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Application of Endoscopic Ultrasound in Pancreaticobiliary Diseases from Diagnostic to Therapeutic Yield

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ABSTRACT

Background: Pancreaticobiliary diseases significantly contribute to global morbidity and mortality. Endoscopic ultrasound (EUS) is a highly accurate diagnostic tool for pancreaticobiliary disorders, surpassing other imaging modalities. Beyond diagnosis, EUS plays a crucial role in tissue sampling, cancer staging, and interventional procedures, making it an essential tool in both diagnostic and therapeutic management. **Aim**: This study aimed to evaluate the role of EUS in diagnosing and managing pancreaticobiliary disorders, highlighting its effectiveness in both diagnostic and therapeutic approaches.

Subjects and Methods: A descriptive cross-sectional study was conducted from April 2022 to May 2024, including 100 patients who underwent EUS for pancreaticobiliary disorders. The study assessed the diagnostic accuracy and therapeutic applications of EUS in comparison to other imaging modalities.

Results: In a study of 100 patients, EUS demonstrated superior diagnostic accuracy, identifying 35 malignant pancreatic lesions compared to just 17 found by other imaging techniques. It also proved more effective at detecting microlithiasis and common bile duct (CBD) strictures, diagnosing six cases versus one from other methods. Four patients previously suspected of pancreatic lesions were instead diagnosed with Lemmel syndrome. EUS's role as an essential supplemental diagnostic tool for unclear CBD strictures was confirmed. In terms of therapeutic applications, EUS-guided interventions were successfully performed on eight patients with favorable outcomes. **Conclusion and recommendations:** EUS has evolved into a safe, sophisticated tool with enhanced therapeutic potential. Integrating it into pancreatic centers should be prioritized for its diagnostic and treatment capabilities.

Keywords: Endoscopic intervention; Biliary stricture; Pancreatic malignancy; Lemmel syndrome; EUS-guided biopsy

INTRODUCTION

Pancreaticobiliary diseases are a significant cause of morbidity and mortality worldwide. Endoscopic ultrasound (EUS) has emerged as a superior diagnostic tool compared to transabdominal ultrasound (TUS) in detecting pancreaticobiliary disorders [1]. EUS plays a vital role in the local and regional assessment of various malignancies and offers advanced interventional procedures, including drainage of pancreatic and biliary ductal obstructions, management of peripancreatic collections, and tumor-directed therapies[2]. EUS-guided interventions are generally considered safe, effective, and minimally invasive compared to percutaneous radiological or surgical approaches. In addition to its diagnostic role, EUS is crucial for tissue sampling and cancer staging. The growing field of interventional EUS has expanded its use in therapeutic applications, making it a key component in modern gastroenterology[3].

EUS is also valuable in diagnosing early chronic pancreatitis (CP). Over time, EUS-based CP diagnosis has evolved from a qualitative assessment to more advanced scoring systems that incorporate multiple parenchymal and ductal features. Recent advancements, such as quantitative EUS elastography, allow for objective measurement of pancreatic fibrosis, offering a promising tool for early CP detection[4].

In cases of biliary obstruction, endoscopic retrograde cholangiopancreatography (ERCP) and percutaneous transhepatic biliary drainage (PTBD) remain the standard approaches. However, endoscopic ultrasound-guided biliary drainage (EUS-BD) and gallbladder drainage (EUS-GBD) are emerging as viable alternatives for managing complex biliary disorders[5].

Given the increasing role of EUS in both diagnosis and treatment[6], this study aimed to evaluate its application in pancreaticobiliary diseases, comparing its accuracy and clinical benefits to other imaging modalities.

PATIENTS AND METHODS

Study setting:

This study was conducted at Al-Azhar University and the Theodor Bilharz Research Institute (TBRI), involving 100 consecutive patients who presented with pancreaticobiliary diseases detected through radiological imaging who attended to Endoscopy Department. The aim of the study was to document the diagnostic and therapeutic yield of EUS in clinical practice.

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Study design:

A descriptive cross-sectional study was performed over 24 months, from April 2022 to May 2024, including patients who met the inclusion criteria.

Data collection

All patients underwent a standardized diagnostic workup including detailed history, focused clinical examination, and baseline laboratory investigations (CBC, coagulation profile, liver and renal function tests, electrolytes). Imaging with abdominal ultrasound, CT abdomen and pelvis with contrast, or MRCP was performed to evaluate the pancreaticobiliary system. Endoscopic ultrasound (EUS) was performed as a part of routine clinical evaluation. EUS was conducted under sedation using a radial echoendoscope. In cases with suspected ampullary or pancreatic lesions, EUS-guided fine needle aspiration (FNA) or biopsy (FNB) was performed using a convex array echoendoscope and 19- or 22-gauge needles. This comprehensive approach enabled accurate anatomical and histopathological assessment of pancreatobiliary pathology.

Therapeutic EUS was carried out when clinically indicated following standard institutional protocols (no experimental or interventional treatments were introduced specifically for the purpose of the study). All collected data were observational, and patients were not followed prospectively beyond the index procedure.

The final diagnosis was established based on the integration of all clinical data, imaging findings, and the results of tissue acquisition (EUS-guided FNA or FNB). In cases where pathology was inconclusive, follow-up data and additional investigations were also considered to confirm the final diagnosis.

Ethical consideration:

The study protocol was approved by the Ethical Committee of the Faculty of Medicine (For Girls), Cairo, Al-Azhar University, under approval number 1232, dated 9/2/2022. All patients provided informed consent before the procedure. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human subjects.

Statistical analysis:

All data were documented and then analyzed using IBM SPSS Statistics version 22. Numerical data were presented as mean, standard deviation (SD), and range. Qualitative data were expressed as frequencies and percentages. Diagnostic validity measures, including sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), were calculated.

RESULTS

A total of 100 patients were included in this study, with a nearly equal gender distribution (52% female, 48% male). The mean age was 54.3 ± 14.5 years (range: 18–85 years). Clinical Presentations: Abdominal pain was the most common symptom, reported in 94% of patients. Jaundice was observed in 64% of case. Pruritus (itching) was present in 34% of patients. The most frequently reported constitutional symptoms included weight loss (54%), anorexia (19%), and nausea (17%). Comorbidities, Diabetes mellitus was the most common associated condition (54%). Hypertension was recorded in 29% of patients (Table 1).

Table (1): **Patient Demographics and Clinical Characteristics**

Demographic Characteristics	**Statistics, N. (%)**
Sex:	
- **Female**	52 (52.0)
- **Male**	48 (48.0)
Age (year):	
- **Range**	(85- 18) = **67**
- **Mean ± SD**	**54.3 ± 14.5**
Clinical data	**Statistics Total =100, N (%)**
Jaundice	
- **Yes**	**64 (64.0)**
- **No**	**36 (36.0)**
Itching	
- **Yes**	**34 (34.-0)**
- **No**	**66 (66.0)**
Abdominal pain	
- **Yes**	**94 (94.0)**
- **No**	**6 (6.0)**
Constitutional symptoms	
- **Weight loss**	**54 (54.0)**
- **Anorexia**	**19 (19.0)**
- **Nausea**	**17 (17.0)**
- **Fever**	**6 (6.0)**
- **Vomiting**	**1 (1.0)**
- **No**	**2 (2.0)**
Hypoglycemia	**1 (1.0)**
Associated conditions	
- **Diabetes mellitus**	**54 (54.0)**
- **No associated conditions**	**38 (38.0)**
- **Hypertension**	**29 (29.0)**
- **Cerebrovascular disease**	**9 (9.0)**
- **Hepatitis C virus**	**4 (4.0)**
- **Chronic liver disease**	**3 (3.0)**
- **Atrial fibrillation**	**3 (3.0)**
- **Hepatitis B virus**	**1 (1.0)**
- **Bronchial Asthma**	**1 (1.0)**
- **Epilepsy**	**1 (1.0)**
- **Valvular heart disease**	**1 (1.0)**

Figure (1) shows different imaging modalities (TUS, CT, MRI, MRCP) that detected indeterminate pancreatic lesions in 48% of cases, other biliary lesions 28%, and pancreatic malignancy diagnosed in 17%.

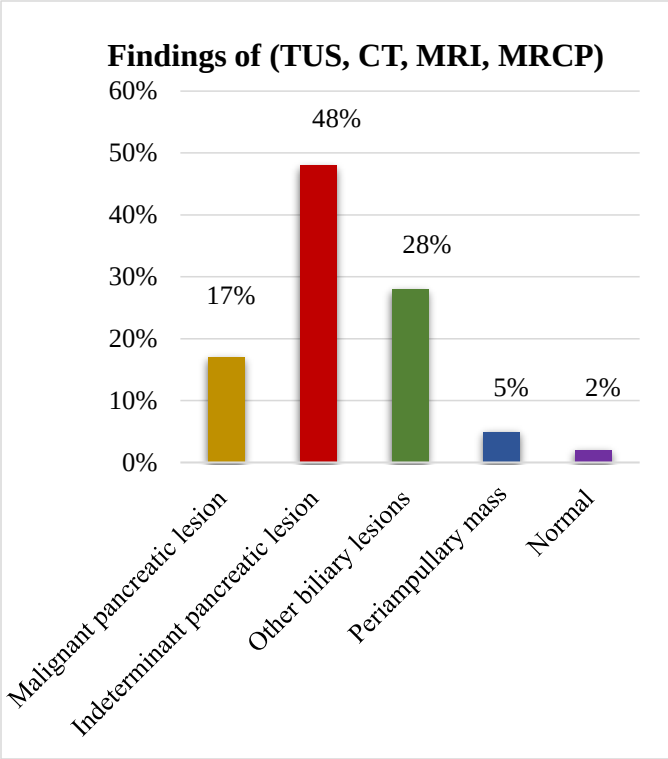

Figure (1): Findings from Imaging Modalities (TUS, CT, MRI, MRCP)

Figure (2) shows EUS findings, which demonstrated malignant pancreatic lesions in 35% of cases and indeterminate pancreatic lesions in 28%

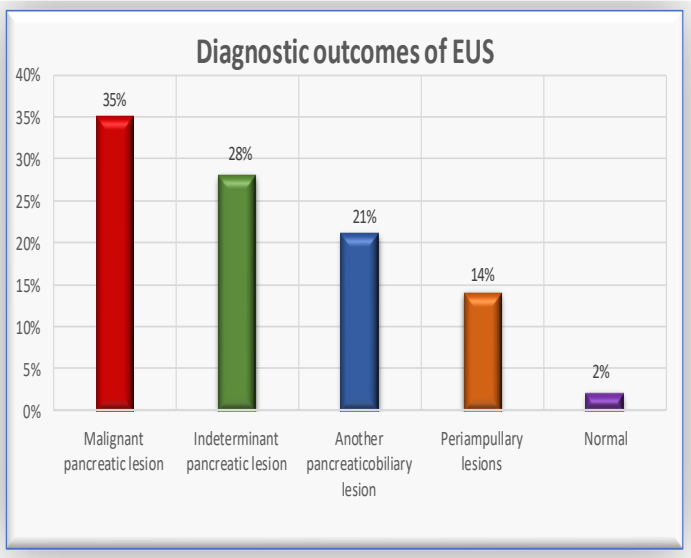

Figure (2): Diagnostic outcomes of Endoscopic ultrasound

Table (2) presents the therapeutic procedures was performed using endoscopic ultrasound (EUS) among the participants of the study. A total of (8) cases were included in the analysis. Among the cases, EUS–hepaticogastrostomy was carried out in 5 patients who had pancreatic ductal adenocarcinoma and had previously undergone unsuccessful endoscopic retrograde cholangiopancreatography.

This accounts for 62.5% of the total cases. In 2 cases, EUS-Cystogastrostomy was performed for individuals diagnosed with pancreatic pseudocyst and unresolved pancreatic pseudocyst. Only 1 case underwent EUS-choledochoduodenostomy. The patient had pancreatic ductal adenocarcinoma and had also experienced failed endoscopic retrograde cholangiopancreatography.

Table (2): Endoscopic ultrasound - therapeutic maneuver among participants

Maneuver	Diagnosis	Cause of intervention	Statistics Total = 8 N (%)
Endoscopic ultrasound – hepatico-gastrostomy	Pancreatic ductal adenocarcinoma	Failed Endoscopic retrograde cholangiopancreatography	5 (62.5)
Endoscopic ultrasound-cystogastro-stomy	Pancreatic pseudocyst	Unresolved pancreatic pseudocyst	2 (25.0)
Endoscopic ultrasound-choledo-choduodeno stomy	Pancreatic ductal adenocarcinoma	Failed Endoscopic retrograde cholangiopancreatography	1 (12.5)

Figure (3) illustrates the final diagnosis for the participants of 100 cases included in this study research. There was a total of 50 cases of malignant pancreatic biliary lesions. Out of these, pancreatic ductal adenocarcinoma was determined in 38 cases. The benign pancreatic biliary lesion was detected in 30% of cases. Periampullary mass was found in 12% of cases and 2% cases were ultimately diagnosed with normal endoscopic findings.

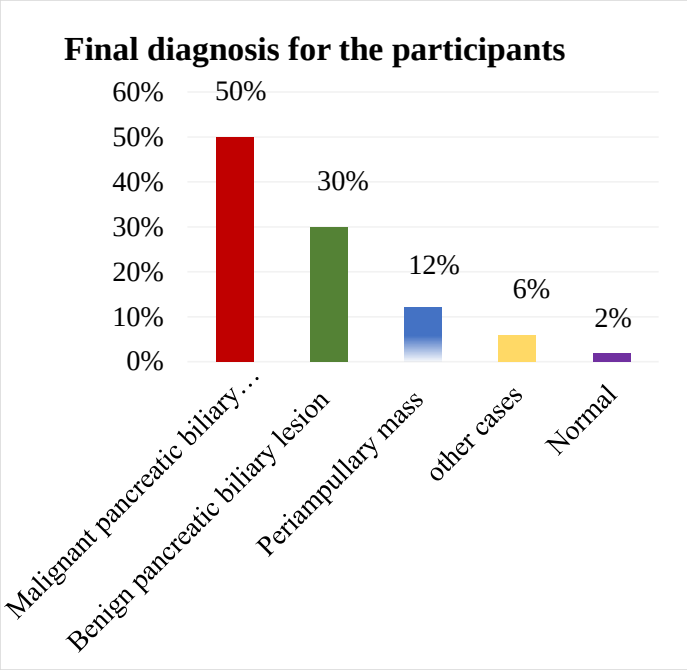

Figure (3): Final diagnosis for the participants

Table (3) demonstrates the validity of CT in diagnosing pancreatic malignant lesions, the calculated sensitivity was equal to 57.7%, specificity was 61.5%, positive predictive value (PPV) 75.0% and the negative predictive value (NPV) was 42.1%.

Table (3): Validity of CT to diagnose malignant lesions

CT	Histopathological findings		Total (39)
	Malignant N (26)	Not Malignant N (13)	
Malignant	15 **(TP)**	5 **(FP)**	**20**
Not Malignant	11 **(FN)**	8 **(TN)**	**19**

TP: True Positive FP: False Positive FN: False Negative TN: True Negative

Table (4) reveals the validity of EUS to diagnose pancreatic malignant lesions, the calculated sensitivity was equal to 87.8%, specificity was 95.7%, positive predictive value (PPV) 97.3% and the Negative predictive value (NPV) was 81.5%.

Table (4): Validity of EUS to diagnose malignant lesions

EUS	Histopathological findings		Total (64)
	Malignant N (41)	Not Malignant N (23)	
Malignant	36 **(TP)**	1 **(FP)**	**37**
Not Malignant	5 **(FN)**	22 **(TN)**	**27**

TP: True Positive FP: False Positive FN: False Negative TN: True Negative

DISCUSSION

Endoscopic ultrasound (EUS) has emerged as a vital tool in the diagnosis and management of pancreaticobiliary diseases. It combines the advantages of high-resolution imaging with the ability to perform tissue sampling and interventional procedures, making it superior to traditional imaging modalities such as CT, MRI, and MRCP [7].

Endoscopic retrograde cholangiopancreatography (ERCP) has been the gold standard for evaluation of the pancreatobiliary disorders. However, it is associated with complications especially pancreatitis, cholangitis and bleeding. For this reason, less invasive and high accurate diagnostic modalities such as endoscopic ultrasound (EUS) is recommended for evaluation of etiology of obstructive jaundice either gall stones or peri-ampullary or pancreatic lesions [8].

Diagnostic Role of EUS

Our study demonstrated that EUS outperformed CT and MRCP in detecting pancreaticobiliary malignancies. EUS identified 35 malignant pancreatic lesions, compared to only 17 cases detected by other imaging techniques. This aligns with previous studies, such as **Sotoudehmanesh *et al.*** [9], which found that EUS had a higher sensitivity than MRCP in evaluating undetermined biliary strictures.

EUS was particularly effective in diagnosing indeterminate pancreatic lesions. Among the 48 cases classified as indeterminate by CT/MRI, EUS further categorized:10 cases as pancreatic cystic lesions, 7 cases as pancreatic head masses, 6 cases as pancreatic pseudocysts and 5 cases as chronic pancreatitis.

These findings are consistent with research by **Cieslak *et al.*** [10], which demonstrated that EUS enhances the diagnostic accuracy of pancreatic and periampullary tumors when conventional imaging is inconclusive.

Additionally, EUS played a critical role in differentiating benign from malignant strictures. In our study, EUS detected 6 cases of microlithiasis and 3 cases of benign CBD strictures, which were missed by CT and MRCP. This reinforces findings from **Saifuku *et al.***, who reported that EUS had a sensitivity of 94.1% and specificity of 82.3% in diagnosing biliary strictures [11].

EUS vs. ERCP in Biliary Disorders

Although ERCP remains the gold standard for biliary interventions, our study highlights that EUS provides superior diagnostic accuracy in cases of indeterminate CBD strictures. Among 66 patients who underwent ERCP, 49 cases (74%) were classified as indeterminate biliary strictures, 8 cases (10.6%) had periampullary lesions, and 2 cases (3%) had malignant distal CBD strictures. EUS, in contrast, identified 35 malignant pancreatic lesions, 28 indeterminate pancreatic lesions, and 14 periampullary lesions. These findings confirm

prior research by **Gan *et al.* [8]** and **Buscarini *et al.* [12]**, which established EUS as more accurate than MRCP and CT in detecting small CBD stones (<5 mm).

EUS in Pancreatitis and Lemmel Syndrome

Our study also found that EUS was highly effective in diagnosing pancreatic pseudocysts and chronic pancreatitis. **Cammarata *et al.* [13]** and **Wilcox *et al.* [14]** similarly recommended EUS for evaluating idiopathic acute pancreatitis, given its high sensitivity in detecting microlithiasis and small pancreatic duct abnormalities. Additionally, four cases suspected of pancreatic malignancy were diagnosed with Lemmel syndrome using EUS and duodenoscopy, highlighting the importance of EUS in evaluating duodenal and periampullary masses.

Therapeutic Applications of EUS

EUS is increasingly being used for minimally invasive interventions. In our study: 5 patients (62.5%) underwent EUS-hepaticogastrostomy after failed ERCP for pancreatic ductal adenocarcinoma, 2 patients (25%) received EUS-cystogastrostomy for unresolved pancreatic pseudocysts and 1 patient (12.5%) underwent EUS-choledochoduodenostomy for malignant CBD stricture. These findings are in agreement with **Salerno *et al.* [6]**, who highlighted the growing role of EUS-guided biliary drainage (EUS-BD) as an alternative to PTBD in cases where ERCP fails.

CONCLUSION

Endoscope ultrasound (EUS) has proven to be a highly accurate and effective tool in the diagnosis and management of pancreaticobiliary diseases. Compared to CT and MRCP, EUS offers superior sensitivity and specificity, particularly in detecting pancreatic malignancies, microlithiasis, and indeterminate CBD strictures. Additionally, EUS-guided interventions provide a minimally invasive and safe alternative for therapeutic procedures in cases where ERCP is unsuccessful.

RECOMMENDATIONS

1. Larger, multicenter studies are needed to further validate the diagnostic and therapeutic applications of EUS in pancreaticobiliary diseases.
2. EUS should be integrated as a first-line diagnostic tool for patients with indeterminate pancreatic lesions and CBD strictures.
3. Future research should explore artificial intelligence (AI) applications in EUS image interpretation to improve diagnostic accuracy.
4. Training programs for endoscopists should emphasize EUS-guided interventions, particularly in cases where ERCP is unsuccessful.

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REFERENCES

1. **Shil B, Banik R, Saha M *et al.* (2021):** Pancreatobiliary diseases: Evaluation by transabdominal and endoscopic ultrasound. Mymensingh Med. J., 30(2):458-465.
2. **Salom F, Prat F (2021):** Current role of endoscopic ultrasound in the diagnosis and management of pancreatic cancer. World J. Gastrointest. Endosc., 14(1):35-48.
3. **Fabbri C, Scalvini D, Paolo G *et al.* (2024):** Complications and management of interventional endoscopic ultrasound: A critical review. Best Pract. Res. Clin. Gastroenterol., 69:101888.
4. **Stoffel E, McKernin S, Khorana A (2019):** Evaluating susceptibility to pancreatic cancer: ASCO clinical practice provisional clinical opinion summary. J. Oncol. Pract., 15(2):108-111.
5. **Takasaki Y, Ishii S, Fujisawa T *et al.* (2020):** Endoscopic ultrasonography findings of early and suspected early chronic pancreatitis. Diagnostics, 10(12):1018.
6. **Salerno R, Davies S, Mezzina N *et al.* (2019):** Comprehensive review on EUS-guided biliary drainage. World J. Gastrointest. Endosc., 11(5):354-364.
7. **Prager M, Prager E, Sebesta C *et al.* (2022):** Diagnostic and therapeutic indications for endoscopic ultrasound (EUS) in patients with pancreatic and biliary disease-novel interventional procedures. Curr. Oncol., 29(9):6211-6225.
8. **Gan S, Rajan E, Adler D *et al.* (2007):** Role of EUS. Gastrointest. Endosc., 66(3):425-434.
9. **Sotoudehmanesh R, Nejati N, Farsinejad M *et al.* (2016):** Efficacy of endoscopic ultrasonography in evaluation of undetermined etiology of common bile duct dilatation on abdominal ultrasonography. Middle East J. Dig. Dis., 8:267-272.
10. **Cieslak K, van Santvoort H, Vleggaar F *et al.* (2014):** The role of routine preoperative EUS when performed after contrast-enhanced CT in the diagnostic work-up in patients suspected of pancreatic or periampullary cancer. Pancreatology, 14(2):125-130.
11. **Saifuku Y, Yamagata M, Koike T *et al.* (2010):** Endoscopic ultrasonography can diagnose distal biliary strictures without a mass on computed tomography. World J. Gastroenterol., 16(2):237-244.
12. **Buscarini E, Tansini P, Vallisa D *et al.* (2003):** EUS for suspected choledocholithiasis: do benefits outweigh costs? A prospective, controlled study. Gastrointest. Endosc., 57(4):510-518.
13. **Cammarata F, Rovati L, Fontana P, Gambitta P, Armellino A, & Aseni P (2023).** Endoscopic Ultrasound to Identify the Actual Cause of Idiopathic Acute Pancreatitis: A Systematic Review. *Diagnostics*, *13*(20), 3256. https://doi.org/10.3390/diagnostics13203256
14. **Wilcox C, Varadarajulu S, Eloubeidi M (2006):** Role of endoscopic evaluation in idiopathic pancreatitis: A systematic review. Gastrointest. Endosc., 63(7):1037-1045.