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Original research

DIAGNOSTIC VALUE OF EUS FOR CHOLEDOCHOLITHIASIS IN PATIENTS INDICATED FOR ERCP

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ABSTRACT

Background: *To evaluate the diagnostic value of endoscopic ultrasound (EUS) in detecting common bile duct (CBD) stones in patients with indications for endoscopic retrograde cholangiopancreatography (ERCP).*

Methods: *A descriptive study included 41 patients with symptoms suspected of common bile duct stones from January 2022 to May 2023.*

Results: *The mean age of the study group was 64 ± 14.1 years, with 58.5% of patients being 60 years or older. There were 20 male and 21 female patients, with a male-to-female ratio of 1:1.05. 100% of patients presented with abdominal pain. The rate of increased total bilirubin was 58.5%, and the rate of increased direct bilirubin was 73.2%. EUS detected CBD dilation > 10mm in 65.9% of patients, stones in 70.7%, stones located in the distal 1/3 of the CBD in 65.5%, and stones > 10mm in 62.1%. ERCP evaluation revealed CBD dilation > 10mm in 75.6% of patients, a mean CBD diameter of 13.9 ± 4.3mm, and 16 patients (39%) with a single stone. The rate of stones >10mm was 53.6%, with a mean stone size of 11.9 ± 4.9mm. EUS had a sensitivity of 100%, specificity of 92.3%, accuracy of 97.6%, positive predictive value of 96.6%, and negative predictive value of 100% in diagnosing CBD stones, which was superior to ultrasound and CT scan.*

Conclusion: *EUS is an effective, safe, and minimally invasive diagnostic tool for CBD stones.*

Keywords: *Bile duct stones, Common bile duct, Endoscopic ultrasound, Endoscopic retrograde cholangiopancreatography.*

I. BACKGROUND

Choledocholithiasis is a common pathological condition involving the formation of stones within the biliary system, which can lead to various severe symptoms and complications if not detected and managed promptly [1, 2]. The prevalence and etiologies of gallstones vary across geographical regions: while cholesterol stones from the gallbladder predominate in Western countries, pigment stones associated with biliary infections and parasites are more prevalent in Asian countries [1].

In the diagnosis of choledocholithiasis, clinical signs and biochemical tests are often nonspecific. Therefore, imaging modalities play a crucial role. Abdominal ultrasound and computed tomography (CT) are commonly the initial imaging techniques due to their availability and cost-effectiveness [3, 4]. However, abdominal ultrasound has low sensitivity in detecting common bile duct (CBD) stones, especially in cases of small stones, distal CBD stones, or patients with significant bowel gas [5, 6]. Conventional abdominal CT may also miss bile duct stones because many bile duct stones are not clearly radiopaque on CT [7].

In this context, endoscopic ultrasound (EUS) emerges as a high-resolution, minimally invasive imaging modality, particularly effective in detecting CBD stones, including those smaller than 5 mm [1,

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8]. Numerous studies worldwide have demonstrated that EUS has higher sensitivity and specificity than ultrasound and CT in detecting CBD stones. Furthermore, EUS allows for a comprehensive evaluation of the biliary system before deciding on endoscopic retrograde cholangiopancreatography (ERCP) intervention, thereby reducing unnecessary ERCP indications - a therapeutic technique with potential complications such as acute pancreatitis, bleeding, and duodenal perforation [2, 9].

However, in Vietnam, the clinical application of EUS in diagnosing CBD stones is not yet widespread, and specific research data are lacking. Therefore, we conducted this study to evaluate the diagnostic value of endoscopic ultrasound in detecting common bile duct stones in patients indicated for endoscopic retrograde cholangiopancreatography.

II. MATERIALS AND METHODS

2.1. Materials

A total of 41 patients with suspected common bile duct (CBD) obstruction due to stones were indicated for endoscopic ultrasound (EUS) and endoscopic retrograde cholangiopancreatography (ERCP) for stone removal or biliary drainage at Hue Central Hospital from January 2022 to May 2023.

Inclusion criteria: Patients indicated for pancreatobiliary EUS and ERCP for stone removal or biliary drainage who agreed to participate in the study.

Exclusion criteria: Patients with contraindications to gastrointestinal endoscopy, a history of gastrectomy making EUS access difficult, malignant diseases of the pancreatobiliary region, or those who did not consent to the study.

2.2. Research Method

In a cross-sectional study, the diagnostic value of EUS was systematically assessed by comparing its findings with those obtained via ERCP, thereby elucidating its clinical utility.

Research Equipment: The research utilized the Fujinon Sonart SU-I EUS system equipped with a radial scanning probe.

EUS Indications: Patients presenting with symptoms of biliary stone disease underwent initial assessment with liver function tests (SGOT, SGPT, bilirubin, etc.) and abdominal ultrasound. Risk stratification for choledocholithiasis was performed according to the 2019 guidelines of the European Society of Gastrointestinal Endoscopy (ESGE) [10]:

Low risk of choledocholithiasis: Normal liver function tests and no bile duct dilation or stones on abdominal ultrasound.

Intermediate risk: Abnormal liver function tests and/or bile duct dilation on abdominal ultrasound without visible stones.

High risk: Evidence of cholangitis or confirmed bile duct stones on abdominal ultrasound.

Patients categorized as intermediate or high risk for choledocholithiasis were indicated for EUS.

EUS Procedure:- Patients received pre-procedural sedation. The echoendoscope was inserted to examine the esophageal, gastric, and duodenal (D1-D2) mucosa and to assess the major duodenal papilla. Ultrasound mode was activated to evaluate the pancreatobiliary region.

2.3. Data analysis

Data were collected using a structured questionnaire and analyzed statistically using SPSS version 22.0 software.

III. RESULTS

The study included 41 patients with suspected CBD stones indicated for EUS and ERCP. The mean age of the study population was 64 ± 14.1 years, with 58.5% aged 60 years or older. There were 20 male and 21 female patients, with a male-to-female ratio of 1:1.05. All patients (100%) experienced abdominal pain. Laboratory tests showed elevated total bilirubin in 58.5% of cases and elevated direct bilirubin in 73.2%. EUS Findings: CBD dilation >10mm was observed in 65.9% of cases. Stones were detected in 70.7% of patients, with 65.5% located in the lower third of the CBD. Stones > 10mm in size accounted for 62.1%. ERCP Findings: CBD dilation > 10mm was found in 75.6% of cases, with a mean diameter of 13.9 ± 4.3mm. Single stones were identified in 16 patients (39%). Stones > 10mm accounted for 53.6%, with an average stone size of 11.9 ± 4.9mm. Diagnostic Performance of EUS for CBD Stones: EUS demonstrated superior performance with a sensitivity (SE) of 100%, specificity (SP) of 92.3%, accuracy (ACC) of 97.6%, positive predictive value (PPV) of 96.6%, and negative predictive value (NPV) of 100%. These metrics were markedly better compared to abdominal ultrasound (SE: 64.29%, SP: 84.62%, ACC: 70.73%, PPV: 90.00%, NPV: 52.38%) and computed tomography (CT) (SE: 82.14%, SP: 84.62%, ACC: 82.93%, PPV: 92.00%, NPV: 68.75%).

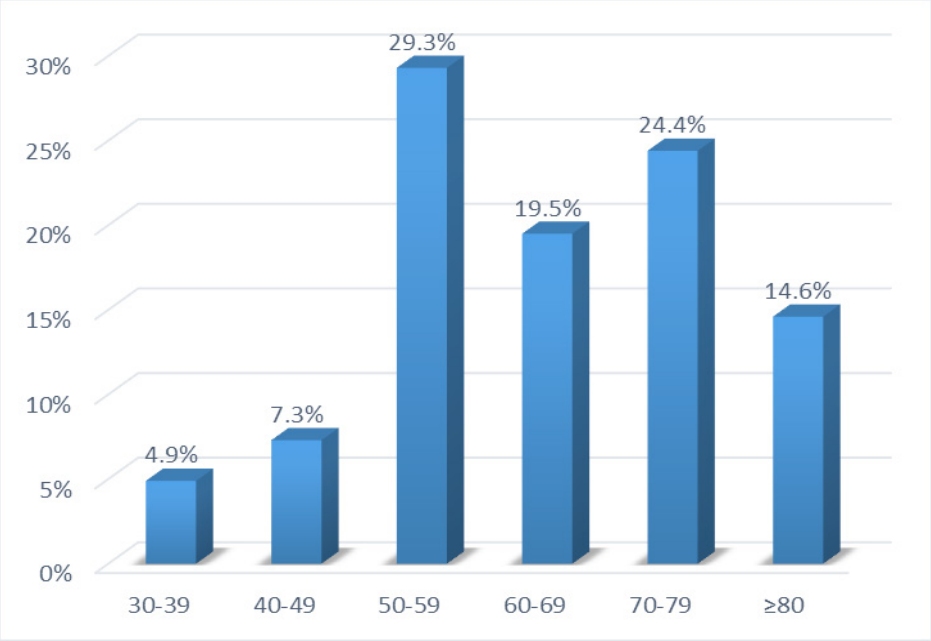

Figure 1. Age

Table 1. Clinical and paraclinical characteristics

Characteristics	n=41 (%)	Average Value Mean ± SD
Abdominal pain	41 (100)	
Fever	18 (43.9)	
Jaundice	16 (39)	
WBC	19 (46.3)	10.87 ± 5.45 (K/µL)
Total Bilirubin	24 (58.5)	74.91 ± 104.96 (µmol/L)
Direct Bilirubin	30 (73.2)	40.12 ± 62.19 (µmol/L)
SGOT	28 (68.3)	166.94 ± 232.93 (U/L)
SGPT	27 (65.9)	179.03 ± 220.54 (U/L)

Table 2. Endoscopic ultrasound Findings

EUS Findings		n	%
CBD Diameter	Non-dilated (< 7mm)	1	2.4
	Mildly dilated (≥ 7mm; ≤ 10mm)	13	31.7
	Largely dilated (> 10mm)	27	65.9
	Total	41	100
Number of Stones	No stones	12	29.3
	1 stone	16	39
	≥ 2 stones	13	31.7
	Total	41	100

EUS Findings		n	%
Location of CBD stones	Upper	5	17.2
	Middle	5	17.2
	Lower	19	65.5
	Total	29	100
Stone Size	Small stones (≤ 10mm)	11	37.9
	Large stones (> 10mm)	18	62.1
	Total	29	100

Table 3. ERCP Findings

ERCP Findings		n	%
CBD Diameter	Non-dilated (< 7mm)	1	2.4
	Mildly dilated (≥ 7mm, ≤ 10mm)	9	22.0
	Largely dilated (> 10mm)	31	75.6
	Total	41	100
Number of Stones	No stones	13	31.7
	1 stone	16	39.0
	≥ 2 stones	12	29.3
	Total	41	100
Stone Size	Small stones (≤ 10mm)	13	46.4
	Large stones (> 10mm)	15	53.6
	Total	28	100

Table 4. Comparison of Ultrasound, CT, and EUS in Detecting CBD Stones

Method		CBD stones ERCP		Total	SE (%)	SP (%)	ACC (%)	PPV (%)	NPV (%)
		Positive	Negative						
US	Positive	18	2	20	64.29	84.62	70.73	90.00	52.38
	Negative	10	11	21					
	Total	28	13	41					
CT	Positive	23	2	25	82.14	84.62	82.93	92.00	68.75
	Negative	5	11	16					
	Total	28	13	41					
EUS	Positive	28	1	29	100	92.31	97.56	96.55	100
	Negative	0	12	12					
	Total	28	13	41					

IV. DISCUSSION

Compared to other imaging modalities, endoscopic ultrasound (EUS) demonstrated superior diagnostic accuracy in detecting choledocholithiasis. In our study, EUS achieved a sensitivity (SE) of 100%, specificity (SP) of 92.31%, and accuracy (ACC) of 97.56%, which were significantly higher than those of computed tomography (CT) (SE: 82.14%, SP: 84.62%, ACC: 82.93%) and abdominal ultrasound (US) (SE: 64.29%, SP: 84.62%, ACC: 70.73%). These results highlight the clear advantage of EUS in detecting bile duct stones, particularly in difficult or ambiguous cases. The positive predictive value (PPV) and negative predictive value (NPV) of EUS were 96.55% and 100%, respectively, outperforming ultrasound (PPV: 90.00%, NPV: 52.38%) and CT (PPV: 92.00%, NPV: 68.75%). This finding is clinically meaningful, as a negative EUS result can virtually exclude the presence of stones, while ultrasound and CT may miss a considerable proportion of true cases.

These results are consistent with previous studies. Netinatsunton (2016) reported a sensitivity of 97.6% and specificity of 80% for EUS [11], while Jeon (2017) and Bansal (2017) also demonstrated the superior performance of EUS, particularly in detecting small stones or in cases where other imaging modalities yielded inconclusive results [12, 13].

The clinical characteristics of the patients in our study were comparable to those reported in earlier research. All patients presented with abdominal pain, 43.9% had fever, and 39% had jaundice—findings in line with De Silva (2019), who also reported abdominal pain as the most common presenting symptom [14]. Elevation of total bilirubin was observed in 58.5% and direct bilirubin in 73.2% of cases, reflecting significant biliary obstruction, consistent with the findings of Nguyen Anh Tan (2022) [15].

Imaging characteristics were also noteworthy. EUS detected CBD dilation >10 mm in 65.9% of patients and mild dilation (≥7 mm and ≤10 mm) in 31.7%, consistent with the 90.3% reported by Duong Minh Thang (2018) [16]. Regarding stone location, 65.5% were identified in the distal third of the CBD, comparable to De Silva (2019), where 68.4% were located in the distal segment [14].

In our study, patients with intermediate or high risk for choledocholithiasis were indicated for EUS. Although the 2019 ESGE guidelines recommend immediate ERCP for patients at high risk of CBD stones, EUS may still be considered in selected clinical situations [17]. Specifically, in high-risk patients without definitive imaging evidence of stones, EUS serves as a valuable tool for diagnostic confirmation prior to ERCP, thereby avoiding unnecessary invasive procedures [18]. EUS is particularly helpful in suspected small stones (< 5 mm) or stones located in the distal CBD, which may be missed by ultrasound or CT [19]. Furthermore, EUS plays an essential role in cases of biliary obstruction of unknown origin, helping to distinguish between benign and malignant lesions prior to ERCP intervention [20]. Individualized use of EUS in high-risk patients can enhance diagnostic accuracy and reduce the risk of complications associated with unnecessary ERCP.

Our study confirms that EUS is the most accurate imaging modality for diagnosing choledocholithiasis (ACC 97.56%), significantly outperforming both CT and ultrasound. However, the study had limitations, including a small sample size (n = 41), which may affect generalizability. The accuracy of EUS is operator-dependent [1] and may be influenced by spontaneous passage of small stones into the duodenum during the interval between EUS and ERCP [21]. Further large-scale studies comparing EUS with MRI and ultrasound are warranted, and the application of artificial intelligence (AI) should be considered to enhance diagnostic precision and reduce operator dependency [22].

V. CONCLUSION

EUS is an effective, safe, and minimally invasive diagnostic tool for CBD stones. With further technological advancements and expanded research, EUS has the potential to become the standard approach for biliary disease management both in Vietnam and globally.

Conflict of interest statement

The authors declare no conflicts of interest regarding the research, authorship, and publication of this article.

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