A comparison between endoscopic ultrasound-guided rendezvous and percutaneous biliary drainage after failed ERCP for malignant distal biliary obstruction

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Background and study Aims: Selective biliary cannulation is unsuccessful in 5% to 10% of patients undergoing endoscopic retrograde cholangiopancreatography (ERCP) for malignant distal biliary obstruction (MDBO). Percutaneous biliary drainage (PBD) has been the gold standard, but endoscopic ultrasound guided rendezvous (EUSr) have been increasingly used for biliary decompression in this patient population. Our aim was to compare the initial success rate, long-term efficacy, and safety of PBD and EUSr in relieving MDBO after failed ERC.

Patients and methods: A retrospective study involving 50 consecutive patients who had an initial failed ERCP for MDBO. Twenty-five patients undergoing EUSr between 2008–2014 were compared to 25 patients who underwent PBD immediately prior to the introduction of EUSr at our center (2002–2008). Comparisons were made between the two groups with regard to technical success, duration of hospital stay and adverse event rates after biliary decompression.

Results: The mean age at presentation was 66.5 (±12.6 years), 28 patients (54.9%) were female. The etiology of MDBO was pancreaticobiliary malignancy in 44 (88%) and metastatic disease in 6 (12%) cases. Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 6 (12%) cases. Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 6 (12%) cases. Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 6 (12%) cases. Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 6 (12%) cases. Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 6 (12%) cases. Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 6 (12%) cases. Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 6 (12%) cases. Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 6 (12%) cases.
safer and potentially more efficacious alternative to PBD [2]. However, in this study a variety of EUS-BD methods were employed and PBD was only performed after a failed attempt at EUS-BD. Because EUS-BD techniques and their role in treating MDBO are still evolving, it remains unclear how outcomes compare to the current gold standard in this setting, PBD. The aim of this study was to compare the initial success rate, long-term efficacy and safety of PBD and EUSr in relieving MDBO after failed initial ERC.

**Patients and Methods**

This was a retrospective comparative study involving 50 consecutive patients with MDBO in whom biliary decompression could not be achieved via ERCP at a single academic tertiary referral center. Patients were identified from a manual search of the institutional endoscopic database (Provation MD, Minneapolis, MN). A manual chart review was performed and the clinical and endoscopic data were extracted from each patient's electronic medical record including demographics (age, gender), type of malignancy (pancreaticobiliary, metastatic), laboratory data, complications, number of repeat biliary interventions, and length of hospitalization. Twenty-five consecutive patients who underwent EUSr between 2008 and 2014 were compared to a cohort of 25 patients who underwent PBD immediately prior to the introduction of EUSr at our center (2002 – 2008). All EUSr procedures performed at our institution between 2008 and 2014 were included in this study. Patients with surgically altered anatomy (Roux-En-Y gastric bypass, pancreaticoduodenectomy, hepatocjejunostomy) were excluded from the study. The Institutional Review Board of Washington University School of Medicine/Barnes Jewish Hospital approved review of clinical data for the purpose of this study.

EUSr was performed at the university hospital endoscopy unit by 1 of 5 experienced endoscopists expert in EUS, ERC, and interventional EUS. All patients were under monitored anesthesia care and received antibiotics during the procedure and for 3 to 5 days thereafter. The number of failed ERC attempts prior to attempting EUSr or PBD was recorded. The definition of failed biliary cannulation with ERC was not standardized in this study and the decision to use an alternative method of biliary cannulation was determined by the attending endoscopist. During the time of the study, our group’s approach to EUS-BD was to attempt EUSr rather than other techniques after failed ERC. All EUSr were performed using a transduodenal approach with the echoendoscope seated in the duodenal bulb. Primarily this decision is based on the risk of complications, primarily bile leak, with other EUS-BD methods. After failed ERC at our center, EUSr was attempted during the same endoscopy session. If EUSr was unsuccessful, the decision to use an alternative method of EUS-BD, refer a patient to PBD, or perform ERC at a later date was at the discretion of the attending endoscopist. All EUSr procedures were performed using a therapeutic linear echoendoscope (GF-UC140P or GF-UCT140; Olympus Medical Systems, Center Valley, PA). Once the scope was seated in the duodenal bulb, the bile duct was identified and color flow Doppler was used to confirm the lack of intervening vessels. Next, the bile duct was accessed, prior to 2009, using a 19-gauge FNA needle and then using an access needle (EchoTip Access Needle, Cook Medical Inc., Bloomington, IN) thereafter. The needle was advanced into the lumen of the extrahepatic bile duct, the stylet was removed, and bile was aspirated to verify positioning within the bile duct. Next, contrast was injected and a cholangiogram was obtained. Following the cholangiogram, a long guidewire [0.035 inch Jagwire (Boston Scientific Corporation, Natick, MA) or 0.025 inch angled Visiglide wire (Olympus America, Center Valley, PA)] was then passed through the access needle into the bile duct. The guidewire was manually manipulated to advance through the major papilla and was coiled within the duodenum. The access needle and echoendoscope were then removed, leaving the wire in place. Alongside the wire, a duodenoscope (TFJ 140–160; Olympus Medical Systems, Center Valley, PA) was inserted to the level of the papilla. The biliary tree was then deeply cannulated with a sphincterotome using the guidewire placed via EUSr as a guide to where the biliary opening lay. If cannulation was unsuccessful using this technique, then the luminal end of the guidewire was grasped with a snare or forceps and pulled through the duodenoscope so that both ends of the guidewire exited the patient’s mouth and were under the control of the endoscopist. This allowed a sphincterotome or balloon catheter to be advanced over the wire directly into the biliary tree. Subsequently, a biliary stent was placed across the stricture. Technical success of EUSr was defined by the wire being advanced into the duodenum via the major papilla and a stent placed in a retrograde manner (Fig. 1). Patients were not routinely admitted to the hospital for observation following EUSr if the procedure was performed on an outpatient basis.

PBD was performed by experts in Interventional Radiology under moderate sedation using well established techniques [7]. Most patients initially received external biliary drainage which at the discretion of the attending radiologist could be converted to a metallic biliary stent when clinically appropriate [7]. Patients were monitored in the hospital for a minimum of 23 hours following PBD placement. Following PBD placement, any repeated procedure (stent/tube exchange) was recorded as repeated interventions.

Procedure-related adverse events (AEs) were divided into early (within 7 days) and late (greater than 7 days) from the index procedure. AE recorded included recurrent biliary obstruction, bleeding (defined as an acute >3 g/dL drop in Hgb requiring PRBC transfusion or overt bleeding outside of what is typically accepted post procedure that required further medical/surgical management), pancreatitis, bile leak and cholecystitis.

**Statistical analysis**

Data are reported as mean ± standard deviation (SD) for normally distributed data, and median and range for skewed data. Grouped continuous variable data were compared using two-tailed Student’s t test and Mann-Whitney U test where appropriate. Inter-group and categorical comparisons were made using the Chi-square and Fisher’s exact tests. A p value of <0.05 was required for statistical significance. All statistical analyses were performed using PASW 19.1 (SPSS, Inc., Chicago, IL).

**Results**

During the 12-year study period, 1076 patients underwent an initial ERC for malignant distal biliary obstruction at our medical center, biliary access via ERC was unsuccessful in 54 (5.0%). Four patients elected to pursue hospice care after failed ERC, and further attempts at biliary decompression were not made. Fifty patients [mean age 66.5 ±12.6 years, 28 (54.9%) females] were included in this study. The etiology of MDBO was pancreaticobiliary.
ary malignancy in 44 (88%) and metastatic malignancy in 6 (12%) cases. In the EUSr group, pancreaticobiliary malignancies included pancreatic adenocarcinoma in 20 (80%), neuroendocrine tumor in 1 (4%), and ampullary/duodenal cancer in 3 (12%) patients. Patients underwent a median of 1 (range 1–3) unsuccessful ERCP attempts. The reason for failed biliary cannulation at time of ERCP was tumor-related ampullary deformity in 34 (68%) cases and inability to cannulate a normal appearing ampulla in 16 (32%). There were no significant differences in any of the baseline characteristics between the EUSr and PBD groups (Table 1).

Biliary drainage was technically successful by EUSr in 19 (76%) cases and by PBD in 25 (100%) (P = 0.002, Table 2). Median length of hospital stay after initial drainage was 1 day (range 0–26) in the EUSr group vs 5 days (range 1–20 days) in the PBD group (P = 0.02). The median length of hospital stay following successful EUSr was 1 day (range 0–13), significantly shorter than the PBD group (P = .002). Nine patients in the EUSr group underwent the procedure on an outpatient basis and were not admitted to the hospital within the subsequent 14 days. Clinical success, defined as a 50% drop in bilirubin within 7 days of the index procedure was obtained in 24 (96%) in the EUSr group and 20 (80%) of those in the PTC group. Five patients in the EUSr group underwent a pancreaticoduodenectomy at a median of 12 days (range 7–165) following biliary drainage; there were no intraoperative or postoperative biliary complications.

EUSr was unsuccessful in 6 cases (24%); summarized in Table 3. Reasons for failed EUSr included inability to pass the guidewire antegrade into duodenum (n = 5), inability to locate a safe window EUS for biliary puncture due to duodenal deformity (n = 1). In cases where EUSr was unsuccessful, biliary drainage was obtained by PBD (n = 3), repeat ERCP (n = 2), and EUS-guided choledochoduodenostomy (n = 1). Both patients who had biliary access obtained through repeat ERCP underwent the procedure within 24 hours after EUSr was attempted. The median time to PBD following failed ERCP was 1 (range 0–3) day. The median hospital length of stay for failed EUSr was 4 days (range 0–26), which was similar to the primary PBD group (5 days, P = 0.64).

Table 1 Baseline demographics.

<table>
<thead>
<tr>
<th></th>
<th>EUSr (n = 25)</th>
<th>PBD (n = 25)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years; mean ± SD)</td>
<td>65.4 ± 11.6</td>
<td>67.7 ± 13.6</td>
<td>0.25</td>
</tr>
<tr>
<td>Gender (female)</td>
<td>15</td>
<td>13</td>
<td>0.57</td>
</tr>
<tr>
<td>Etiology of biliary obstruction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pancreatobiliary malignancy</td>
<td>24</td>
<td>20</td>
<td>0.12</td>
</tr>
<tr>
<td>Metastatic malignancy</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Unsuccessful ERCP attempts (median, range)</td>
<td>1 (1–2)</td>
<td>1 (1–2)</td>
<td>0.26</td>
</tr>
<tr>
<td>Reason for failed ERCP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tumor invasion/ deformity</td>
<td>18</td>
<td>7</td>
<td>0.54</td>
</tr>
<tr>
<td>Normal ampulla</td>
<td>16</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
Early AEs occurred in 4 (16%) patients in the EUSr group and 3 (12%) in the PBD groups (P=0.68, Table 3). Early AEs included recurrent biliary obstruction (2 PBD), bleeding (2 EUSr, 1 PBD), pancreatitis (1 EUSr), and bile leak (1 EUSr). In the EUSr group, bleeding was related to a gastroduodenal artery pseudoaneurysm in 1 patient and was successfully treated with percutaneous embolization; a second patient developed hemobilia from a PBD after a failed EUSr, this was successfully treated by re-positioning of the PBD. In the PBD group one patient developed hemobilia; this was successfully treated with PBD repositioning and did not require vascular intervention. Delayed AE occurred in 3 (12%) patients in the EUSr group and 6 (5%) in the PBD group (P=0.27, Table 4).

Repeat biliary intervention was required for 3 patients in the EUSr group and 14 in the PBD group (P=0.001). Scheduled biliary interventions, including drain and stent changes were required in 14 patients in the PBD group, a median of 19 days (range 1–33) following initial drainage and in 3 patients in the EUSr group, a median of 5 days (range 1–105) later (P<0.001). Conversion of PBD to metal biliary stent was successful in 10 (40%) patients following initial PBD placement. Recurrent biliary obstruction, requiring intervention occurred in 4 patients in the PBD group, at a median of 237 days (range 1–272) after initial drainage and in one patient in the EUSr group, 476 days after stent placement (Fig. 2, Log Rank P=0.01).

**Discussion**

Since being first reported in 2001 by Giovannini et al., EUS-BD has been increasingly used as an alternative in patients with MDBO who fail ERCP [8]. Numerous techniques have been and are being developed with growing data supporting its use and efficacy [1–5, 9–14]. In our study, EUSr was found to be a safe and effective method of biliary drainage in patients with MDBO after failed initial ERC it was associated with shorter post-procedure
With the recent introduction of lumen opposing stents, EUS-guided choledochoduodenosotmy has become an attractive alternative to EUS-guided biliary decompression.[16] However, the currently available lumen opposing stents were not designed specifically for the biliary tree and may pose a risk of cholecystitis in patients with a gallbladder in situ as well as stent erosion or migration. Thus, we feel that if EUS guided biliary drainage is attempted rendezvous should remain the preferred first line approach, given the fact that it preserves the anatomic integrity of the biliary tree and avoid creation of a fistula.

It remains unclear whether EUS techniques are superior in efficacy, safety, and cost when compared to PBD in patients with MDBO who have failed ERC. It is well known that PBD is highly successful but generally requires repeat procedures and periprocedural adverse events are not infrequent rates ranging from 10% to 32% in the modern literature [6]. In a recent study, Khashab et al studied a group of 73 patients with MDBO who failed repeat ERC and found that technical success was higher in the PBD group but the adverse event rate was higher in the latter group of patients. Regarding successful biliary drainage, defined as reduction in total bilirubin by 50% in 2 weeks, the groups were not statistically different [2]. However, a major critique of the study is patients were enrolled to the PBD group only after failed ERC and EUS-BD; potentially biasing the study against PBD. In our study AE rates were similar between the EUSr and PBD groups. However, recurrent biliary obstruction occurred more frequently and repeated procedures were required more often in the PBD group. Repeated biliary manipulation may lead to further complications and requires the patient to have repeated hospital visits for catheter checks and changes. Recurrent biliary obstruction is a major source of morbidity and treatment interruption in patients undergoing chemotherapy. Given the fact that EUSr is associated with a lower rate of recurrent biliary obstruction it stands to reason that this approach would be preferable in patients receiving neoadjunct or palliative chemotherapy [17, 18]. Moreover, the length of hospital stay was significantly shorter in the EUSr group, landing another advantage to EUSr; particularly in cases where the initial ERC is performed on an outpatient basis and if EUSr is performed in the same endoscopic session. Finally, we hypothesize that patients would experience a lower quality of life following PBD when compared to EUSr as external drainage catheters typically repeated interventions. It cannot be understated however, that there are important advantages of PBD. First, PBD is more widely available and the techniques of PBD are well established and standardized. Furthermore, complications of PBD are typically minor and do not require surgical backup that may only be available at tertiary medical centers. That being said, EUS techniques have a key advantage of being performed at the same session of ERC. However, if initial EUSr fails, it could be argued that PBD is a safer therapeutic option given no need for repeat anesthesia and its almost universal technical success. Technology, ie stents and guidewires, that focus solely on EUS-BD are needed and currently in development [19, 20]. With the development of technology and as experience by interventional endoscopists is gained, the technical success rates of EUS-BD are likely to improve.

The major limitation of our study is its retrospective nature and limitations inherent to this design. The use of historical controls may have introduced some degree of bias; however there were no significant differences in the baseline characteristics and the protocol (minimum of 23 hours inpatient observation) following PBD placement remains the same at our institution. We also de-

### Table 4 Adverse events.

<table>
<thead>
<tr>
<th>Adverse events</th>
<th>EUSr</th>
<th>PBD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early (&lt;7 days)</td>
<td>4</td>
<td>3</td>
<td>0.68</td>
</tr>
<tr>
<td>Biliary obstruction</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Bleeding</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bile leak</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Late (&gt;7 days)</td>
<td>3</td>
<td>6</td>
<td>0.27</td>
</tr>
<tr>
<td>Biliary obstruction</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Cholecystitis</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

EUSr, endoscopic ultrasound-guided rendezvous; PBD, percutaneous biliary drainage

![](Fig.2_Kaplan_Meyer_Estimate_of_time_to_biliary_obstruction.png)

**Fig. 2** Kaplan Meyer Estimate of time to biliary obstruction.
tected no difference in the rate of adverse events comparing EUSr and PBD, however our sample size may be insufficient to detect a meaningful difference in this regard. Additionally, this was a single-center study; results may not be applicable to institutions with different practice patterns for endoscopic and percutaneous biliary drainage. Finally, we focused our study on patients with malignant distal biliary obstruction and we cannot comment on the efficacy and safety of EUS guided biliary drainage in the treatment of hilar biliary structures or benign biliary disease.

Conclusions

In summary, EUSr is a safe and effective method of biliary drainage in patients with MDBO after failed ERC Initial technical success with EUSr was significantly lower than with PBD, however when EUSr was successful patients had a significantly shorter post-procedure hospital stay and required fewer follow-up biliary interventions than those undergoing PBD.

Competing interests: None

References