

# Role of endoscopic ultrasound in evaluation of unexplained common bile duct dilatation on magnetic resonance cholangiopancreatography

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## Abstract

**Background** Dilated common bile duct (CBD) without obvious cause is a not uncommon finding on magnetic resonance cholangiopancreatography (MRCP). The aim of this study was to evaluate the diagnostic performance of endoscopic ultrasound (EUS) in patients with unexplained dilated CBD on MRCP.

**Methods** Patients referred for EUS evaluation of a dilated CBD were retrospectively analyzed with respect to serum alkaline phosphatase prior to EUS and subsequent outcome after EUS.

**Results** Over a 3-year period, 40 patients (24 males; mean age 38.9±9.9 years) with dilated CBD were retrospectively identified. Ten patients had elevated serum alkaline phosphatase. The diagnosis reached after EUS examination was: CBD stones in 15 (37.5%) with largest size of CBD stone being 9 mm, mass in CBD in 2 (5%), benign biliary stricture in 2 (5%), biliary stricture with underlying chronic pancreatitis in 1 (2.5%) patient respectively. EUS examination revealed normal CBD in 20 (50%) patients and two of these patients had periampullary diverticulum. All the patients with abnormal liver function tests had a detectable CBD pathology whereas 20/30 (66.6%) patients with normal liver biochemistry had normal EUS findings. There was no significant difference in the mean CBD diameter between the groups with demonstrable pathology compared with those without ( $P=0.64$ ).

**Conclusion** EUS is a useful investigational modality for patients with unexplained dilated CBD on MRCP. The mean CBD diameter and the presence of normal liver function tests are not predictive of underlying pathology.

**Keywords** Endoscopic ultrasound, common bile duct stones, magnetic resonance cholangiopancreatography, endoscopic retrograde cholangiopancreatography, ampulla

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## Introduction

The evaluation of biliary system abnormalities can be carried out using many investigational modalities including transabdominal ultrasonography (US), computed tomography (CT), magnetic resonance cholangiopancreatography (MRCP),

endoscopic ultrasonography (EUS) and endoscopic retrograde cholangiopancreatography (ERCP) [1]. Although US provides a quick, non-invasive and a cheap method to evaluate the bile duct, it is operator-dependent and the image quality depends largely on the intervening tissues. CT, although non-invasive, involves exposure to radiation and contrast and has low sensitivity in detecting biliary diseases. ERCP has been the gold standard for evaluation of the biliary tract. However, because of being invasive and having potential for serious adverse effects like post-ERCP pancreatitis, there have been increasing attempts to develop non-invasive and safer diagnostic modalities for evaluation of biliary tract. MRCP has been the non-invasive imaging technique of choice in evaluation of biliary disease as it provides fairly accurate information about the status of biliary system. Although advances in MR technology have improved the ability to image biliary abnormalities, the need for use of contrast and the inability to provide a histological diagnosis are its limitations [1]. EUS has emerged as an

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Conflict of Interest: None

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**Table 1** Clinical and EUS profile of 40 patients with dilated common bile duct

Age/Sex	Liver function tests	Biliary Colic	Vague abdominal discomfort	EUS findings
38/F	Abnormal	Yes	-	Stone
25/F	Abnormal	No	Yes	Stone
28/F	Abnormal	No	Yes	Stone
42/M	Abnormal	Yes	-	Stone
52/M	Abnormal	No	Yes	Mass
54/M	Abnormal	No	Yes	Mass
38/M	Abnormal	No	No	Stone
40/F	Abnormal	Yes	-	Stone
36/M	Abnormal	No	No	Stricture
28/F	Abnormal	No	Yes	Stricture
26/M	Normal	No	Yes	Stone
28/M	Normal	No	Yes	Normal
30/F	Normal	Yes	-	Stone
37/F	Normal	No	Yes	Normal
43/M	Normal	No	Yes	Normal
48/F	Normal	No	Yes	Normal
28/F	Normal	No	Yes	Normal
54/M	Normal	No	No	Stone
60/M	Normal	Yes	-	Normal
42/M	Normal	No	Yes	Normal
37/M	Normal	No	Yes	Chronic pancreatitis
54/M	Normal	No	Yes	Stone
27/F	Normal	No	Yes	Normal
45/M	Normal	No	Yes	Normal
55/M	Normal	No	Yes	Stone
30/F	Normal	No	Yes	Stone
25/F	Normal	No	Yes	Normal
46/M	Normal	No	No	Normal
37/F	Normal	No	Yes	Stone
28/M	Normal	No	Yes	Normal
46/F	Normal	No	Yes	Normal
44/M	Normal	Yes	-	Stone
48/M	Normal	No	Yes	Stone
42/M	Normal	No	Yes	Normal
38/F	Normal	No	Yes	Normal
34/M	Normal	No	Yes	Normal
36/M	Normal	No	Yes	Normal
28/M	Normal	No	Yes	Normal
28/F	Normal	No	Yes	Normal
52/M	Normal	No	Yes	Normal

important tool for evaluation of biliary disease. Apart from providing important diagnostic information concerning the biliary anatomy, it offers an opportunity to sample the tissue/lesion thereby providing a histologic diagnosis. It also helps determine invasion and local staging of any malignant lesion [2]. The available literature does not clearly indicate the best way to approach patients with asymptomatic biliary dilatation

as also the role of EUS in patients where MRCP has not been able to pinpoint the etiology behind biliary dilatation [2]. In clinical practice, we often encounter patients who have a dilated common bile duct (CBD) and thereafter undergo MRCP. The patients with a non-diagnostic MRCP pose a difficult diagnostic dilemma of either investigating further with modalities like ERCP or assuring the patients that everything is normal and

hence no further investigations are required. To answer this diagnostic dilemma, we retrospectively evaluated patients who underwent EUS for unexplained dilatation of CBD on MRCP and subsequently underwent ERCP for confirmation of EUS findings or were followed up for at least one year after EUS examination.

## Materials and methods

We retrospectively retrieved three years' (2008-2011) data of the patients who were referred to us for EUS to evaluate dilated CBD, the cause of which was obscure on previous imaging, and included those patients with dilated CBD in whom evaluation with MRCP did not provide a specific cause. The patients in whom a diagnosis had been provided by prior imaging (CT/MRCP/US), those with obscure etiology on CT and/ or US alone, and those with previous ERCP or pancreaticobiliary surgery were excluded from this study. Prior to EUS examination, values of serum alkaline phosphatase, CBD diameter on MRCP and other details of findings on previous imaging modalities were noted.

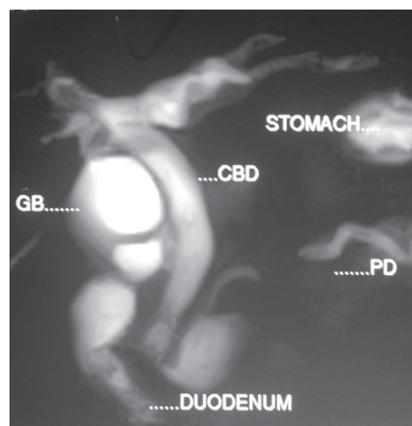
After obtaining an informed consent, EUS examination was performed using a radial echoendoscope (UTR 3830, Pentax Inc, Tokyo) at 7.5 MHz with the patient in left-side recumbent position under conscious sedation with intravenous midazolam. All of them were done within a week of MRCP examination. The EUS findings were recorded and confirmed with either a subsequently performed ERCP, surgery and biopsy confirming malignancy, or with the clinical course during follow up (at least 12 months) in cases with normal EUS findings. Patients with choledocholithiasis, diagnosed on EUS, underwent ERCP and balloon sweep of the CBD after endoscopic biliary sphincterotomy. The diagnosis of choledocholithiasis was confirmed only if stones could be seen endoscopically being extracted out of the ampulla following the balloon sweep. Similarly, the diagnosis of CBD sludge was confirmed if sludge or stone fragments could be seen endoscopically coming out of the ampulla following balloon sweep. All the patients included in the study were followed up clinically every 3 months and further investigations were done depending on the disease evolution and diagnostic suspicion.

## Results

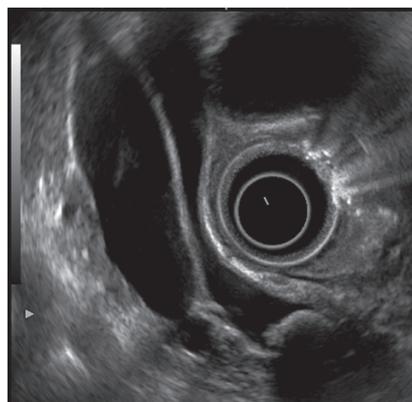
Over a 3-year period, 40 patients (24 males; mean age  $38.9 \pm 9.9$  years; Table 1) met the inclusion criteria. Of these 40 patients, 28 (70%) patients had undergone side viewing endoscopy using a duodenoscope prior to EUS examination and all of them had normal ampulla. None of these 40 patients had jaundice. Six (15%) patients had history of biliary colic whereas 30 (75%) patients underwent abdominal imaging because of history of vague upper abdominal discomfort. In four patients a dilated CBD was found on abdominal imag-

ing done for evaluation of other systems. Seventeen (42.5%) patients had prior cholecystectomy. Ten (25%) patients had elevated serum alkaline phosphatase and the mean CBD diameter on MRCP was  $8.9 \pm 1.1$  mm. The mean CBD diameter in patients who had undergone cholecystectomy was  $8.8 \pm 0.98$  mm and this was not significantly different from patients with intact gallbladder ( $9.1 \pm 1.1$  mm;  $P=0.50$ ). The diagnosis reached after EUS examination was: CBD stones in 15 (37.5%) with largest size of CBD stone being 9 mm, mass in CBD in 2 (5%), benign biliary stricture in 2 (5%), biliary stricture with underlying chronic pancreatitis in 1 (2.5%) patient (Fig. 1, 2, 3).

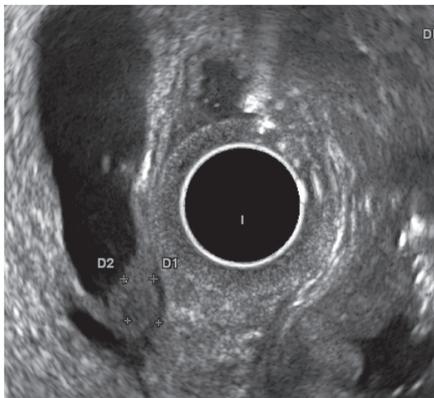
EUS examination revealed normal CBD in 20 (50%) of the patients and two of these patients had periampullary diverticulum suggested on EUS and confirmed on subsequent duodenoscopy. The CBD stones were confirmed in a subsequent ERCP and were removed following biliary sphincterotomy. The two patients with CBD mass underwent ERCP and endoscopic biopsy following biliary sphincterotomy which revealed the mass to be due to cholangiocarcinoma and both patients underwent Whipple's resection. Patients with benign



**Figure 1** MRCP showing dilated common bile duct with no identifiable cause of biliary obstruction  
GB, gallbladder; CBD, common bile duct; PD, pancreatic duct



**Figure 2** EUS in same patient showing common bile duct stone



**Figure 3** EUS in a patient with dilated common bile duct showing bile duct tumor

biliary stricture underwent endoscopic dilatation with multiple plastic stents. The patients with normal EUS findings were followed up for a period of 1-4 years and during this period there have been no pancreaticobiliary symptoms or complications.

As mentioned earlier, 10 patients had elevated serum alkaline phosphatase and 30 patients had normal liver function tests. All the patients with abnormal liver function tests had a detectable CBD pathology (stones in 6, cholangiocarcinoma in 2 and benign CBD stricture in 2 patients, respectively) whereas 20/30 (66.6%) patients with normal liver function tests had normal EUS findings. The mean CBD diameter in patients with elevated serum alkaline phosphatase was  $9.1 \pm 1.1$  mm and this was comparable with patients having normal liver function tests ( $8.9 \pm 1.1$ ;  $P=0.49$ ). There was no difference in the mean CBD diameter between the groups with demonstrable pathology compared with those without ( $8.9 \pm 0.9$  mm and  $9.0 \pm 1.1$  mm, respectively;  $P=0.64$ ).

## Discussion

Dilatation of CBD can result from diverse causes: choledocholithiasis, CBD stricture, cholangiocarcinoma, perampullary diverticulum, pancreatic head mass, sphincter of Oddi dysfunction and papillary stenosis, etc [1-3]. A dilated CBD can indicate underlying biliary pathology; it may however also occur in patients with advanced age or post-cholecystectomy status in the absence of any pathology [3,4]. Therefore it is important to evaluate further the patients with CBD dilatation to rule out any sinister underlying etiology. MRCP is an excellent non-invasive modality for diagnosis of various pathologies causing CBD dilatation with its diagnostic results being comparable to ERCP [5,6]. Therefore, once MRCP demonstrates only a mildly dilated CBD, the treating physician is faced with a dilemma of investigating further with an ERCP or stopping all investigations presuming the dilatation to be normal variant. EUS is an excellent modality

to image the CBD because of close proximity of the transducer placed in the duodenum to the CBD. The sensitivity of EUS for detection of CBD stones has been demonstrated to be equivalent to ERCP and has also been shown to be an excellent modality for evaluation of pancreaticobiliary disorders [7].

Although both EUS and MRCP are excellent modalities for evaluation of pancreaticobiliary disorders, it is important to evaluate their comparative diagnostic performance. Most of the studies have shown high diagnostic performance of these two modalities with no significant difference in the diagnostic yield between these two modalities [5,8,9]. Therefore, if both modalities have comparable diagnostic accuracy would EUS be able to detect any pathology in patients with inconclusive MRCP? Studies have shown that although MRCP and EUS are comparable, the diagnostic yield of MRCP dips down in presence of dilated CBD and small CBD stones [10,11]. Therefore, in these situations EUS has better diagnostic yield than MRCP. Hence, in the current study we evaluated the role of EUS in patients with dilated CBD and inconclusive MRCP and attempted to identify patients with high likelihood of underlying pathology in spite of inconclusive MRCP. In our study EUS was able to establish diagnosis in 50% of patients with inconclusive MRCP with the majority of the patients having CBD stones. In a study of 49 patients who underwent ERCP for evaluation of asymptomatic biliary dilatation ~60% of patients were found to have some abnormality on ERCP with 20% of patients having benign biliary strictures and 23% patients having juxtampapillary duodenal diverticulum [12]. However, of 11 (22.5%) patients with juxtampapillary duodenal diverticulum, only two had evidence of it indenting the CBD. In another study, 90 patients with dilated CBD of unexplained cause on US were evaluated with EUS and correct diagnosis was achieved in 92% cases with EUS [13].

Malik *et al* retrospectively evaluated the role of EUS in evaluation of asymptomatic biliary dilatation in 47 patients of which 15 had also undergone MRCP. They allocated the patients in two groups: one with normal liver function tests (LFTs;  $n=32$ ) and another with abnormal liver biochemistry ( $n=15$ ). The authors reported that the diagnostic yield of EUS was low in patients with normal LFT (6%) while the yield was much higher in those with abnormal LFTs (53%;  $P=0.001$ ) [14]. Choledocholithiasis and perampullary diverticula were the most common findings. In our study, also all the patients with abnormal liver function tests had a detectable CBD pathology (stones in 6, cholangiocarcinoma in 2 and benign CBD stricture in 2 patients respectively) on EUS whereas 20/30 (66.6%) of patients with normal liver function tests had normal EUS findings. In contrast to the study of Malik *et al*, where only 15/47 (32%) patients had undergone prior EUS MRCP, all the patients in our study had undergone a previous EUS evaluation with MRCP which could not establish the underlying etiology.

It is important to have a clear and evidence-based approach to evaluation and management of an asymptomatic dilated biliary system. While those with sinister etiologies causing biliary obstruction should not be missed, it is also important that those who do not have a pathologic cause of

## Summary Box

### What is already known:

- Dilated common bile duct (CBD) without obvious cause is a not uncommon finding on magnetic resonance cholangiopancreatography (MRCP)
- Endoscopic ultrasound (EUS) provides important diagnostic information concerning the biliary anatomy and also provides an opportunity to sample the tissue/lesion thereby providing a histological diagnosis

### What the new findings are:

- EUS is an important diagnostic modality that can help establish the diagnosis in patients with dilated CBD and normal MRCP
- Elevated serum alkaline phosphatase may identify a subgroup of patients who have a higher likelihood of an organic cause of dilated CBD but presence of a normal serum alkaline phosphatase does not predict absence of an organic cause of CBD dilatation

biliary dilatation are not subjected to unnecessary invasive/semi-invasive evaluation. The results from our study indicate that abnormal LFTs can help identify the subset of patients with high pre-test probability of an abnormal EUS examination. But, not all patients with normal LFTs eventually had a normal EUS examination. Likewise, the mean diameter was not significantly different amongst those with organic lesions detected on EUS vis-à-vis those with normal EUS. This indicated that the CBD diameter is not an indicator of presence of organic abnormality. However, the study is limited by the fact that it was a retrospective analysis of cases. Also, both EUS and MRCP can miss the diagnosis of papillary stenosis and sphincter of Oddi dysfunction. However, all our patients with normal EUS findings remained free of any pancreaticobiliary symptoms or complications during the follow up period of 1-4 years and so these disease processes seem to be less likely to exist in this patient subgroup.

In conclusion, EUS is an important diagnostic modality that can help establish the diagnosis in patients with dilated CBD

and normal MRCP. Elevated serum alkaline phosphatase may identify a subgroup of patients who have a higher likelihood of an organic cause of dilated CBD. However, presence of a normal serum alkaline phosphatase does not predict absence of an organic cause of CBD dilatation.

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