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# A STUDY TO EVALUATE THE ROLE OF MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY AS AN IMAGING MODALITY IN PANCREATICOBILIARY DISEASE

Radio-Diagnosis

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## ABSTRACT

**Background:** Ultrasonography and CT scans (abdomen and pelvis) are cost-effective and frequently utilized, however they have low sensitivity for pancreaticobiliary disorders. When diagnosing pancreaticobiliary disease, invasive procedures like ERCP are the best, but they need a qualified team of specialists. MRCP, a non-invasive imaging method for pancreatic and biliary disorders, is becoming more popular. **Objective:** To assess the feasibility of MRCP in diagnosing the biliary tract and pancreatic diseases and pathologies and establish its efficacy as a superior imaging technique for evaluating such conditions. **Methods:** This prospective observational study involved 50 patients who underwent MRCP after initial ultrasound (USG) assessment. MRCP was specifically performed in individuals diagnosed with pancreaticobiliary disorder during the USG examination. The transabdominal ultrasound examination was performed with a GE Voluson E8 equipped with a convex probe and operating at a frequency range of 1-5 MHz.**Results:** The MRCP showed a higher diagnostic rate in identifying Choledocholithiasis (22 cases) compared to USG (9 cases), with a difference of 13 cases. MRCP also showed superior performance in identifying Distal CBD Stricture, Infiltrating Cholangiocarcinoma, and Chronic Pancreatitis, with a discrepancy of 2 instances for each condition. MRCP had a 100.00% diagnosis rate for conditions like Choledochal Cyst, Cystic Duct Calculi, Acute Pancreatitis, Pancreatic Mass, and Pancreatic Trauma, while USG had a 0.00% rate for Distal CBD Stricture and 50.00% for Chronic Pancreatitis. **Conclusions:** The importance of MRCP for pancreaticobiliary disease diagnosis, particularly when USG is unclear. It also emphasizes the importance of clinical symptoms and medical history for appropriate diagnosis and treatment.

## KEYWORDS

ERCP- endoscopic retrograde cholangiopancreatography , MRCP- magnetic resonance cholangiopancreatography , MRI-Magnetic Resonance Imaging , USG- Ultrasonography.

## INTRODUCTION

Pancreaticobiliary disorders affect the pancreas, gallbladder, and bile ducts. These illnesses have diverse symptoms and severity. Gallbladder and bile duct stones that irritate and obstruct. Pancreatic inflammation may be acute or chronic, or acute on chronic for which most common causes are alcohol, drugs and gallstones.[1, 2]

Cholelithiasis is the most common biliary tract illness, with 5-15% of patients developing choledocholithiasis, sometimes asymptomatic [3-5]. Untreated bile duct stones can cause significant morbidity and mortality, necessitating prompt diagnosis and treatment. Strictures, tumors, and infections can also obstruct bile ducts, while pancreatic cancer, often diagnosed late, is challenging to treat. Symptoms of pancreaticobiliary disorders include jaundice, pale stools, dark urine, itching, fever, nausea, vomiting, and right upper quadrant pain. Strictures, gallstones, and tumors constrict bile ducts. Bile duct infections may cause inflammation and other issues. Pancreatic cancer is commonly diagnosed late and difficult to treat.[7]

Ultrasonography, with an 83% sensitivity for pathologic conditions, is the initial imaging modality for suspected acute biliary disease. Diagnostic tests include blood tests, CT, MRI, and endoscopic retrograde cholangiopancreatography (ERCP) [10, 11]. Early detection and treatment are crucial for improving outcomes, with routine checkups and a healthy lifestyle playing significant roles [12]
CT scans are recommended for right upper quadrant discomfort or jaundice, though their sensitivity for gallstones is lower than other methods. With 90% sensitivity, CT may struggle to find mixed stones due to their soft tissue compaction. Endoscopic retrograde cholangiopancreatography (ERCP) is the most accurate gallstone diagnosis test, but it has a high morbidity rate and fatality rate due to its invasiveness and operator dependence. [14, 15].

Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive imaging procedure for the pancreatic and biliary ducts, avoiding the risks of ERCP. MRCP is ideal for assessing ductal pathology, detecting conditions like cholelithiasis, biliary obstruction, and acute cholecystitis, and providing critical clinical data in emergencies. Unlike ERCP, MRCP does not use ionizing radiation or iodinated contrast agents [18].

MRCP is particularly useful for biliary-enteric anastomosis, failed ERCP, or ERCP contraindications, becoming the primary imaging modality. It accurately diagnoses conditions like choledocholithiasis and biliary strictures, providing detailed images and distinguishing between benign and malignant blockages [19]. MRCP offers high contrast resolution, quick imaging, and detailed views of pancreaticobiliary anatomy without operator involvement, enhancing diagnostic accuracy [20-22].

MRCP's advantages include its ability to reveal extra ductal cancers and avoid ERCP complications like bleeding and sepsis [16]. Despite its high cost and limited availability, MRCP is becoming increasingly popular due to its non-invasiveness, accuracy, and safety. In this study we aim to assess the feasibility of MRCP in diagnosing the biliary tract and pancreatic diseases and pathologies and establish its efficacy as a superior imaging technique for evaluating such conditions.

## MATERIALS AND METHODS:

This prospective observational study included 50 patients and was conducted in the Department of Radiodiagnosis from June 2022 to December 2023. The study focused on patients with symptoms suggestive of pancreaticobiliary disease who visited the OPD or emergency department or were admitted to different wards. Patients with diseases such as acute and chronic pancreatitis, malignant diseases of the pancreas, cystic diseases of the bile ducts (choledochal cyst, choledochocele), and sclerosing cholangitis were included, primary biliary cirrhosis, anatomical variants (such as pancreatic divisum and aberrant cystic duct), biliary diseases, postoperative biliary complications, stones and strictures of the pancreas and cholangiocarcinoma. Exclusion criteria were patients with pacemakers, ferromagnetic aneurysm clips, intraorbital or metallic foreign bodies, severe claustrophobia and orthopedic metal implants.
An MRCP was performed after the initial USG assessment, but only in individuals in whom the USG diagnosis included a pancreaticobiliary disorder. A transabdominal ultrasound was performed using a GE Voluson E8 with a convex probe of 1-5 MHz.

A superconducting 1.5 Tesla magnum with eight channels, MAGNETOM SEMPRA SEIMENS, was used for the MRCP technique/procedure in this study. In preparation for the procedure, a fasting period of approximately 6 hours was needed to promote filling of the gallbladder. A total of 50 patients suffering from various pancreaticobiliary diseases were included in this study. A detailed

medical history was taken and each patient underwent a routine spin echo (SE).

All sequences were performed in a single breath hold. The entire examination was usually completed within 25 to 30 minutes. The results were evaluated in the Department of Radiodiagnosis by senior radiology consultants.

All patients were instructed to come with an empty stomach on the day of the USG examination. Patients were asked to fast 4-6 hours before the examination to promote filling of the gallbladder and emptying of the stomach for MRI with MRCP. All metal objects were removed before the examination. Breathing was induced in a few uncooperative and critically ill patients. No exogenous contrast medium is required for imaging the pancreas and bile ducts.

**STATISTICALANALYSIS:**
SPSS version 23.0 was used for all the statistical analysis. Data were expressed as numbers and percentages (%). Data were collected on different pancreaticobiliary pathologies. We compared the diagnosis accuracy of USG as compared to MRCP.

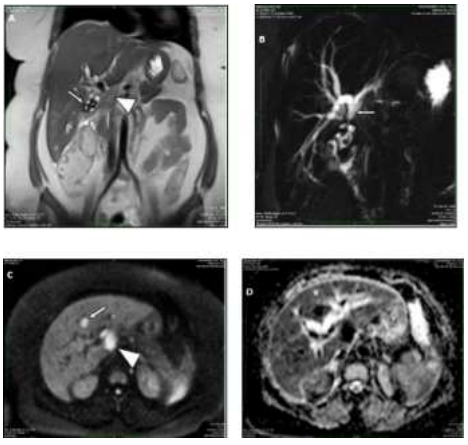

**Figure 1:** 43-year old female with RUQ pain, fatigue and loss of weight from last 5 months.

(A) Coronal T2-WI shows multiple calculi in the gallbladder lumen (arrow) and T2 intermediate intensity thickening of the wall infiltrating the hilum (arrowhead) in a case of Carcinoma gallbladder.

(B) The coronal MRCP projection image shows cut-off of the primary confluence (arrow) due to hilar infiltration resulting in bilobar intra-hepatic biliary radicle dilatation.

(C), D) Diffusion-weighted axial images with corresponding ADC map show metastatic lesion in the Segment IV (arrow) and an enlarged lymph node in the portocaval region showing diffusion restriction (arrowhead).

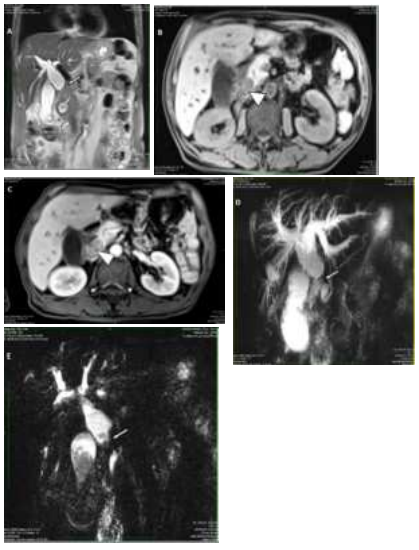

**Figure2:** A 62 year's male patient, with complaints of pain abdomen, multiple episodes of vomiting, decrease appetite, jaundice and weight loss since 4 months.

(A) Coronal T2-WI image showing T2 intermediate intensity periductal growth (arrow) involving the mid CBD causing stricture with upstream biliary tree dilatation in a case of CBD cholangiocarcinoma.

(B, C) The growth shows progressive enhancement in the delayed phase T1-FS images of contrast enhanced MRI (arrowheads).

(D) MRCP projection image showing abrupt stricture (arrow) of the mid CBD with bilobar moderate IHBRD and gallbladder hydrops(*) and cholecystitis.

(E) MRCP section on the right shows shouldered margins of the stricture suggesting likelihood of malignancy (arrow).

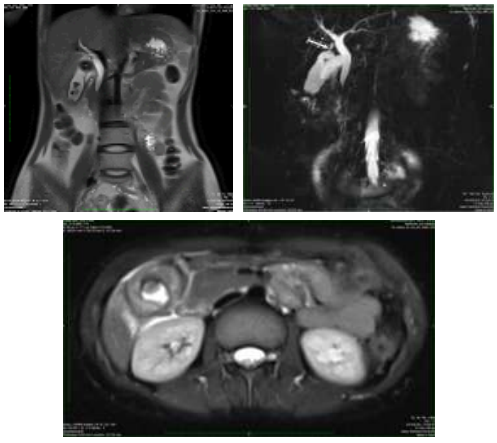

**Fig 3:-** A 25 years old female came to the medicine OPD with chief complains of RUQ pain and generalized weakness.

(A) Coronal T2-WI shows hypointense calculi in the lumen of gallbladder and cystic duct. The calculus in the cystic duct shows characteristic “Mercedes–Benz” sign (arrow).

(B) Coronal oblique MRCP projection image showing filling defect of the cystic duct calculus (arrow). The biliary tree is mildly prominent.

(C) Axial T2 FS-WI showing circumferential gallbladder wall thickening with subtle pericholecystic fluid suggestive of cholelithiasis with choledocholithiasis.

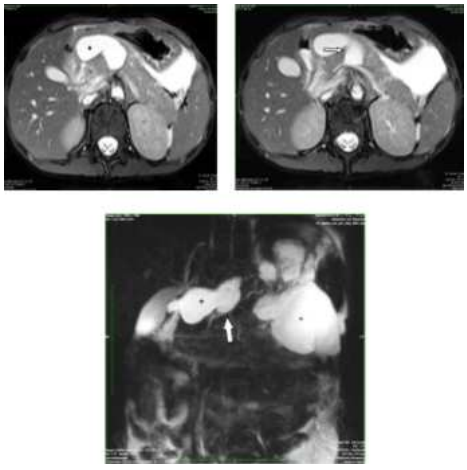

**Figure 4:** A 11 years child with history of trauma came to emergency with complain of sever abdomen pain after trauma.

(A) ( B) T2-FS WI axial images showing laceration in the neck of pancreas with duct transection (AAST Grade 3 injury) and post-traumatic pseudocysts.

(B) MRCP projection images show multiple pseudocysts (*) with one

in the neck of pancreas communicating in the MPD (arrow).

## RESULTS:

The data provides information on the demographic distribution of a group of 50 persons. The distribution of age groups is diverse, with the majority of persons falling between the 51-60 and 61-70 year old groups (22% each), while the smallest proportion is found among those aged 21-30 (4%). The gender breakdown reveals a higher proportion of females (64%) compared to men (36%). In terms of occupation, housewives make up the majority at 46%, with farmers and labourers each accounting for 20%. The majority of people (54%) are part of the middle class. In terms of behaviours, the majority (66%) of individuals have a past record of smoking, while 56% have a history of alcohol intake. This data offers a concise overview of the group's demographic composition, socioeconomic standing, and lifestyle preferences (Table 1).

**Table 1: Baseline characteristics of the patients**

| | | n | % |
|---|---|---|---|
| Age | ≤20 years | 3 | 6.00 |
| | 21-30years | 2 | 4.00 |
| | 31-40years | 5 | 10.00 |
| | 41-50years | 10 | 20.00 |
| | 51-60years | 11 | 22.00 |
| | 61-70years | 11 | 22.00 |
| | >70years | 8 | 16.00 |
| Gender | Male | 18 | 36.0% |
| | Female | 32 | 64.0% |
| Occupation | Farmer | 10 | 20.00 |
| | Housewife | 23 | 46.00 |
| | Worker | 10 | 20.00 |
| | Student | 4 | 8.00 |
| | Tailor | 1 | 2.00 |
| | Teacher | 1 | 2.00 |
| | Unemployed | 1 | 2.00 |
| Socio-econmic status | Lower class | 23 | 46.0 |
| | Middleclass | 27 | 54.0 |
| History of smoking | No | 17 | 34.0 |
| | Yes | 33 | 66.0 |
| History of alcohol | No | 22 | 44.0 |
| | Yes | 28 | 56.0 |

The clinical symptoms observed in the study cohort were predominantly abdominal pain (96.00%), followed by fever (40.00%), decreased appetite (20.00%), and jaundice (58.00%). Other symptoms included weakness (38.00%), vomiting (36.00%), nausea (10.00%), abdomen distension (6.00%), and weight loss (6.00%). Only a small proportion of patients had a history of surgery (6.0%), while the majority had no such history (94.0%). Similarly, approximately half of the patients had a history of chronic illness (52.0%), with the remaining half reporting no chronic illness (48.0%). Hypertension (HTN) and Type 2 Diabetes Mellitus (T2DM) were prevalent among 52.0% of the patients each. Overall, jaundice was reported in 58.0% of the cases (Table 2).

**Table 2: Details of Clinical symptoms, History of surgery, History of chronic illness and co-morbidity of the patients**

| | | n | % |
|---|---|---|---|
| Clinical symptoms | Pain Abdomen | 48 | 96.00 |
| | Fever | 20 | 40.00 |
| | Decrease Appetite | 10 | 20.00 |
| | Abdomen Distension | 3 | 6.00 |
| | Jaundice | 29 | 58.00 |
| | Weakness | 19 | 38.00 |
| | Vomiting | 18 | 36.00 |
| | Nausea | 5 | 10.00 |
| | Weight Loss | 3 | 6.00 |
| History of surgery | Yes | 3 | 6.0 |
| | No | 47 | 94.0 |
| History of chronic illness | Yes | 26 | 52.0 |
| | No | 24 | 48.0 |
| HTN | - | 26 | 52.0 |
| T2DM | - | 26 | 52.0 |
| Jaundice | - | 29 | 58.0 |

When comparing Ultrasonography (USG) with Magnetic Resonance Cholangiopancreatography (MRCP), both methods had the same diagnostic rate of Cholelithiasis, which was 100.00%. However, in the instance of Choledocholithiasis, MRCP demonstrated a considerably greater diagnostic rate (22 cases) compared to USG (9 cases), resulting in a difference of 13 cases and a diagnostic rate of 40.91% for USG. MRCP demonstrated superior diagnostic performance compared to USG in identifying Distal CBD Stricture, Infiltrating Cholangiocarcinoma, and Chronic Pancreatitis, with a discrepancy in diagnosis rates of 2 instances for each condition. MRCP demonstrated a diagnosis rate of 100.00% for conditions such as Choledochal Cyst, Cystic Duct Calculi, Acute Pancreatitis, Pancreatic Mass, and Pancreatic Trauma. In contrast, USG exhibited varying rates, with a diagnostic rate of 0.00% for Distal CBD Stricture and 50.00% for Chronic Pancreatitis. Regarding GB Mass/Nodular Lesion, MRCP had a slightly superior diagnostic rate compared to USG, with 3 instances diagnosed vs 2 cases, resulting in a difference of 1 case. The diagnostic rate for USG was 66.67% (Table 3).

**Table 3: Diagnosis accuracy of USG as compared to MRCP**

| | USG | MRCP | Differences | Diagnosis rate of USG |
|---|---|---|---|---|
| Cholelithiasis | 36 | 36 | 0 | 100.00% |
| Choledocholithiasis | 9 | 22 | 13 | 40.91% |
| Choledochal Cyst | 2 | 2 | 0 | 100.00% |
| Distal CBD Stricture | 0 | 2 | 2 | 0.00% |
| Infiltrating Cholangiocarcinoma | 1 | 3 | 2 | 33.33% |
| Cystic Duct Calculi | 1 | 1 | 0 | 100.00% |
| Chronic Pancreatitis | 2 | 4 | 2 | 50.00% |
| Acute Pancreatitis | 2 | 2 | 0 | 100.00% |
| GB Mass/Nodular Lesion | 2 | 3 | 1 | 66.67% |
| Pancreatic Mass | 2 | 2 | 0 | 100.00% |
| Pancreatic Trauma | 1 | 1 | 0 | 100.00% |

## DISCUSSION

Early detection of biliary disease is crucial for effective patient care and treatment. This study investigated the diagnostic capability of Magnetic Resonance Cholangiopancreatography (MRCP) in identifying pancreaticobiliary disorders.

Pancreaticobiliary disorders were more prevalent among adults aged over 40 (80.0%)[18]. A retrospective analysis of pancreatic Endoscopic Ultrasound (EUS) characteristics by Nguyen et al. (1999) found a higher prevalence of hyperechoic foci in individuals over 50 compared to those under 50.[19] Wang et al. (2014) reported that patients with pancreaticobiliary disease and dysfunction had an average age of 51.8 years, ranging from 16 to 92.[20] Additionally, pancreaticobiliary ducts were wider in individuals over 40, consistent with findings from previous studies by Hastier et al. and Kreel and Sandin.[21,22] .

In our study, women were found to be 1.56 times more likely to suffer from pancreatic and biliary tract diseases compared to men. Similarly, Guo et al. [23] found 9 men and 17 (65.4%) women in the pancreatic mass producer (PMP) group, a ratio of 1:1.89. Research by Morine et al. [24] suggests that pancreaticobiliary disease disproportionately affects women, with a ratio of 3:1 compared to men. Terumi Kamisawa et al [25] found that of 107 patients with pancreatobiliary malfunction (PBM), 80 (74.77%) were women and 27 (25.23%) were men, giving a female to male ratio of 2.96:1.

In our study, the most common symptoms reported by the patients were abdominal pain (96%), followed by fever (40.00%), loss of appetite (20.00%), flatulence (6.00%), jaundice (58.00%), weakness (38.00%), vomiting (36.00%), nausea (10.00%) and weight loss (6.00%). In addition, 78% of patients complained of fever, decreased appetite and stomach discomfort. Kumar et al (2023)[26] observed that most patients had severe gastrointestinal pain, obstructive jaundice, unexplained fever, anemia and weight loss. Obstructive jaundice was found in 14 of these patients (23.3%). According to Nirhale et al. (2018) and Verma et al. jaundice was the most common complaint in our study participants (92%).[27]

In our study, both USG & MRCP showed equal accuracy in the

diagnosis of various pancreatic and biliary diseases, achieving 100% diagnostic accuracy in cholelithiasis, choledochal cyst, cysts, acute pancreatitis, pancreatic mass and trauma. In particular, USG accurately detected masses or nodular lesions of the gallbladder in 66.67% of cases, choledocholithiasis in 40.91% of cases, chronic pancreatitis in 50.00% of cases and infiltrating cholangiocarcinoma in 33.33% of cases. It is noteworthy that no stricture of the distal common bile duct (CBD) was detected during the USG examination. However, it's worth noting that the present study included both benign and malignant cases, which could account for these differences compared to previous research. In terms of magnetic resonance cholangiopancreatography (MRCP), Kaur et al.[32] reported a sensitivity of 100% for identifying benign diseases, which aligns with findings by Singh et al.[29] The sensitivity for detecting malignant diseases using MRCP was 95%, consistent with other studies Raguram, Singh et al., and Kushwah et al.].[30,33]

Our findings indicate that ultrasonography (USG) is as effective as magnetic resonance cholangiopancreatography (MRCP) in diagnosing various conditions. USG demonstrated a diagnostic accuracy of 100% for cholelithiasis, choledochal cyst, cystic duct calculus, acute pancreatitis, pancreatic tumor, and trauma, mirroring the performance of MRCP in these cases. According to Kaur et al. (2018),[32] ultrasonography (USG) demonstrated 100% specificity for both malignant and benign diseases, consistent with Singh et al. (96.15%) and Kurian et al. (94.4%).[29,30]. Bhargava et al. discovered that the sensitivity of USG in diagnosing choledocholithiasis ranged from 25% to 58%. However, Kaur et al.[32] reported a higher sensitivity of 63% for USG in identifying choledocholithiasis. In contrast, both Singh et al. and Kaur et al.[29,32] found MRCP to have a sensitivity of 100% for this condition. In our study, both USG and MRCP exhibited 100% specificity, with no false positives, consistent with the findings of Kushwahet al.[30] USG and MRCP also demonstrated diagnostic accuracies of 88% and 100%, respectively, similar to the results reported by Kurian et al.[31] . Our study found that ultrasound (USG) detected gallbladder cancer with 66.67% sensitivity. Kaur et al. (2018) [32] reported an 86% sensitivity for USG in detecting gallbladder cancer, while Kushwah et al.[30] noted 100% sensitivity. The sensitivity and specificity of MRCP and USG were 100%. USG showed 33.33% sensitivity for diagnosing infiltrating cholangiocarcinoma, with the cause of bile duct blockage identified in about two-thirds of cases. USG frequently revealed gallbladder cancer as the primary malignant cause of bile duct occlusion, followed by cholangiocarcinoma. Kaur et al. (2018) [32] reported 60% sensitivity for USG in detecting cholangiocarcinoma, while Singh et al. found 66.67% specificity, 100% sensitivity, and 96% accuracy.

In our study, USG had 0% sensitivity for identifying distal CBD stricture. Kaur et al. (2018) reported 20% sensitivity and 100% specificity for benign strictures. Limitations in approach led to poor sensitivity, with indirect signs of stenosis observed but not the distal CBD and periampullary regions.

Our study found that USG has 100% sensitivity for detecting acute pancreatitis, pancreatic mass and pancreatic fibrillation, but only 50% sensitivity for chronic pancreatitis. This is less than Kaur et al. (2018) and Kushwah et al. (66.6%).[30,32] The sensitivity and diagnostic accuracy of MRCP are 100%.

MRCP identified the cause of obstruction in over 90% of patients, with Swaraj et al. (2023) reporting a diagnostic accuracy of 98.33.[36] Our results are consistent with those of Farid et al. who found 97% accuracy in detecting obstructive jaundice and 100% accuracy in localising the obstruction.[39] Other studies, such as those by Shadan, Kurian, Varghese and Romagnuolo, reported similar sensitivities and specificities.[31] In our study, USG had a diagnostic accuracy of 74.36% in predicting pancreaticobiliary disease. Swaraj et al (2023) found that USG accurately identified the causes of obstruction in 33% of patients, with a detection rate of 64.3%.

## CONCLUSION:

The study found that MRCP outperformed Ultrasonography (USG) in detecting various pathologies like choledocholithiasis, pancreatic masses, and distal common bile duct strictures. MRCP also showed higher sensitivity in diagnosing gallbladder cancer. Jaundice was the most common complaint, with MRCP accurately predicting its cause in over 90% of cases. Positive correlations were observed between pancreaticobiliary diseases,hypertension, Type 2 Diabetes Mellitus and chronic alcohol consumption.

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