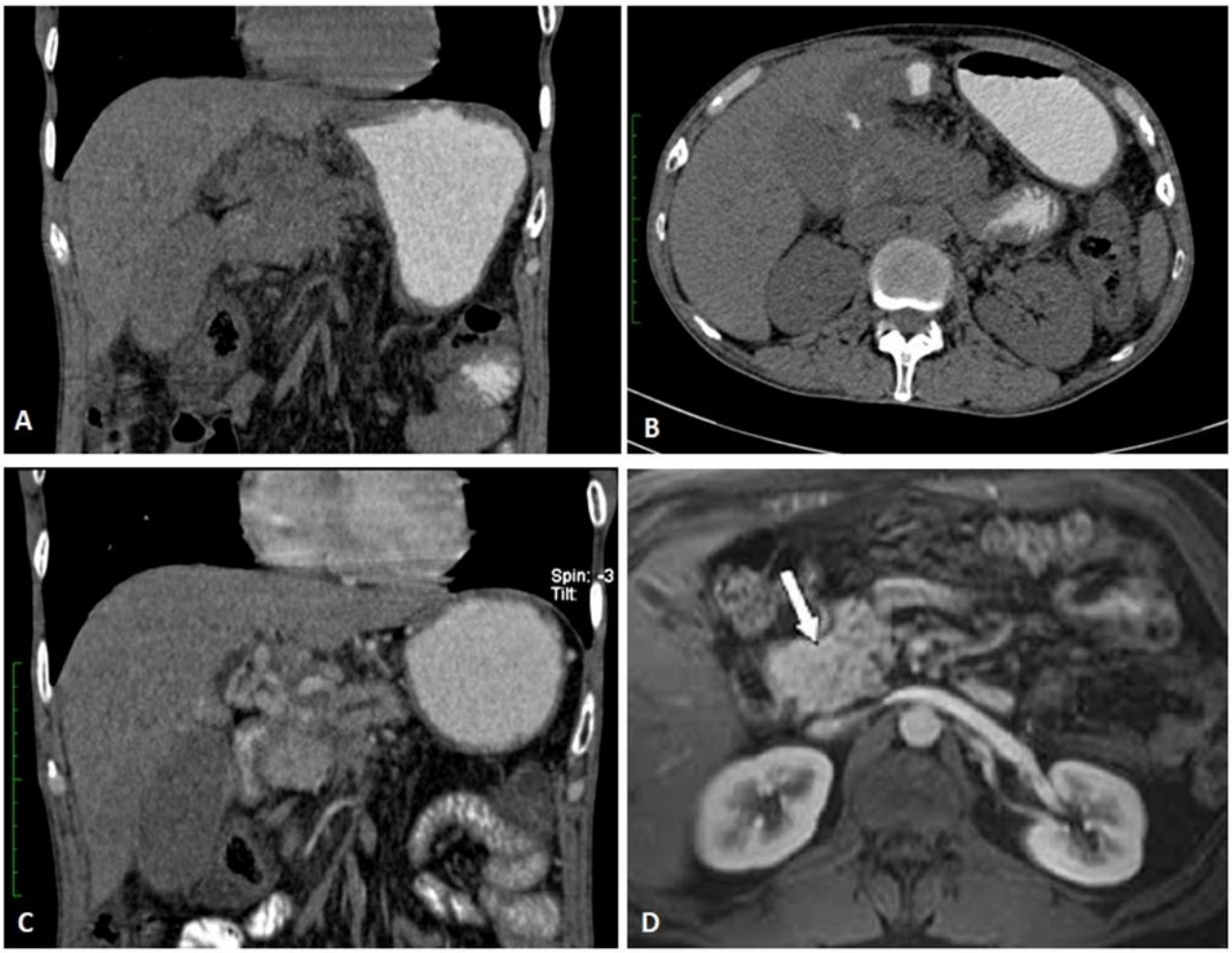
CASE 9: CARCINOMA PANCREAS INVOLVING UNCINATE PROCESS



NCCT abdomen (A) coronal, (B) axial and CECT abdomen (C) coronal, (D) axial sections of a 55-year-old male show large ill-defined heterogeneously enhancing mass arising from the uncinate process of pancreas with adjacent vascular invasion and peripancreatic fat stranding. CBD and MPD are dilated

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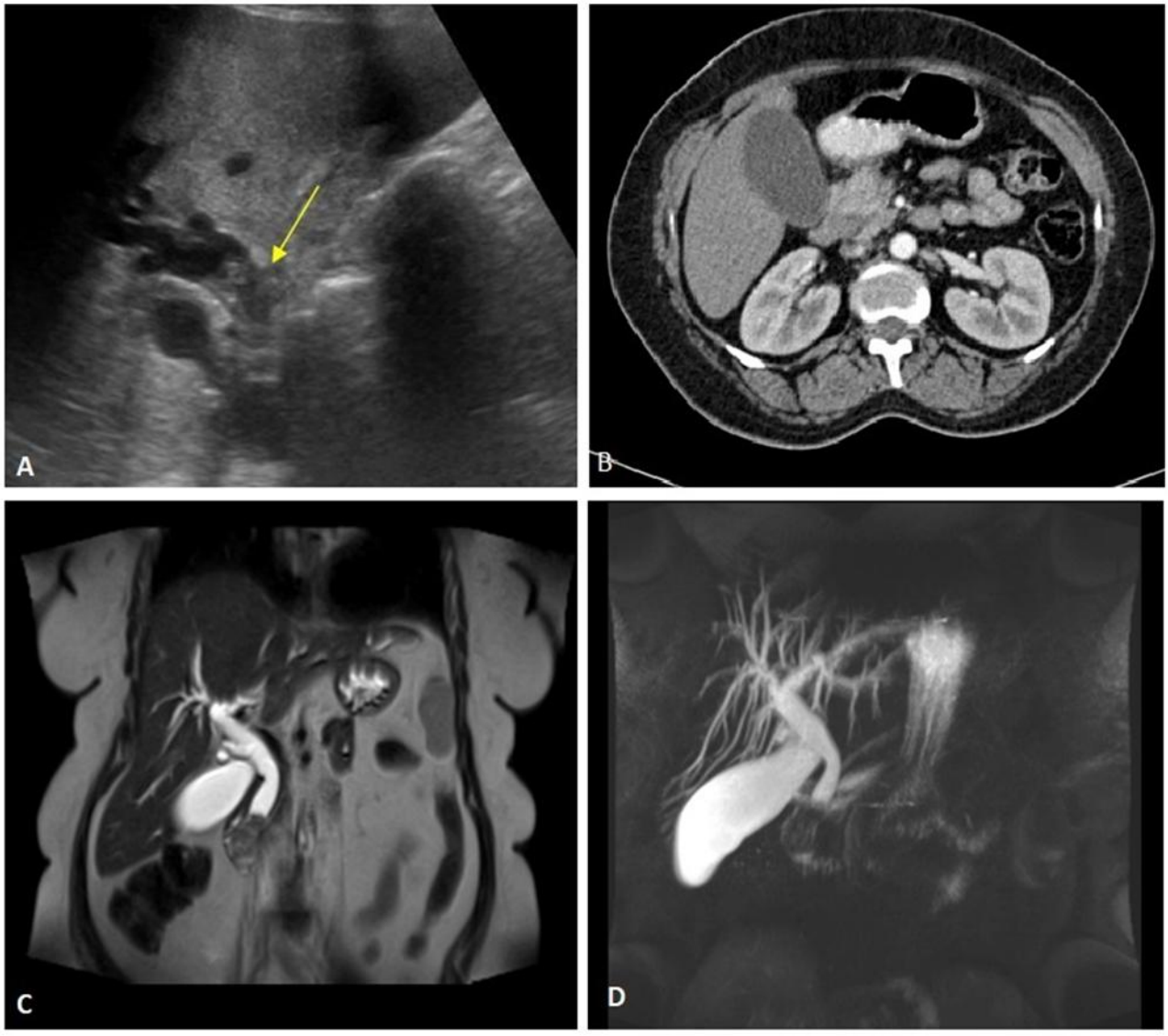
CASE 10: CHOLANGIOCARCINOMA



(A) Transabdominal USG axial, (B)NCCT axial sections at the level of Gall bladder, (C)T2 coronal & (E)HASTE FS show a heterogenous lesion in the distal CBD extending to the ampulla of Vater and presenting as a polypoid mass in second part of duodenum.

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