The role of endoscopic ultrasound in evaluation of unexplained common bile duct dilation in patients with normal liver function Tests

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ABSTRACT

Background: Endoscopic ultrasonography (EUS) is one of the most recentad vances in gastrointestinal endoscopy. Endoscopic ultrasonography has various applications, such as staging of gastrointestinal malignancy, evaluation of submucosal tumors, and has grown to be an important modality inevaluating the pancreaticobiliary system. With regard to the biliary system, EUS is useful for the detection and staging of periampullary tumors,detection of microlithiasis and choledocholithiasis and evaluation of benign and malignant bile-duct strictures. **Aim of the study:** The aim of this study is to assess the diagnostic yield of endoscopic ultrasound (EUS) in patients with CBD dilatation, normal liver function tests and previous inconclusive imaging technique. **Patients and methods:** Data used in this study was collected using aprospective study on 41 patients referred for assessment of nonspecific abdominal pain and proved to have common bile duct dilatation with no obvious cause according to abdominal ultrasound and magneticresonance imaging (MRI). Variables included in his study were age, gender, liver function test and findings of imaging techniques, abdominal ultrasound, MRCP and EUS. **Results:**The current study included 41 patients with an age range of 21 -88years and a mean age of 60.24 ±13.55 years. It included 11 (26.8 %) malesand 30 (73.2 %) females with a male to female ratio of 1: 2.73. The biochemical investigations were within normal range including ALK, ALT,AST and TSB. According to EUS, dilated CBD was seen in 27 (65.9 %)cases; whereas, normal CBD was seen in 14 (34.1 %) cases. CBD stone was identified in 6 (14.6 %) cases, CBD mass was seen in 4 (9.4 %) cases including two cases of distal cholangiocarcinoma and there were also twocases of early ampullary tumors, and CBD benign stricture was seen in 2(4.9 %) cases. Choledochal cystic disease was seen in a single case. Portalbiliopathy was seen in a single case and chronic pancreatitis was seen in 2(4.9 %) cases. Suspected papillary stenosis was seen in 2 (4.9 %) cases and the diagnosis was confirmed by subsequent follow up for 3 to 6 months. The proportion of patients with dilated CBD was higher in thosewith surgically removed gallbladder in comparison with those with retained gall bladder, 91.7 % versus 55.2 % and the difference was statisticallysignificant (P = 0.033).There was no significant association between age and dilated CBD (P = 0.062).
Conclusion: The use of EUS offers the better diagnostic tool in terms ofsensitivity and specificity for detecting CBD dilatation in patients with normal liver enzymes; EUS enables the identification of causes of CBD dilatation in patients in whom other techniques such TUS, and MRI fail to do that and thereby reducing the need for further invasive procedures like ERCP and its associated complications.

Introduction:

Ultrasound is an inexpensive and noninvasive investigating tool that can be used efficiently to evaluate pathologies affecting liver and biliary tree (1-3).Most often, ultrasound of the upper abdominal quadrant is performed for the assessment of inflammation and obstruction of biliary tree, cholecystitis and choledocholithiasis. Ultrasound have the ability to characterize liver pathology regarding location, consistency (solid versus cystic) and border regularity (4).Other imaging techniques such as magnetic resonance imaging (MRI) and computed tomography (CT) are also helpful in identifying and characterizing liver pathology (5-7). Scan images and a contrast are used at particular time onsets during these techniques in order to gather arterialphase, portal phase and venous phase. Based on the way by which a particular pathology takes contrast, radiologist and physicians can get sufficient idea about the nature of liver pathology even without requesting a tissue diagnosis (liver biopsy). The computed tomography is less expensive even though, MRI has the superiority of giving better soft tissue details (8,7). When there is biliary tract obstruction, there will be an associated rise in liver enzymes, jaundice and other manifestations such as abdominal pain and fever (9).

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The association among biliary tract dilatation, raised liver enzymes and jaundice is to be expected in clinical practice; however, the widespreaduse of sophisticated imaging techniques allows the detection of dilated bile duct in the setting of normal liver enzymes and lack of jaundice in patients with non specific abdominal pain (9). The available data about such setting in the available published articles is relatively scant, particularly in our community, therefore, the planning and conduction of the current study was justified in order to highlight the role of endoscopic ultrasound in the characterization of such condition.

The upper normal diameter of the common bile duct (CBD) is uncertain, but it is conventionally agreed to be 7 mm (10, 11, 9). The diameter of the bile duct is determined by a number of factors among which are the age of patients, previous cholecystectomy and technique of imaging used (12, 13). Because of intestinal gas, it may difficult to measure diameter of distal common bile duct using transabdominal ultrasound in comparison with other techniques such as cholangiopancreatography (MRCP), MRI, computed tomography (CT), percutaneous transhepatic cholangiography (PTC) or endoscopic retrograde cholangiopancreatography (ERCP) (14). However, the other techniques may also provide improper estimates of the exact diameter of a common bile duct. For instance, the wall thickness is going to be included with diameter estimation when using CT or MRCP and dilatation resulting from contrast is going to produce overestimate ofduct diameter estimated by ERCP and transhepatic cholangiography (15,13).

Endoscopic ultrasonography (EUS) is one of the most recent advances in gastrointestinal endoscopy. Available EUS devices include echoendoscopes, such as radial scanning and linear array echoendoscopes, and catheter ultrasound probes. It has various applications, such as staging of gastrointestinal malignancy, evaluation of submucosal tumors, and has grown to be an important modality in evaluating the pancreaticobiliary system. With regard to the biliary system, EUS is useful for the detection and staging of periampullary tumors,detection of microlithiasis and choledocholithiasis and evaluation of benign and malignant bile-duct strictures. It may be used as an adjunct to transabdominal ultrasound for the detection and characterization of gallbladder polyps. In addition, EUS is helpful in the staging of gallbladder cancer as well as in diagnosing anomalous pancreaticobiliary junction with its associated pancreatobiliary diseases (16).

When CBD dilatation exists in asymptomatic patients having no clinical and laboratory alarm signs and when non-invasive imaging techniques, such as MRCP ,TUS or CT fail to detect the cause, medical suspicion for biliary disease is minimal; therefore, further investigations become unnecessary (11).

Diagnostic EUS may have a role in the detectingthe etiology of dilatation, in this situation, in spite of negative results of previous imaging techniques, with negligible complications (17).

EUS gather endoscopy with high-resolution and real-time ultrasound, which provides excellent sonographic visualization of the extrahepatic biliary tree without bowel gas interference because of its ability to situate the transducer close to the extrahepatic bile duct. In addition, EUS providessystematic and accurate visualization of the duodenum wall, including the papillary region(18).

Aim of the study:

The aim of this study is to assess the diagnostic yield of endoscopic ultrasound (EUS) in patients with CBD dilatation, normal liver function tests and previous inconclusive imaging technique.

Patients and methods :

Study design:

Data used in this study was collected using a prospective study on 41 patients referred for assessment of non specific abdominal pain and proved to have common bile duct dilatation with no obvious cause according to abdominal ultrasound and magnetic resonance imaging (MRI), associated with normal liver function tests. Regarding patients with elevated liver enzymes and dilated biliary system , there is a high probability of pathological findings and usually those patients proceeded for ERCP which considered both diagnostic and therapeutic. previous study in our center covered those group of patients. Regarding other diagnostic tools, CT scan was not included because of radiation risk exposure and lower sensitivity than MRCP, cholangioscopy was not available in our center at time of study.

The upper limit for transverse diameter of 7mm for common bile duct has been used to define normal size; however, there is no universal definition for common bile duct size as it can change with aging or following cholecystectomy (19).The study was carried out at Gastroenterology and Hepatology Teaching Hospital at Medical City Complex during the period from January 2019 to February 2020.

Study sample:

The sample included in the current study enrolled patients with an age range of 21 to 88 and they were 11 (26.8 %) males and 30 (73.2 %) females.

Inclusion criteria:

All the patients have no jaundice, normal liver function test with dilated common bile duct with non-conclusive previous imaging studies.

Exclusion criteria:
-Jaundice with elevated liver enzymes.
-Patients in whom diagnosis was settled by previous investigations.
-Patients underwent ERCP.

Variables under investigation:
The following variables were included in the questionnaire form:
-Demographic characteristics: age and gender.
-Laboratory investigations: Liver function tests, ALP, AST, ALT and TSB.
-Findings of previous abdominal ultrasound: bile duct dilatation, bile duct diameter and presence of intact or surgically removed gallbladder.
-Finding of previous MRCP: bile duct dilatation, bile duct diameter.

Preparation
The patients should be fasting for 8 hours and vitally stable for anesthesia with no overt cardiopulmonary insult.

Procedure
Examination was performed under conscious sedation using midazolam 5mg or diazepam 5m with pethidine 50 mg at slow intravenous injection. The patient should be put in left lateral position, with monitoring of vital signs including O2 saturation, pulse rate, respiratory rate and systemic blood pressure. Mouth piece is put immediately before the patient has received sedation.
The examination has been done by trans-duodenal approach which has been accomplished in all patients.
Examination included assessment of bile duct diameter, ampullary and periampullary region, pancreas and pancreatic duct with a search of the cause of dilatation such as mass, stone, stricture or diverticulum.
In all patients EUS examination was carried out using EG3870UTKPentax linear echendosocpe which is connected to Hitachi-ultrasound HI Vision-Avius.
Follow up of all patients ranged from 3 months to 6 months.

Statistical analysis:
Data were collected and transformed into a spread sheet of Microsoft Office Excel 2010 and then into an SPSS (statistical package for social sciences) version 23. Numeric quantitative data were expressed as mean, range and standard deviation (SD), whereas, qualitative data were expressed as number and percentage. Comparison of mean between any two groups was done according to independent sample t-test, while chi-square test was used to evaluate association between any two categorical variables.
The level of significance was considered at $P \leq 0.05$.

Result:
The current study included 41 patients with an age range of 21 -88years and a mean age of 60.24 ±13.55 years. There were 3 (7.3 %), 13 (31.7%) and 25 (61.0 %) patients within 20-39, 40-59 and ≥ 60 age intervals. Thestudy included 11 (26.8 %) males and 30 (73.2 %) females with a male tofemale ratio of 1: 2.73, as shown in table 3.1.

Table 3.1: Demographic characteristics of patients enrolled in the currentstudy

Characteristic	Result
Number of cases	41
Age (years)	
Mean ±SD	60.24±13.55
Range	21 -88
20-39, *n* (%)	3(7.3%)
40-59, *n* (%)	13(31.7%)
≥ 60, *n* (%)	25(61.0 %)
Gender	
Male, (%)	11(26.8%)
Female, (%)	30(73.2%)

Findings of conventional abdominal ultrasound examination areshown in table 3.2. Overall, reports of conventional abdominal ultrasoundincluded information about common bile duct (CBD) and gall bladder.Dilated CBC was seen in all enrolled patients (100.0 %) and informationabout CBD diameter was available for 35 (85.4 %) patients only.
Mean CBD diameter was 11.97 ±4.11 mm and it ranged from 7 -26 mm. No CBD massand no CBD stone were identified in abdominal ultrasound.

Table 3.2:Finding of conventional abdominal ultrasound examination

Characteristic	Result
Common bile duct (CBD)	
Dilated CBD, *n* (%)	41 (100.0 %)
Information about diameter, *n* (%)	35(85.4%)
CBD diameter	
Mean ±SD	11.97±4.11
Range	7 -26

The findings of magnetic resonance imaging (MRI) are shown in table3.3. Common bile duct dilatation was seen in all cases and the meandiameter was 12.30 ±5.33 mm with a range of 6.8 -32 mm. Reporting ofCBD diameter was seen in 39 (95.1 %) cases.
Dilatation of pancreatic duct was seen in 7 (17.1 %) cases and thediameter was reported in 3 (7.3 %) cases with a mean of 6.70 ±2.52 mm anda range of 4.60 -9.50 mm.

Table 3.3: Findings of magnetic resonance imaging (MRI)

Characteristic	Result
Common bile duct (CBD)	
Dilated CBD, *n* (%)	41 (100.0 %)
CBD diameter (mm)	
Cases in which diameter reported, *n* (%)	39 (95.1 %)
Mean ±SD (range)	12.30±5.33 (6.8-32)
Pancreatic duct (PD)	
Dilated PD, *n* (%)	7 (17.1 %)
Pancreatic duct diameter (mm)	
Cases in which PD diameter reported, *n* (%)	3 (7.3 %)
Mean ±SD(range)	6.70±2.52(4.60 -9.50)

The findings of endoscopic ultrasound (EUS) were shown in table 3.4. Dilated CBD was seen in 27 (65.9 %) cases; whereas, normal CBD was seen in 14 (34.1 %) cases. Mean diameter of CBD was 8.91 ±3.70 mm and it ranged from 3 -21 mm. CBD stone was identified in 6 (14.6 %) cases, CBD mass was seen in 4 (9.4 %) cases and CBD distal benign stricture (chronic cholangitis) was seen in 2 (4.9 %) cases. Mass lesions included two cases of distal cholangiocarcinoma and there were also two cases of early ampullary tumors, T1, N0 and ampullary tumor T3, N1.

Choledochal cystic disease was seen in a single case. Portal biliopathy was seen in a single case and chronic pancreatitis was seen in 2 (4.9 %) cases.Suspected papillary stenosis was seen in 2 (4.9 %) cases and the diagnosis was confirmed by subsequent ERCP.
Diagnosis was unsettled in 9 cases (22.0 %) due to loss of follow up.
Two cases were suspicion of ampullary tumors, and in the remaining 7 cases (17 %) no pathology was found.

Table 3.4: Finding of endoscopic ultrasound (EUS)

Characteristic	Results
Common bile duct (CBD)	
Normal CBD	14 (34.1 %)
Dilated CBD, *n* (%)	27 (65.9 %)
CBD Diameter	
Mean ±SD	8.91±3.70
Range	3 -21
Diagnosed cases	
Stone, *n* (%)	6 (14.6 %)
Mass, *n* (%)	4 (9.8 %)
Distal benign Stricture (chronic cholangitis), *n* (%)	2(4.9%)
Choledochal cystic disease, *n* (%)	1 (2.4 %)
Portal biliopathy, *n* (%)	1 (2.4 %)
Chronic Pancreatitis, *n* (%)	2 (4.9 %)
Papillary stenosis, *n* (%)	2 (4.9 %)
Undiagnosed cases	
Suspected ampullary tumors	2(4.9%)
Unexplained CBD dilatation	7 (17 %)

PD: pancreatic duct; SOD: sphincter of Oddi dysfunction.

Both conventional ultrasound (US) and magnetic resonance imaging (MRI) resulted in overdiagnosis of CBD dilatation in comparison with EUS. 14 cases were diagnosed to have dilation of CBD by both US and MRI; however, they were proved to be normal by EUS. Therefore, no agreement(Kappa statistic = 0.00) was obtained by both US and MRI with EUS, as shown in tables 3.5 and 3.6.

Table 3.5: Comparison between endoscopic ultrasound (EUS) and conventional abdominal ultrasound (US) regarding detection of common bile duct (CBD) dilatation.

US	EUS			Kappa
	Total	Dilated	Normal	
Dilated	41	27	14	0.00
Normal	0	0	0	
Total	41	27	14	

EUS: endoscopic ultrasound; US: abdominal ultrasound; Kappa: Kappa agreement statistics

Table 3.6: Comparison between endoscopic ultrasound (EUS) and magnetic resonance imaging (MRI) regarding detection of common bile duct (CBD) dilatation

MRI	EUS			Kappa
	Total	Dilated	Normal	
Dilated	41	27	14	0.00
Normal	0	0	0	
Total	41	27	14	

MRI: magnetic resonance imaging; US: abdominal ultrasound; Kappa: Kappa agreement statistics.

The sensitivity, specificity, positive predictive value (PPV), negative predictive values (NPV), rate of true positive results (TP), false positive results (FP), true negative (TN) results and false negative (FN) results of both US and MRI in comparison with EUS were shown in table 3.7.

In addition, the means CBD as measured by both US and MRI were significantly higher than that obtained by EUS, 11.97 ±4.11 mm and 12.30±5.33 mm versus 8.91 ±3.70 mm, respectively (P< 0.05), as shown in table 3.8.

Table 3.7: The accuracy of abdominal ultrasound (US) and MRI in detecting common bile duct (CBD) dilatation in comparison to endoscopic ultrasound (EUS)

Characteristic	**US**	**MRI**
Sensitivity %	0.0	0.0
Specificity %	100.0	100.0
PPV %	---	---
NPV %	65.9	65.9
Accuracy %	65.9	65.9
TP, *n* (%)	27 (65.9 %)	27 (65.9 %)
TN, *n* (%)	0 (0.0 %)	0 (0.0 %)
FP, *n* (%)	14 (34.1 %)	14 (34.1 %)
FN, *n* (%)	0 (0.0 %)	0 (0.0 %)

US: abdominal ultrasound; MRI: magnetic resonance imaging; PPV: positive predictive value; NPV: negative predictive value; TP: true positive; TN: true negative; FP: false positive; FN: false negative; (---): positive predictive value (PPV) could not be calculated because of division on zero mathematical problem.

Table 3.8: showing comparison of mean common bile duct (CBD) diameter measured by three methods: endoscopic ultrasound (EUS), magnetic resonance imaging (MRI) and abdominal ultrasound (US)

	US	MRI	EUS	p-value
CBD (mm)	11.97 ±4.11	12.30±5.33	8.91 ±3.70	0.04

Discussion:

In the present study, 41 patients with common bile dilation and normal liver enzymes were included; their age was in the range of 21 -88 years and a mean of 60.24 ±13.55 years; however, the majority of cases were above 60 years of age. The mean age in the current study was less than that reported by some authors (11)who studies the yield of EUS in 57 patients with CBD dilatation and normal liver enzymes with a mean age of 66.8±9.7 years. In another study carried out by others (20), in 2017 on 70 patients with unexplained CBD dilatation based on transabdominal ultrasound, the mean age was 61.8 years and the range was 25 to 83 years; indeed, this age range and mean of age are very close to that reported in the present study. The mean age of patients with unexplained CBD according to abdominal imaging in the study of some authors (21)was 64 years which is higher than that reported in the current study.

In the current study, the majority of patients were female accounting for 73.2 % and this finding was in line with that of previous authors (10, 11). whereas, the proportion of women in the study conducted by some authors (20)in 2017 was 61.4 % and in the study carried out by others (21), the proportion of females was 64 % which is less than that reported by the current study but still indicating that the majority of patients with unexplained dilatation of CBD are often females.

In the current study, the conventional transabdominal ultrasound showed CBD dilatation in all enrolled patients and accordingly the range of CBD diameter was between 7 and 26 mm with a mean of 11.97 ±4.11.

In the current study, magnetic resonance imaging (MRI), has confirmed the existence of dilatation of CBD dilatation in almost all enrolled patients (95.1 %) with a mean diameter of 12.30 ±5.33 mm which is slightly higher than that reported by transabdominal ultrasound. However, MRI failed to identify the cause of CBD dilatation and therefore, those patients were candidate for further investigation by EUS. In the study conducted by some authors (11) in 2014, magnetic resonance cholangiopancreatography (MRCP) was carried out in 63.1% of patients and it failed to identify the cause of CBD dilatation, therefore, EUSwas performed later. This finding is similar to the finding of the current study that MRCP can fail to indentify cause of CBD in patients with normal liver enzymes and lack of jaundice.

In the current study, EUS has confirmed CBD in only 27 (65.9 %) cases; therefore, based on EUS findings, both transabdominal ultrasound and MRCP may result in overestimation of CBD diameter. This finding was evident since the mean diameter of CBD according to EUS was significantly less than that seen by Transabdominal ultrasound and MRCP, 8.91 ±3.70 mm versus 11.97 ±4.11 mm and 12.30 ±5.33 mm, respectively.

The reported CBD diameter in the current study was far less than that reported by previous study (11), 8.91 ±3.70 mm versus 12.5±3.6mm.However, other authors (10), in 2007 have reported a CBD diameter of 8.51 mm by EUS in patients with normal liver enzymes which is approximately similar to that of the current study versus (8.91 ±3.70 mm).

Of the 27 cases with CBD dilatation, CBD stone was identified in 6 (14.6 %) cases in the present study. In a previous study (11)Bruno et al., (2014), abnormal findings were reported in 12 (21 %) and CBD stone was identified in a single case only. In addition, previous reports (10)Malik et al.,(2007) have reported CBD stone in 3%. However, other authors (21), in 2012 have identified abnormalities in 54 (39%) patients with unexplained CBD dilatation according to abdominal imaging of whom 11 (8%) had CBD stone; however, they included cases with abnormal liver enzymes in their study. Previous study (22), in 2013 evaluated the role ofEUS in 40 patients with unexplained CBD dilatation according to abdominalimaging and found that 15 (37.5%) had CBD stones following EUS examination.

Some disorders are associated with isolated common bile dilation with no associated raised liver enzymes or jaundice. Choledocholithiasis affects 10 to 20 % of patients with gallstones and can be asymptomatic in approximately 50 % of cases and stones might be not identified within common bile duct by the use of conventional non invasive imaging modalities despite demonstration of duct dilation (23).

The sensitivity of TUS in detection of CBD stones is between 18% and 74% (24-26). Other techniques such as helical computed tomographic cholangiography (HCT-C) and MRCP have shown better sensitivities in comparison with conventional CT and TUS. Nevertheless, based on research work, EUS have more accurate diagnostic capability in detecting common bile stones as small as 5 mm in diameters in comparison with HCT-C and MRCP (27). In the setting of suspected common bile duct stone, the sensitivity of EUS may reach 90 % (28-30).

In a prospective study performed by previous authors in patients with dilated biliary duct, EUS increased the likelihood of accurate diagnosis of choledocholithiasis as the cause of obstruction from 49% to 84% (31).

Some authors compared MRCP and EUS when detecting choledocholithiasis that shows cost-effectiveness and greater accuracy of EUS when detecting distal small stones in non-dilated ducts (32,33, 34,35, 27).

In the present study, mass was seen in 4 (9.4 %) cases where as in the study of previous authors (11), mass lesions were seen in 3 cases and in the study of others (20), there 17 cases out of 74 with mass lesions. In our study, mass lesions included 2 cases of distal cholangiocarcinoma and two cases of ampullary tumors. In the study of some authors (22)mass lesions were seen in 2 (5%).In the present study, CBD stricture was seen in 2 cases, but previous study by some authors (11)mentioned nothing about CBD stricture; however, others (22)have identified CBD stricture in 7.5 % of cases.'In addition , EUS in the current study has identified a single case of choledochal cystic disease, a finding that was not reported by (11). Moreover, portal biliopathy was seen in a single case and pancreatitis was seen in 2 (4.9 %)cases in the current study. Some authors (11)also confirmed pancreatitis by EUS in 2 cases. Others (21)have also identified chronic pancreatitis in 9 (6%) of enrolled patients. Others (10)have also reported pancreatitis in 9 % of cases. Other authors (22)have identified chronic pancreatitis in 2.5 %.

In addition to stone, inflammatory strictures and neoplastic conditions, congenital anomalies such as choledochal cyst and duct dilatation are also causes of biliary tract dilatation which are usually detected during childhood period; however, these congenital abnormalities may remain undetected until adulthood in approximately quarter of cases (36, 37). In the current study in addition, suspected papillary stenosis was seen in 2 (4.9 %) cases and the diagnosis was confirmed by subsequent ERCP. This finding was not reported by some authors (11)but other authors (20)have identified 5 cases with papillary stenosis.In this study two cases were suspicion of ampullary tumors, and in the remaining 3 cases no pathology was found similar finding in other study (38). In the study of previous authors (11) there were six patients with a periampullary diverticulum, and in the study of others (10) there were 3 % of cases with periampullary diverticulum, a finding that was lacking in the current study.

Furthermore, previous report (39) presented evidence of mass, stricture or ductal filling defect on pre-EUS imaging or symptoms suggestive of sphincter of Oddi dysfunction or chronic pancreatitis, they selected 40 patients with isolated dilatation of CBD.Therefore, substantial variations in the causes of CBD dilatation between current study and previous studies in other countries are present, reflecting variation in risk factors related to some environmental and or genetic predisposition.

In an abstract published in 2009, 30 patients with biliary dilatation and no evident causes on prior imaging underwent EUS (40). Similarly to other studies, prevalence of abnormal findings during EUS examination was different between the patients With abnormal and those with normal liver chemistry tests (55% and 33% respectively).

Conversely, the number of pathological findings in the latter group differed from percentages reported by other authors (10, 11), probably because no details were specified in this study, about clinical presentation and previously used imaging techniques.In the current study, both conventional ultrasound (US) and magnetic resonance imaging (MRI) resulted in overdiagnosis of CBD dilatation in comparison with EUS. In addition, the means CBD as measured by both US and MRI were significantly higher than that obtained by EUS these result in accordance to other study (22).

The other techniques may also provide improper estimates of the exact size of a common bile duct. For instance, the wall thickness is going to be included with size estimation when using CT or MRCP and dilatation resulting from contrast is going to produce overestimate of duct size estimated by ERCP and transhepatic cholangiography (13, 15). In the present study, the proportion of patients with dilated CBD was higher in those with surgically removed gallbladder in comparison with those with retained gallbladder, 91.7 % versus 55.2 % and the difference was statistically significant (P = 0.033). The likely explanation is that elderlypatients with previous cholecystectomy operations may suffer from transfer of pressure fluctuation, previously accommodated by the gallbladder, to the common bile duct leading to its dilatation (14, 41, 42, 43).In the current study, there was no significant association between age and dilated CBD. A number of studies, done within the last three decades, have shown an increase in the diameter of common bile duct in elderly individuals (12,15, 44,, 45, 46). Some authors have suggested that the loss of elastic fibers with aging with compensatory dilatation is a possible cause for common bile dilation in elderly patients (47). Added to that, other authors have hypothesized that the use of calcium channel blockers and nitroglycerine and fragmentation of longitudinal bands within smooth muscles may result in hypotonia of these muscles within the wall of biliary tree with subsequent dilatation (46, 48).

Conclusions:

1. In this study approximately two thirds of patients have been identified to have significant pathological findings following EUS

2. The use of EUS offers the better diagnostic tool in terms of sensitivity and specificity for detecting CBD dilatation in patients with non specific abdominal pain associated with normal liver enzymes.

3. EUS enables the identification of causes of CBD dilatation in patients in whom other techniques such TUS and MRI fail to do that.

4. EUS gives the most accurate measurement of CBD since other techniques, MRI and TUS, are associated with overestimation.

Recommendations:

1. EUS is recommended in any patient with CBD dilatation detected by other imaging modality when these modalities fail to identify a cause for such dilatation even when serum liver enzymes are normal.

2. Conduction of a larger sample size study that is multicentric is recommended to validate the results of the current study.

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