Which patients with dilated common bile and/or pancreatic ducts have positive findings on EUS?

Vernon Carriere, Jason Conway, Jerry Evans, Susanne Shokoohi, Girish Mishra

Wake Forest Baptist Hospital, Winston Salem, NC, United States

Key words: endoscopic ultrasound dilated ducts

Abbreviations: PD, pancreatic duct ; CBD, common bile duct; ERCP, endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound; MRCP, magnetic resonance cholangiopancreatography; CEA, carcinoembryonic antigen

Background: Patients with dilated common bile duct (CBD) (>7mm) and/or pancreatic duct (PD) on abdominal imaging are often referred for endoscopic ultrasound (EUS). In many cases, the EUS shows no obvious etiology for the dilated ducts.

Objective: Find clinical factors that may predict which patients are more likely to have positive findings on EUS to explain the etiologies for the dilated ducts.

Design: Retrospective database analysis.

Setting: Tertiary-care university hospital.

Patients: Patients referred for EUS for dilated CBD and/or PD from January 2004 to February 2010 were included in this study. Only patients without an obvious etiology for the dilated ducts on abdominal imaging were included.

Interventions: An EUS was performed by using either a radial echoendoscope or a linear endoscope to evaluate the common bile duct and/or the pancreatic duct. When appropriate fine needle aspiration of the mass or cyst was performed.

Main Outcome Measurements: The characteristics of patients who had positive findings on EUS to explain the etiology of their dilated PD and/or CBD.

Results: A total of 140 patients were included in the study with a mean age of 64 years, 51 (36%) male and 115 (82%) white. The majority of our patients had a presenting symptom of abdominal pain 105 (75%). 49 (36%) had elevated AST or ALT, 25 (8%) had an elevated bilirubin and 13 (23%) had an elevated lipase. EUS findings explained the dilated ducts in 54 (39%) of our patients, most common diagnoses included: CBD stone in 11 (8%), non-calcific chronic pancreatitis in 9 (6%), pancreatic mass in 8 (6%), IPMN in 7 (5%). On bivariate analysis patients who were older ($p = 0.006$), male ($p = 0.001$), had elevated LFTs ($p = <0.001$), had elevated lipase ($p = 0.021$) or had dilated CBD and PD ($p = 0.007$) were more likely to have an etiology for their dilated duct(s) discovered on EUS.

Limitations: A retrospective study with a small number of patients.

Conclusion: Older patients, males and those patients presenting with concurrent elevations in the AST/ALT and/or lipase were more likely to have an underlying etiology discovered on EUS. Furthermore, EUS may detect an undiagnosed pancreatic malignancy in patients presenting with unexplained duct dilation.

Introduction

With the increased use of abdominal imaging on patients with nonspecific symptoms, such as abdominal pain, patients are being diagnosed more often with a dilated pancreatic duct (PD) and/or common bile duct (CBD).¹ In general, the CBD is considered dilated if over 7mm^{2,3} and the pancreatic duct is considered dilated if over 3 mm in the head of the pancreas but the diameter of the pancreatic duct does increase with age.^{4,5} Endoscopic retrograde cholangiopancreatography (ERCP) had

been the standard for evaluating a dilated common bile duct or pancreatic duct for many years,⁶ but with complications such as post-ERCP pancreatitis,⁷ other methods to evaluate the CBD and PD have been utilized more often. Endoscopic ultrasound (EUS) and magnetic resonance cholangiopancreatography (MRCP) are often selected to further evaluate patients with a dilated PD or CBD given their favorable complication profile.⁸⁻¹⁰

The etiology of a patient's dilated duct can be explored with further investigation via MRCP, EUS or ERCP.^{11,12} In the majority of cases, the etiology for the dilated duct(s) is benign but clinicians are always concerned for an underlying neoplasm.¹² Agarwal et al reported that 11.5% of patients who were found to have a dilated pancreatic duct on abdominal imaging had a pancreatic adenocarcinoma.¹³ In a retrospective review, a dilated pancreatic duct was found several months prior to the diagnosis

*Correspondence to: Vernon Carriere; Email: vernoncarriere@gmail.com
Submitted: May/03/2012; Revised: Jun/27/2012; Accepted: Aug/03/2012
Previously published online: www.landesbioscience.com/journals/jig
DOI: 10.4161/jig.23739

of pancreatic cancer in a majority of patients.¹⁴ Evaluation of a dilated duct(s) can be challenging and EUS is often used to aid in the diagnosis.

At our tertiary referral center, we are asked to evaluate a significant number of patients explicitly for a dilated PD or CBD. Unfortunately, many patients have a normal EUS with either a normal duct caliber or no explanation for the cause of their dilated duct(s). The aim of our study was to find clinical factors that may predict which patients are more likely to have positive findings on EUS to describe the etiology for their dilated duct(s).

Patient and Methods

We used our endoscopy software (Endosoft) to locate patients from January 2004 to February 2010 with the search criteria of "dilated pancreatic duct" or "dilated common bile duct" within the indication field presenting for an EUS. Once the patients were identified their electronic charts were reviewed for demographics, imaging used to diagnosis the dilated duct, pertinent medical history, laboratory data and findings on EUS. The abdominal imaging used to diagnose the dilated duct(s) was reviewed and patients who had a clear etiology for their dilated duct(s) (i.e., choledolithiasis, pancreatic cancer, etc.) were excluded from the study. Any patient that had dilated duct(s) and did not have a clear etiology on abdominal imaging to explain their dilated duct(s) was included. If a pancreatic mass or cyst was identified on EUS then the location, size, carcinoembryonic antigen (CEA) level, amylase level, fine needle aspiration (FNA) results and surgical pathology results were recorded.

All patients were examined with an echoendoscope (Olympus GIF-Q160, GIF-N30, GIF-XP 160). All the procedures were performed by 3 endoscopists (JC, JE, GM). Statistical analysis was performed using Intercooled Stata 8.0 for Windows (Stata

Corp., College Station, TX, USA). The institutional review board at our medical center approved the study.

Results

One hundred and forty patients met our inclusion criteria. Patient characteristics are summarized in **table 1**. The mean age of our patients in the study was 64.03 ± 14.96 years. The majority of the patients were female ($n = 89$) and Caucasian ($n = 115$). The most common presenting symptom being abdominal pain ($n = 105$). The common bile duct was the most frequently found dilated duct ($n = 94$) followed by both the pancreatic and common bile ducts ($n = 30$). The dilated duct was discovered in the majority of cases by computer axial tomography ($n = 101$). The majority of patients ($n = 86$) had normal findings on EUS. In individual found to have an etiology on EUS the following were noted: choledolithiasis ($n = 11$), non-calcified chronic pancreatitis ($n = 9$), pancreatic mass ($n = 8$) and intraductal papillary mucinous neoplasm ($n = 8$). The findings on EUS are summarized in **table 2**. A total of 17 pancreatic lesions underwent fine needle aspiration, 6 of these were pancreatic adenocarcinoma, 4 were mucinous cystic neoplasms and the remaining 7 were benign or had insufficient sampling. The median diameter of the pancreatic masses was 18 mm (range 5-35 mm).

We performed a bivariate analysis with two groups based on those who had findings on EUS to explain the etiology of their dilated duct(s) and those patients with an unclear etiology for their ductal dilation. The data is summarized in **table 3**. We found that the average age of patients in which no etiology was found for their dilated duct was 61.3 ± 14.9 years as opposed to the group in which an etiology was found which was 68.4 ± 14.11 years ($p=0.006$). Any elevation in the patients liver function test (LFT) was also found to be statistically different in the two

Figure 1. Flow chart

Table 1. Patient Characteristics (no. patients = 140) method

Characteristics	n
Mean (SD) age (y)	64.03 ± 14.96
Sex	
Male	51
Female	89
Race	
White	115
Black	21
Presenting symptom	
Abdominal Pain	105
No complaint	12
Weight loss	5
Nausea	3
Other	15
History of acute pancreatitis	15
History of chronic pancreatitis	5
Prior cholecystectomy	70

Table 2. EUS Findings

No finding to explain dilated duct	86 (61.43%)
Cholelithiasis	11 (7.86%)
Ampullary tumor	3 (2.14%)
Periampullary diverticulum	4 (2.86%)
Non-calcific chronic pancreatitis	9 (6.43%)
Chronic calcific pancreatitis	4 (2.86%)
Pancreatic mass	8 (5.71%)
Pancreatic cyst	4 (2.86%)
Intraductal papillary mucinous neoplasm	7 (5.00%)
Common bile duct stricture	3 (2.14%)
Choledochocoele	1 (0.71%)

Table 3. Patient characteristics, labs, and imaging stratified by EUS findings of an etiology for dilated duct(s) (N = 140)

	No Findings on EUS	Findings on EUS	p
Number of patients	86	54	
Age (years) (mean(SD))	61.32 ± 14.90	68.43 ± 14.11	0.006
Sex			
Male	22	29	
Female	64	25	0.001
Duct dilated			
CBD	66 (77%)	28 (52%)	0.002
Pancreatic	8 (9%)	8 (15%)	0.318
Both	12 (14%)	18 (33%)	0.007
Diameter of CBD (mm)	12.1 ± 3.19	11.9 ± 4.19	0.7692
Diameter of PD (mm)	4.95 ± 2.23	7.1 ± 3.32	0.0214
Imaging used to diagnose dilated duct			
Ultrasound	15 (18%)	1 (2%)	0.005
Computed Tomography (CT) scan	61 (72%)	40 (75%)	0.633
MRI	7 (8%)	10 (19%)	0.108
AST elevated	16 (19%)	19 (37%)	0.021
ALT elevated	12 (14%)	20 (38%)	0.001
Alk phos elevated	14 (17%)	24 (46%)	<0.001
Any LFT elevated	12 (14%)	20 (38%)	0.001
Lipase elevated	4 (11%)	9 (41%)	0.021

groups. Abnormal liver enzymes were found in 38% of patients versus 14% where an abnormality was noted on EUS ($p=0.001$). Lipase elevation were also found to be an indicator that an etiology of the dilated duct was more likely to be discovered ($p=0.021$). Male patients were more likely than female patients to have the etiology of their dilated duct diagnosed ($p=0.001$). If an ultrasound was used to diagnosis the dilated duct initially then it was less likely that the etiology would be discovered ($p=0.005$). The average size of the CBD in each group was not significantly different at $12.1 \pm 3.19\text{mm}$ with no clear etiology versus $11.9 \pm 4.19\text{mm}$ in the group where an etiology was discovered. Isolated

CBD dilation predicted that EUS was unlikely to discover the etiology ($p=0.002$) whereas dilation of both the PD and CBD was more likely to yield an etiology on EUS ($p=0.007$). No statistical difference was noted with reference to race, presenting symptom, alcohol use, prior cholecystectomy or history of pancreatitis.

Discussion

As more patients undergo abdominal imaging, incidentally discovered dilation in the pancreatic duct or common bile duct will likely continue to increase.¹ Because of the inherent risk

associated with ERCP, namely post-ERCP pancreatitis, current guidelines recommend other modalities to evaluate the biliary or pancreatic system.¹⁵ EUS has been shown to be effective in diagnosing the etiology of the dilated duct(s) and reduces the need for unnecessary ERCPs.^{16,17} EUS is a safe procedure with very low complication rates and is often used to evaluate patients with dilated duct(s).⁸

Previous studies have evaluated the utility of EUS in evaluating dilated CBD and PD. Similar to Malik et al, we found that patients with a dilated CBD and abnormal LFT were more likely to have findings on EUS to explain the dilated common bile duct.¹² Unique to our study was that an etiology for the dilated duct(s) was more likely to be discovered on EUS if both the PD and CBD were dilated but less likely if only the CBD was dilated. Analogous to Malik et al, we found a majority of patients (61.3%) had no findings on EUS to explain the etiology of their dilated duct(s).¹² From this we can conclude that the majority of patients referred for a dilated CBD will not have an etiology discovered.

Other studies have evaluated patients who had a dilated pancreatic duct to findings on EUS. Agarwal et al¹³ reported that some patients with a dilated pancreatic duct had an underlying malignancy. We found that 6% of patients had a pancreatic mass, 5% had an intraductal papillary mucinous neoplasm and 2% had ampullary tumors. Agarwal et al¹³ reported 11.5% of patients with a dilated PD had an underlying pancreatic malignancy and that 33.3% of patients with a dilated PD with an abrupt cutoff had a pancreatic malignancy. EUS has already been shown to be very effective in diagnosing pancreatic adenocarcinoma and pancreatic cystic neoplasms.^{18,19} We could not find any previous study that evaluated patients with both a dilated PD and CBD and correlated this with EUS.

Our study is the first to show that patients who were male, had elevated lipase or had a dilated pancreatic duct and common bile duct were more likely to have findings on EUS to explain the etiology of their dilated duct(s). The most common etiology for a dilated duct(s) was choledocholithiasis followed by chronic pancreatitis. All patients who had a finding on EUS to explain the dilated duct had at least one of the variables we found significant in our analysis, including dilated CBD and PD, elevated LFT's, elevated bilirubin or elevated lipase. Interestingly, we had 8 patients diagnosed with a pancreatic mass that had not been identified on previous abdominal imaging. Also as in some previous studies, our study found that patients with abnormal LFTs were more likely to have findings on EUS.¹² We are unable to explain why males undergoing EUS for dilated ducts were more likely to have an etiology discerned.

As in any retrospective study, our study has limitations. Each patient underwent a slightly different evaluation at the referring facility prior to referral for EUS. A more standardized evaluation may have identified the etiology of the dilated ducts in some patients but we feel that a variety of patients' previous evaluations represents a common problem for referral centers. Also, most interpretations were rendered by radiologists who were not necessarily experts in abdominal imaging. However, this heterogeneity in expertise represents real time scenario. A prospective study with standardized labs, history and abdominal

imaging reviewed by an expert radiologist would be ideal. We felt our patient population is representative of patients with a dilated pancreatic and/or common bile duct(s) typically referred to a tertiary care center.

In conclusion, with the increased use of abdominal imaging it is likely that more patients will be diagnosed with a dilated common bile duct or pancreatic duct. Often, the duct will be normal on further examination. There are many ways to approach patients with a dilated duct such as repeating abdominal imaging,²⁰ but EUS is a safe and effective technique to evaluate these patients. A small percent of the patients will have an underlying malignancy as the etiology of their dilated duct(s). Certain factors such as increased age, male, abnormal lipase and abnormal LFT may help to predict which patients are more likely to have findings on EUS to explain the etiology of their dilated duct(s).

References

1. Levin DC, Rao VM, Parker L, Frangos AJ, Sunshine JH. Recent trends in utilization rates of abdominal imaging: the relative roles of radiologists and nonradiologist physicians. *J Am Coll Radiol* 2008; 5: 744-7.
2. Bowie JD. What is the upper limit of normal for the common bile duct on ultrasound: how much do you want it to be? *Am J Gastroenterol* 2000; 95:897-900.
3. Parulekar SG. Ultrasound evaluation of common bile duct size. *Radiology*. 1979; 133:703-7.
4. Sivak MV, Sullivan BH. Endoscopic retrograde pancreatography: analysis of the normal pancreatogram. *Am J Dig Dis* 1976; 21: 263-9.
5. Cotton PB. ERCP. *Gut* 1977; 18: 316-41.
6. Cohen S, Bacon BR, Berlin JA, Fleischer D, Hecht GA, Loecherer PJ Sr, et al. National Institutes of Health State-of-the-Science Conference Statement: ERCP for diagnosis and therapy, January 14-16, 2002. *Gastrointest Endosc* 2002; 56: 803-9.
7. Christensen M, Matzen P, Schulze S, Rosenberg J. Complications of ERCP: a prospective study. *Gastrointest Endosc* 2004; 60:721-31.
8. Nickl NJ, Bhutani MS, Catalano M, Hoffman B, Hawes R, Chak A, et al. Clinical implications of endoscopic ultrasound: the American Endosonography Club Study. *Gastrointest Endosc* 1996; 44:371-7.
9. Barish MA, Yucel EK, Ferrucci JT. Magnetic resonance cholangiopancreatography. *N Engl J Med* 1999; 341:258-64.
10. Kirchin MA, Runge VM. Contrast agents for magnetic resonance imaging: safety update. *Top Magn Reson Imaging* 2003; 14:426-35.
11. Kim JE, Lee JK, Lee KT, Park DI, Hyun JG, Paik SW, et al. The clinical significance of common bile-duct dilatation in patients without biliary symptoms or causative lesions on ultrasonography. *Endoscopy* 2001; 33:495-500.
12. 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* 2007; 52:508-12.
13. Agarwal B, Krishna NB, Labundy JL, Safdar R, Akduman EI. EUS and/or EUS-guided FNA in patients with CT and/or magnetic resonance imaging findings of enlarged pancreatic head or dilated pancreatic duct with or without a dilated common bile duct. *Gastrointest*
14. Gangi S, Fletcher JG, Nathan MA, Christensen JA, Harmsen WS, Crownhart BS, et al. Time interval between abnormalities seen on CT and the clinical diagnosis of pancreatic cancer: retrospective review of CT scans obtained before diagnosis. *AJR Am J Roentgenol* 2004; 182:897-903.
15. Adler DG, Baron TH, Davila RE, Egan J, Hirota WK, Leighton JA, et al. ASGE guideline: the role of ERCP in diseases of the biliary tract and the pancreas. *Gastrointest Endosc* 2005; 62:1-8.
16. Garrow D, Miller S, Sinha D, Conway J, Hoffman BJ, Hawes RH, et al. Endoscopic ultrasound: a meta-analysis of test performance in suspected biliary obstruction. *Clin Gastroenterol Hepatol* 2007; 5: 616-23.
17. Lee YT, Chan FK, Leung WK, Chan HL, Wu JC, Yung MY, et al. Comparison of EUS and ERCP in the investigation with suspected biliary obstruction caused by choledocholithiasis: a randomized study. *Gastrointest Endosc* 2008; 67:660-8.
18. Brugge WR, Lewandrowski K, Lee-Lewandrowski E, Centeno BA, Szydio T, Regan S, et al. Diagnosis of pancreatic cystic neoplasms: a report of the cooperative pancreatic cyst study. *Gastroenterology* 2004; 126:1330-6.
19. Eloubeidi MA, Chen VK, Eltroum IA, Jhala D, Chhieng DC, Jhala N, et al. Endoscopic ultrasound-guided fine needle aspiration biopsy of patients with suspected pancreatic cancer: diagnostic accuracy and acute and 30-day complications. *Am J Gastroenterol* 2003; 98:2663-8.
20. Holm AN, Gerke H. What should be done with a dilated bile duct? *Curr Gastroenterol Rep* 2010; 12:150-6.