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Diagnostic Value of Endoscopic Ultrasonography (EUS) in the Unexplained Common Bile Duct Dilatation

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ABSTRACT

Background: Many etiologies can be behind common bile duct dilatation that is undiagnosed, such as pancreatic and periampullary tumors, choledocholithiasis, or an inflammatory condition as stenosis. Endoscopic ultrasound (EUS) may have a major diagnostic value in detecting etiologies of dilated CBD undetected by other non-invasive modalities.
Objectives: This study aimed to determine whether endoscopic ultrasonography is helpful in detecting a common bile duct dilatation that isn't clear. **Methods:** This study was conducted on 67 participants who had unexplained CBD dilatation at Tropical Medicine Department, Zagazig University. Every patient underwent TUS, CT, MRCP and EUS. Findings of EUS were seen and verified by ERCP, surgery, or a biopsy that revealed cancer. Those who had normal results underwent three months of clinical monitoring. **Results:** 77.6% and 59.7% of patients underwent US and CT respectively prior to MRCP and EUS. By MRCP, 82.1% of patients were normal, 11.9% had stone, while 3% had CBD mass and 3% had stricture. While by using EUS, 50.7% were normal, 22.4% had stone, while 8.9% had ampullary lesion. Post EUS outcome 37 (55.2%) of patients had only medical follow up while 22.4% had stone extracted by ERCP, 6 patients (8.9%) had sphincterotomy and biopsy from lesions, 4 cases of them had adenocarcinoma, the other 2 cases had adenoma and 2 cases had CBD stricture treated by sphincterotomy and stent dilatation. 2 cases of pancreatic cancer underwent Whipple operation. EUS denied results of MRCP in 25 cases.
Conclusion: EUS has a very useful role in the diagnostic work up for patients with unexplained CBD dilatation with or without symptoms.
Keywords: Diagnostic, Endoscopic ultrasound, Common bile duct, Dilatation.

INTRODUCTION

Common bile duct (CBD) dilatation that is undiagnosed with unidentified cause by imaging might be attributed to many pathological causes like periampullary and pancreatic neoplasms, choledocholithiasis and/or inflammatory strictures. Also, CBD can be dilated in non-pathological conditions such as old age and prior cholecystectomy [(1)].

There are many investigational modalities of biliary system abnormalities incorporating endoscopic ultrasonography (EUS), transabdominal ultrasound (US), magnetic resonance imaging (MRI), endoscopic retrograde cholangiopancreatography (ERCP), and computed tomography (CT) [(2)]. Transabdominal ultrasonography (US) lacks accuracy since the imaging quality varies depending on the tissues and is operator-dependent in between, in determining the cause of biliary dilatation. Additionally, CT imaging lacks sensitivity in the diagnosis of biliary diseases and exposes users to radiation and contrast material [(3)]. Despite being while being the gold standard for biliary tract evaluation, ERCP has a number of disadvantages, including the possibility of life-threatening consequences including post-ERCP pancreatitis, hemorrhage, perforation, and even mortality [(4)]. Magnetic resonant cholangiopancreatography (MRCP) is the preferred imaging method for evaluating biliary tract abnormalities due to its high accuracy unfortunately it has limitations also like the inability to attain a histological diagnosis and the complications of contrast usage [(3)].

In the last decades the development of EUS as a cutting-edge technique for biliary abnormalities not only the highly sensitive diagnostic yield but also offers opportunity for histological tissue/lesion sampling and staging [(5)]. However, this study aimed to assess the role of EUS in identifying the precise cause of unexplained common bile duct dilatation because there is limited information regarding the yield of such EUS in individuals with unexplained CBD dilation.

PATIENTS AND METHODS

This prospective cohort study was conducted at Tropical Medicine, Zagazig University Hospitals between January 2020 and January 2022. The study comprised 67 participants with enlarged common bile ducts (internal diameter of CBD $\geq$ 7 mm [(6)]) proved by any other diagnostic imaging (US, CT, MRCP) irrespective to clinical data either symptomatic or not.

Exclusion criteria:

Patients with history of cholecystectomy or previous biliary surgery, patients having platelet count <50,000/cmm, patients with severe liver or kidney dysfunction, and patients having contraindication to sedation by Propofol.

Patients were categorized according to findings of EUS after MRCP modality into: Group (A) included patients who had no new findings in EUS with agreement with MRCP and group (B) contained patients who had new findings in EUS with disagreement with MRCP.

All patients underwent rigorous history taking, comprehensive clinical examinations, and the subsequent laboratory tests: liver enzymes (ALT, AST, and serum alkaline phosphatase), albumin, total and direct bilirubin, complete blood count, serum creatinine, coagulation profile PT and INR.

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Abdominal ultrasound: Experienced ultrasonologists performed the examination using an ultrasound machine with a (3.5–5) MHz curvilinear probe.

CT was carried out utilizing a high-speed advantage scanning (Siemens somatom plus and X-vision Toshiba)

MRCP technique were performed on a 1.5T magnetic resonance imaging (MRI) device with a thoracic phased array coil (Phillips Intera Version 2.6, Phillips Healthcare). No oral or contrast medications were given.

Endoscopic Ultrasound examination utilizing a Hitachi EUB-7000 HV ultrasound unit coupled to a Pentax linear array EUS machine type EG-3870-UTK (HOYA Corporation, PENTAX Lifecare Division, Showanomori Techno-logy Center, Tokyo, Japan) (Hitachi Medical Systems, Tokyo, Japan) The examination was performed with the patient in the left lateral decubitus position while being mildly sedated intravenously with midazolam and/or propofol, with the help of an anesthesia professional, and while being connected to instruments that monitor blood pressure, oxygen saturation, and pulse oximetry. One endosonographer handled every examination. We employed the Cook 22G or 19G needle (Echotip®; Wilson-Cook, Winston Salem, NC, United States) for EUS-FNA biopsies. The results of the EUS were noted and validated by an ERCP that was carried out later, by surgery and a biopsy that confirmed the presence of cancer, or, in cases where the EUS results were normal, by the clinical course over the length of follow-up (at least three months). After endoscopic biliary sphincterotomy, patients with choledocholithiasis, identified on EUS, underwent ERCP and balloon sweep of the CBD. After choledocholithiasis was discovered in real-time during an EUS session, the ERCP was carried out.

Follow up*:* was done to all cases after 3 months by clinical exam, lab findings and imaging based on the disease's progression and diagnostic suspicion.

Ethical consideration: Study approval was taken from IRB, Faculty of Medicine, Zagazig University with approval number 5821_ 22_12_2019 . All participants provided written consent after being fully briefed about the study's methodology.

Statistical analysis

Using IBM SPSS version 23.0 for Windows, data were analyzed (SPSS Inc., Chicago, IL, USA). The information presented as mean, standard deviation, and median (Min-Max). Frequency and percentage were used to express categorical data. The level of significance was identified at $P<0.05$.

RESULTS

Sixty-seven patients included in this interventional study their ages ranged between 25 and 75 years with the mean age of 55.5 years, there was a female predominance as 64.2% were females and 35.8% were males. Abdominal pain was present in 71.6% of patients. 38.8% had dyspepsia, 34.3% had jaundice and 14.9% had weight loss. Prior US and CT imaging were 77.6% and 59.7% of patients respectively **(Table 1)**.

MRCP results showed that the majority of patients were normal 55 (82.1%), while eight patients (11.9%) had CBD stone, only two cases (3%) had CBD mass and two patients had CBD stricture. On the other hand, after the patients undergone EUS, 34 patients (50.7%) had no pathology in CBD, and fifteen patients (22.4%) had stones, six cases (8.9%) had ampullary lesion, three cases had periampullary diverticulum (PAD), and three cases had CBD stricture. CBD mass, periampullary mass, and chronic pancreatitis were found in six cases two cases for each pathological lesion **(Table 2).** Regarding post EUS outcome, 37 cases (58.2%) (34 normal & 3 diverticulum) of patients underwent medical follow up for 3 months with no significant changes in clinical picture, laboratory investigations and imaging. While 30 cases underwent ERCP with sphincterotomy ± stent insertion such cases were (15 cases with CBD stone, 6 with ampullary mass, 3 stricture and 2 cases each for pancreatic mass, CBD mass and chronic pancreatitis). Fifteen cases (22.4%) had stone extracted by ERCP, 6 patients with ampullary mass (8.9%) had sphincterotomy and biopsy from lesions; 4 cases of them had adenocarcinoma while two cases had adenoma. Three cases had cholangiocarcinoma; 2 of them showed CBD mass in EUS and the other case showed stricture in CBD. 2 cases with chronic pancreatitis on EUS underwent ERCP that showed stricture. Two cases had CBD stricture treated by sphincterotomy and stent dilatation and the two cases who had pancreatic mass underwent Whipple operation **(Table 3).** Regarding the new findings in EUS among the overall patients; 34 cases (50.7%) showed normal findings and 33 cases (49.3%) had pathological findings. While in MRCP, 55 (82.1%) of patients had normal findings and 12 (17.9%) had pathology. EUS confirmed previous findings of MRCP in 42 (62.7%) cases, 32 normal, 6 stones, 2 CBD mass and 2 cases of biliary stricture. While, EUS showed new results in 25 (37.3 %) of cases; 23 of them had pathological lesions that showed normal in previous MRCP, while two cases showed pathology (stone) in MRCP and approved to be normal after EUS **(Table 4).**

EUS denied results of MRCP in 25 cases as 23 cases showed pathology after being normal in MRCP (nine patients had CBD stones, six patients had ampullary masses, three cases had PAD, two cases had chronic pancreatitis, two cases had pancreatic mass and only one patient had malignant stricture), while two cases proved normal by EUS after they were reported to have CBD stones in previous MRCP **(Table 5).**

EUS FNA was done for 15 cases, 6 cases of ampullary mass; 4 cases (26.6%) were diagnosed as ampullary adenocarcinoma and 2 cases (13.3%) as ampullary adenoma, 3 cases of stricture, 2 cases (13.3%) were diagnosed as benign papillitis and the other case as cholangiocarcinoma. 2 cases of pancreatic mass were diagnosed as pancreatic adenocarcinoma (13.3%), 2 cases of CBD mass were diagnosed as cholangiocarcinoma, 2 cases of chronic pancreatitis were confirmed by FNA **(Table 6).**

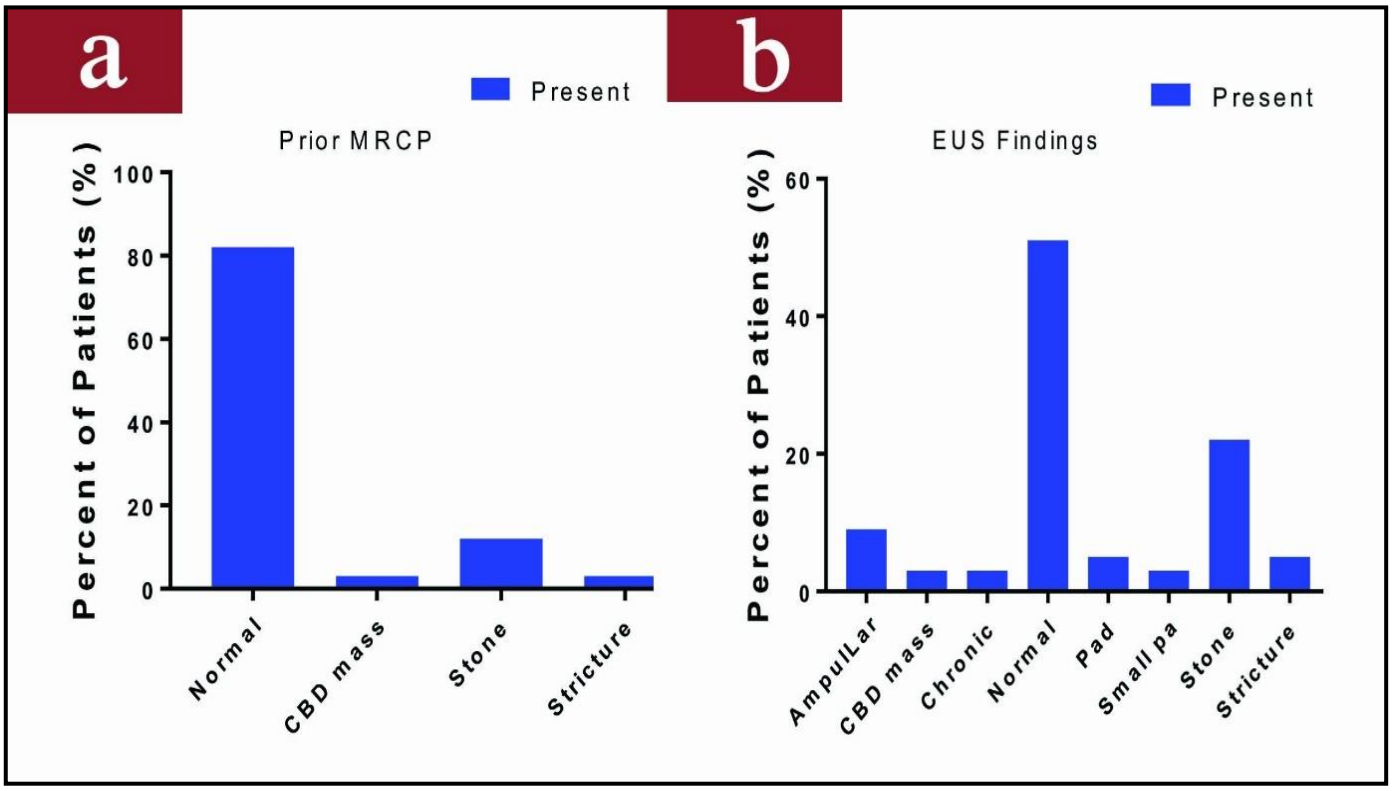

Figure (1): (A) MRCP findings among the studied patients (B) EUS findings among the studied patients.

Table (1): Demographic and clinical data of the studied patients (N=67)

Variables	Overall Patients (N=67)
Age	
Mean ± SD	55.5± 12.5
Median (Min-Max)	56 (25-75)
Gender	
Male	24 (35.8%)
Female	43 (64.2%)
Abdominal pain	48 (71.6%)
Dyspepsia	26 (38.8%)
Jaundice	23 (34.3%)
Weight loss	10 (14.9%)
Underwent US	52 (77.6%)
Underwent CT	40 (59.7%)

Data are represented as mean ± SD &Median (Min-Max) or number (%).

Table (2): MRCP and EUS findings of the studied patients (N=67)

Variables	Overall Patients (N=67)
MRCP Findings	
Normal	55 (82.1%)
Stone	8 (11.9%)
CBD mass	2 (3%)
Stricture	2 (3%)
EUS Findings	
Normal	34 (50.7%)
Stone	15 (22.4%)
Ampullary mass	6 (8.9%)
Peri-ampullary diverticulum	3 (4.5%)
Stricture	3 (4.5%)
CBD mass	2 (3%)
Chronic pancreatitis	2 (3%)
Pancreatic mass	2 (3%)

Data are represented as number (%).

Table (3): Post EUS outcome of the studied patients (N=67)

Post EUS outcome	
ERCP and sphincterotomy +	***30 (44.7%)***
*stent dilatation for stricture	2 (3%)
*biopsy for ampullary lesion (adenoma adenocarcinoma)	6 (8.9%)
*stones extracted	15 (22.4%)
*biopsy for CBD mass (cholangiocarcinoma)	3 (4.5%)
*stricture then follow up for chronic pancreatitis	2 (3%)
*then Whipple operation for pancreatic mass	2 (3%)
Follow up for normal cases and PAD	***37 (55.2%)***

Table (4): New finding in EUS among the overall patients (N=67)

Overall Patients, N=67	MRCP	EUS
Normal finding n (%)	55 (82.1%)	34 (50.7%)
Pathological finding n (%)	12 (17.9%)	33 (49.3%)
Agreement of finding in both MRCP & EUS	42 (62.7%)	
Pathology EUS after Normal MRCP	23 (34.3%)	
Normal EUS after Pathology MRCP	2 (3%)	

Data are represented as number (%).

Table (5): Patients with new finding in EUS in contrast with prior MRCP

Pathology in EUS after Normal MRCP	**Total 23 (34.3%)**
Stone	9 (13.4%)
Ampullary mass	6 (8.9%)
Peri-ampullary diverticulum	3 (4.5%)
Chronic pancreatitis	2 (3%)
Pancreatic mass	2 (3%)
Stricture	1 (1.5)
Normal EUS after Pathology MRCP	**Total 2 (3%)**
Stone	2 (3%)

Data are represented as number (%)

Table (6): EUS fine needle aspiration (FNA) was done

Variables	Overall Patients(N=15)
Ampullary mass 6 (40%)	Adenocarcinoma 4 (26.6%) Adenoma 2 (13.3%)
Stricture 3 (20%)	Benign papillitis 2 (13.3%) Cholangiocarcinoma 1 (6.6%)
Pancreatic mass 2 (13.3%)	Adenocarcinoma 2 (13.3%)
CBD mass 2	Cholangiocarcinoma 2 (13.3%)
Chronic pancreatitis 2	Chronic pancreatitis 2 (13.3%)

DISCUSSION

EUS is an essential technique for examination of biliary illness where MRCP cannot reveal the etiology of biliary dilatation. The biliary anatomy can be accurately diagnosed with EUS, and there is also the chance to obtain a sample for a histological conclusion. Moreover, it permits evaluation of invasion and local staging of any malignant lesion [7, 8].

This prospective cohort research comprised 67 patients with unexplained common bile duct dilatation. There were 24 males and 43 females, ranging in age from 25 to 75 years with mean age of 55.5 ± 12.5 years. Many previous studies reported similar findings as **Mrabti *et al.*** [9] who reported that there was a female predominance as 78.6% (n = 33) of the study participants. Women made up the majority of the patients, who had a sex ratio of M/F: 0.2 and age range of 28 to 80 years. Also, many previous studies reported close results [6, 7, 10]. In contrast **Phan *et al.*** [8] reported that the majority of patients (63.5%) were men, and at diagnosis, the average age was 64.6 ± 14.7 years. As common there are numerous factors that can result in bile duct dilatation, when one of these factors is present, patients may experience biliary pain, jaundice, or changes in their liver's chemistry [11].

Regarding clinical features of the patients in our study the abdominal pain was the most predominant symptom (71.6%) followed by dyspepsia (38.8%), jaundice (34.3%) and weight loss (14.9%). This was consistent with the research of **Sotoudehmanesh *et al.*** [6] who reported that clinical features were abdominal pain (77.6%), weight loss (27%), and Jaundice (40%). Also, **Ding *et al.*** [7] reported that the most common symptoms were abdominal pain (60.9%), followed by Jaundice (31.3%), fever (11.3%), nausea and emesis (5.2%), and weight loss (3.5%). However, **Atalla *et al.*** [10] reported that upper abdominal pain and jaundice were the two most typical presentations in their cohort (n = 43, 70.5% each) (n = 10, 16.4%).

In our study 77.6% and 59.7% of patients underwent inconclusive US and CT respectively for diagnosis of symptoms prior to MRCP and EUS. **Bruno *et al.*** [11] revealed that after earlier, inconclusive imaging tests, all patients were referred to EUS: 4 (7%) patients received transabdominal ultrasonography (TUS), 36 (63.1%) TUS MRCP procedures, 6 (10.5%) TUS and CT procedures, and 11 (19.3%) TUS, CT, and MRCP procedures. While, in terms of prior imaging, **Oppong *et al.*** [12] reported that 26 (36%) patients had either a CT scan or MRI and 29 (40%) had both. Also, **Phan *et al.*** [8] reported that prior to EUS, an average of 1.8 ± 1.0 imaging investigations were carried out on each patient.

Choledocholithiasis, can grow due to a variety of diseases, including stricture, cholangiocarcinoma, periampullary diverticulum, pancreatic head mass, sphincter of Oddi dysfunction, papillary stenosis, and others. A dilated CBD may be indicative of underlying biliary pathology, although it can also occur in older people or those who have undergone cholecystectomy without any pathology [7, 13]. The individuals with CBD

dilatation must therefore be assessed further in order to rule out any sinister underlying causes. With diagnostic outcomes MRCP is an excellent non-invasive method for the diagnosis of various illnesses causing CBD dilatation and is comparable to ERCP in this regard [14]. Therefore, the treating physician must decide whether to pursue further research with an ERCP or stop all investigations in the event that the MRCP only shows a mildly dilated CBD. Due to the proximity of the transducer put in the duodenum to the CBD, EUS is a fantastic technique to imaging the CBD [5].

It has been established that EUS is an effective method for evaluating pancreaticobiliary diseases and that its sensitivity for detecting CBD stones is equivalent to that of ERCP [15, 16].

Since MRCP and EUS are both superior diagnostic techniques for pancreaticbiliary diseases, it is crucial to compare their diagnostic efficacy. Most of the investigations have showed strong diagnostic performance of these two modalities with no significant difference in the diagnostic yield between these two modalities [13]. Hence, in individuals with equivocal MRCP, EUS would be able to identify any abnormality provided both modalities have equivalent diagnostic accuracy. Research have revealed that while MRCP and EUS have similar diagnostic yields, MRCP suffers when there are tiny CBD stones or dilated CBD [16].

In our study, there is highly significant difference between the MRCP and EUS detection rates of underlying pathology in overall studied patients with dilated CBD. The present study findings showed that by using MRCP, the majority of patients (82.1%) were normal, 11.9% had stone, while 3% had CBD mass and 3% had stricture. While, by using EUS, 50.7% were normal, 22.4% had stone, 8.9% had ampullary lesion, three cases had peri-ampullary diverticulum, three cases had CBD stricture, two cases had CBD mass, two cases had chronic pancreatitis and two cases had pancreatic mass. MRCP showed normal findings in 82.1% of patients while EUS revealed 50.7% normal findings. In **Bruno *et al.*** [11] of 57 patients who were evaluated, 12 (21%) had aberrant EUS findings.

In contrast **Sotoudehmanesh *et al.*** [6] showed that only 13 (8.5%) of 152 patients in their study had "normal" EUS results. Notable findings included 26 cases of CBD stones, 14 cases of ampullary tumors, 10 cases of distal CBD tumors, 8 cases of pancreatic cancers in patients with abnormal LFT and 68 patients had CBD dilatation in their MRCPs. The higher frequency of pathological findings in this study may be attributed to the large sample size (152 patients chosen from 922 who had EUS during study period). Moreover, a prior meta-analysis revealed that EUS was much more sensitive and accurate at diagnosing CBD stones than MRCP was, most likely as a result of a higher rate of small choledocholithiasis identification [17].

In our trial the post EUS outcome showed that 55.2% of patients underwent medical follow-up, ERCP and sphincterotomy was done for 30 case (44.7%) as following: 15 cases (22.4%) had stone extracted, 6 patients (8.9%) had biopsy from ampullary lesions, 4 cases approved had adenocarcinoma, 2 cases had adenoma, 2 cases showed stricture and their EUS showed chronic pancreatitis and 2 cases had CBD stricture treated by stent dilatation. Also, 2 cases underwent Whipple operation and 3 cases showed cholangiocarcinoma 2 of them show CBD mass in EUS and the other case show stricture in CBD.

ERCP was performed after choledocholithiasis was discovered in real-time during an EUS session. According to an abstract by JS Leeds, EUS and ERCP can be safely performed simultaneously without raising the chance of unfavorable outcomes [18], and a study by **Vila *et al.*** [19] found that the anesthetic dose was significantly decreased when EUS and ERCP were performed in one session as opposed to two. Studies on cost-effectiveness have shown that EUS is a less expensive option to MRCP, especially if ERCP can be performed concurrently. EUS may be considered as an alternative to MRCP, particularly when the therapeutic decision is supported [20].

Because of the danger of post-ERCP pancreatitis, alternate imaging is currently advocated in place of diagnostic ERCP when clinical suspicion for pathology is low. Given their similar diagnostic performance qualities to ERCP and their safety profiles, MRCP and EUS are excellent imaging alternatives for the biliary tract [21].

Also, **Anderson *et al.*** [22] and, **Early *et al.*** [23] reported that ERCP, which is significantly riskier than diagnostic EUS, has a much smaller role as a diagnostic modality, and has a very low complication rate. Several studies have compared MRCP and EUS for the purpose of identifying choledocholithiasis, the majority of them claim that EUS is superior, particularly for seeing tiny stones in non-dilated ducts [5,24]. **Scheiman *et al.*** [25] performed a cost analysis along with a prospective comparison of EUS, MRCP, and ERCP in patients with suspected biliary disease. They came to the conclusion that EUS was superior to MRCP for detecting CBD stones in a patient population with a low illness incidence and had the best cost-utility due to the avoidance of pointless ERCP exams. These results are also supported by our findings.

CONCLUSION

EUS has a very useful role in the diagnosis process for individuals with unexplained CBD dilatation with or without symptoms. Patients with unexplained CBD dilatation should undergo EUS as they are likely to have a finding on EUS, possibly with the majority of tiny stones of malignant lesions. There is a need for future bigger number of cases to further examine this topic as well as prospective studies with long-term follow-up are needed.

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REFERENCES

1. **Smyth J, Love M (2020):** Unexplained common bile duct dilatation: the role of endoscopic ultrasound. Clin Radiol., 75: 7–8.
2. **Rizvi A, Poneros J, Sethi A, Visrodia K (2022):** Does incidentally detected common bile duct dilation need evaluation? Cleve Clin J Med., 89 (6): 315–9.
3. **Holm A, Gerke H(200):** What should be done with a dilated bile duct? Curr Gastroenterol Rep., 12 (2): 150–156.
4. **Okano N, Ito K, Takuma K, Hara S, Igarashi Y (2021):** Prevention and management of ERCP-related complications. Mini-invasive Surg., 6 (5): 29.
5. C**hhoda A, Dawod S, Grimshaw A, Gunderson C, Mahadev S (2021):** Evaluation of diagnostic yield of EUS among patients with asympto-matic common bile duct dilation: systematic review and meta-analysis. Gastrointest Endosc., 94 (5): 890-901.
6. **Sotoudehmanesh R, Nejati N, Farsinejad M, Kolahdoozan S (2016):** Efficacy of Endoscopic Ultrasono-graphy in Evaluation of Undete-rmined Etiology of Common Bile Duct Dilatation on Abdominal Ultrasonography. Middle East J Dig Dis., 8 (4): 267.
7. **Ding H, Zhou P, Xu M, Chen W, Li Q, Chen T *et al.* (2019):** Combining endoscopic ultrasound and tumor markers improves the diagnostic yield on the etiology of common bile duct dilation secondary to periampullary pathologies. Ann Transl Med., 7 (14): 314–314.
8. **Phan J, Ge P, Kardashian A, Kim S, Sedarat A, Watson R *et al.* (2021):** The role of endoscopic ultrasound in evaluating patients with bile duct dilation of unclear etiology. J Dig Dis., 22 (10): 597–603.
9. **Mrabti S, Mrabti S, Seddik H, Boutallaka H, Loubaris K, Adajou T *et al.* (2019):** Diagnostic value of endoscopic ultrasonography in evaluation of undetermined etiology of bile ducts dilation in imaging. J Gastroenterol Hepatol Res., 8 (5): 2975–9.
10. **Atalla H, Menessy A, Hakim H, Shiomi H, Kodama Y, Ghoneem E (2022):** Clinical utility of linear endosono-graphy in patients with unexplained biliary dilatation and negative MRCP, with predictors for detection of neoplastic lesions. Egypt Liver J., 12 (1): 1–10.
11. **Bruno M, Brizzi R, Mezzabotta L, Carucci P, Elia C, Gaia S *et al.* (2014):** Unexplained common bile duct dilatation with normal serum liver enzymes: Diagnostic yield of endoscopic ultrasound and follow-up of this condition. J Clin Gastroenterol., 48 (8): 9-13.
12. **Oppong K, Mitra V, Scott J, Anderson K, Charnley R, Bonnington S *et al.* (2014):** Endoscopic ultrasound in patients with normal liver blood tests and unexplained dilatation of common bile duct and or pancreatic duct, 49 (4): 473–80.
13. **Abou Bakr S, Elessawy H, Ghaly S, Elezz M, Farahat A, Zaghloul M (2022):** Diagnostic accuracy of endoscopic ultrasound in evaluation of patients with obstructive jaundice: single-center experience. Egypt Liver J., 12 (1): 1–6.
14. **Palwa A, Nisar U, Shafique M, Aamir O, Riaz S, Bukhari A *et al.* (2022):** The Accuracy of Transabdominal Ultrasound (TAUS) in Detection of Choledocholithiasis Keeping Magnetic Resonance Cholangio-pancreatography (MRCP) as Gold Standard. Pakistan Armed Forces Med J., 72 (2): 485–9.
15. **D'Souza L, Buscaglia J (2019):** The Use of Endoscopic Ultrasound in the Evaluation of Unexplained Biliary Dilation. Gastrointest Endosc Clin N Am., 29 (2): 161–171.
16. **Rana S, Bhasin D, Sharma V, Rao C, Gupta R, Singh K (2013):** Role of endoscopic ultrasound in evaluation of unexplained common bile duct dilatation on magnetic resonance cholangiopancreatography. Ann Gastroenterol Q Publ Hell Soc Gastroenterol., 26 (1): 66-69.
17. **Meeralam Y, Al-Shammari K, Yaghoobi M (2017):** Diagnostic accuracy of EUS compared with MRCP in detecting choledocholithiasis: a meta-analysis of diagnostic test accuracy in head-to-head studies. Gastrointest Endosc., 86 (6): 986–993.
18. **Hulley J, Gunn M, Robertson J (2012):** PTU-242 Can endoscopic ultrasound and ERCP be performed safely in the same patient during the same session? Gut, 61 (2): 284–284.
19. **Vila J, Kutz M, Goñi S, Ostiz M, Amorena E, Prieto C *et al.* (2011):** Endoscopic and anesthetic feasibility of EUS and ERCP combined in a single session versus two different sessions. World J Gastrointest Endosc., 3 (3): 57–61.
20. **Schmidt S, Chevallier P, Novellas S, Gelsi E, Vanbiervliet G, Tran A *et al.* (2007):** Choledocholithiasis: Repetitive thick-slab single-shot projection magnetic resonance cholangio-pancreaticography versus endoscopic ultrasonography. Eur Radiol., 17 (1): 241–50.
21. **Malik S, Kaushik N, Khalid A, Bauer K, Brody D, Slivka A *et al.*** EUS yield in evaluating biliary dilatation in patients with normal serum liver enzymes. Dig Dis Sci., 52 (2): 508–512.
22. **Anderson M, Fisher L, Jain R *et al.* (2012):** Complications of ERCP. Gastrointest Endosc., 75 (3): 467–473.
23. **Early D, Acosta R, Chandrasekhara V *et al.* (2013):** Adverse events associated with EUS and EUS with FNA. Gastrointest Endosc., 77 (6): 839–843.
24. **Akkuzu M, Altıntaş E, Yaraş S, Özdoğan O, Ucbilek E, Ates F *et al.* (2020):** EUS accuracy against MRCP for detection of pancreaticobiliary lesions. East J Med., 25 (4): 535–539.
25. **Scheiman J, Carlos R, Barnett J *et al.* (2001):** Can endoscopic ultrasound or magnetic resonance cholangiopancreatography replace ERCP in patients with suspected biliary disease? A prospective trial and cost analysis. Am J Gastro-enterol., 96 (10): 2900–2904.