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EUS-guided *versus* percutaneous liver abscess drainage: A multicenter collaborative study

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ABSTRACT

Background and Objectives: Management of hepatic abscesses has traditionally been performed by image-guided percutaneous techniques. More recently, EUS drainage has been shown to be efficacious and safe. The aim of this study is to compare EUS-guided *versus* percutaneous catheter drainage (PCD) of hepatic abscesses.

Methods: Patients who underwent EUS-guided drainage or PCD of hepatic abscesses from January 2018 through November 2021 from 4 international academic centers were included in a dedicated registry. Demographics, clinical data preprocedure and postprocedure, abscess characteristics, procedural data, adverse events, and postprocedure care were collected.

Results: Seventy-four patients were included (mean age, 63.9 years; 45% male): EUS-guided (n = 30), PCD (n = 44). Preprocedure Charlson Comorbidity Index scores were 4.3 for the EUS group and 4.3 for the PCD group. The median abscess size was 8.45 × 6 cm (length × width) in the EUS group *versus* 7.3 × 5.5 cm in the PCD group. All of the abscesses in the EUS group were left-sided, whereas the PCD group contained both left- and right-sided abscesses (29 and 15, respectively). Technical success was 100% in both groups. Ten-millimeter-diameter stents were used in most cases in the EUS group, and 10F catheters were used in the PCD group. The duration to resolution of symptoms from the initial procedure was 10.9 days less in the EUS group compared with the PCD group (P < 0.00001). Hospital length of stay was shorter in the EUS group by 5.2 days (P = 0.000126). The EUS group had significantly fewer number of repeat sessions: mean of 2 *versus* 7.7 (P < 0.00001) and trended toward fewer number of procedure-related readmissions: 10% *versus* 34%. The PCD group had a significantly higher number of adverse events (n = 27 [61%]) when compared with the EUS group (n = 5 [17%]; P = 0.0001).

Conclusions: EUS-guided drainage is an efficacious and safe intervention for the management of hepatic abscesses. EUS-guided drainage allows for quicker resolution of symptoms, shorter length of hospital stay, fewer adverse events, and fewer procedural sessions needed when compared with the PCD technique. However, EUS-guided drainage may not be feasible in right-sided lesions.

Keywords: EUS; Liver; Abscess; percutaneous drainage; Abscess drainage

INTRODUCTION

Pyogenic liver abscesses are collections of purulent materials in the liver parenchyma secondary to bacterial, parasitic, fungal, or mixed infections. Approximately 40% to 60% of hepatic abscesses occur in patients with underlying biliary tract disease. Hepatic abscess can also occur because of portal seeding and local extension.[1–3] Without treatment, they are associated with high rates of morbidity and mortality. Antibiotic treatment along with percutaneous drainage has been the traditional form of management.[4] This technique is preferred to surgery as it does not require general anesthesia, has a lower hospitalization rate, and causes less trauma to the surrounding tissue.[5] Nevertheless, percutaneous catheter drainage (PCD) is a technique not free from complications. Complications include pain or discomfort at catheter entry site, pericatheter leak, bleeding, dislodgement, peritonitis, or sepsis.[6]

Surgical management may be appropriate for inaccessible abscesses, multilocular abscesses, or for abscesses that fail to resolve with percutaneous drainage.[7,8] However, surgery is an invasive option that can be associated with longer hospital stays and higher rates of morbidity and mortality.[9] Advances in EUS-guided interventions have allowed transluminal drainage of pancreatic fluid collections, the gallbladder, and pelvic abscesses. Given the close proximity of the left lobe of the liver to the gastric wall, EUS-guided drainage has also become an option for management of left-sided pyogenic liver abscesses.[10] Multiple case reports and case series have shown this to be efficacious and safe [Table 1].

The aim of this study is to compare EUS-guided *versus* percutaneous drainage of hepatic abscesses.

METHODS

Study outcomes and analysis

All patients who underwent EUS-guided drainage or percutaneous drainage of hepatic abscesses from January 2018 through November 2021 from 4 international academic centers were

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Table 1

EUS-guided liver abscess drainage studies.

Study	Year	Abscess	Location and approach	Drainage method (approach)	Technical success	Clinical success	Relapses	Adverse events
Seewald et al.[11]	2005	1	Left lobe (TG)	7F NCD	100%	100%	No	No
Ang et al.[12]	2009	1	Left lobe (TG)	8F, 10F pigtail PS	100%	100%	N/A	No
Noh et al.[10]	2010	3	Left lobe (1) Caudate lobe (2) (TG: 2, TD: 1)	7F NCD 7F pigtail PS	100%	100%	No	No
Itoi et al.[13]	2011	2 (Same patient)	Caudate lobe (1) Left lobe (1) (TD, TG)	7F straight and pigtail PS 5F NCD	100%	100%	No	No
Keohane et al.[14]	2011	2	Caudate lobe (2) (TG)	7F and 10F pigtail PS	100%	100%	N/A	No
Ivanina et al.[15]	2012	1	Caudate lobe (TG)	(N/A) F NCD	100%	100%	N/A	No
Medrado et al.[16]	2013	1	Left lobe (TG)	FCSEMS	100%	100%	No	Stent migration
Alcaide et al.[17]	2013	1	Left lobe (TG)	LAMS	100%	100%	No	No
Kawakami et al.[18]	2014	1	Left lobe (TG)	FCSEMS	100%	100%	No	No
Koizumi et al.[19]	2014	1	Left lobe (TG)	7F NCD	100%	100%	No	No
Kodama et al.[20]	2015	1	Left lobe (TG)	FCSEMS	100%	100%	No	Dislodgement of NCC
Tonozuka et al.[21]	2015	7	Left lobe (6) Right lobe (1) (TG: 6, TD:1)	FCSEMS FCSEMS	100%	100%	No	
Ogura et al.[22]	2015	1	Right lobe (TD)	FCSEMS	100%	100%	No	
Kumta et al.[23]	2016	1	Left lobe (TG)	LAMS	100%	100%	No	
Ogura et al.[24]	2016	8	Left lobe (6) Right lobe (2) (TG:6, TD:2)	FCSEMS FCSEMS	100%	100%	No	No
Yamamoto et al.[25]	2017	1	Right lobe (TD)	5F NCD	100%	100%	No	No
Carbajo et al.[26]	2019	9	Left lobe (3) Right lobe (6) (TG: 3, TD: 6)	FCSEMS LAMS (2)	77.8%	77.8%	No	22,2% (GI bleeding and perforation)
Desai et al.[27]	2019	1	Left lobe (TG)	LAMS	100%	100%	No	
Venkatesh et al.[28]	2020	1	Caudate lobe (TG)	7F pigtail PS	100%	100%	No	
Rana et al.[29]	2020	14	Left lobe (11) Caudate lobe (3) (TG = 10, TE = 4)	7F pigtail PS	100%	100%	No	No
Toshima et al.[30]	2020	1	Left lobe (TG)	FCSEMS	100%	10%	No	No
Molinario et al.[31]	2021	1	Left lobe (TG)	LAMS	100%	100%	No	No
Chandra and Chandra[32]	2021	3	Caudate lobe (1) Left lobe (2) (TG)	8F pigtail PS and/or 8F or 10F NCD +/–active aspiration	100%	100%	No	No

FCSEMS: fully covered self-expanding metal stent; LAMS: lumen-apposing metal stent; NCC: nasocystic catheter; NCD: nasocystic drain; PS: plastic stent; TD: transduodenal; TG: transgastric.

Table 2

Baseline characteristics, abscess and procedural data.

N = 74	EUS (*n* = 30)	IR (*n* = 44)
Sex, male	13 (43%)	20 (45.5%)
Age, mean, y	69.6	60.1
Etiology	Biliary stricture (15) Biliary stone disease (10) other (10)	Biliary stricture (19) Biliary stone disease (22) other (3)
Charlson Comorbidity Index	Mean, 4.3	Mean, 4.3
Malignant (yes/no)	Yes (6, 20%)	Yes (7, 16%)
Length of procedure, mean, min	54.5	51
Abscess location—right or left lobe or both	Left (30)	Left (29) Right (15)
Multiple abscesses	Yes (4)	Yes (5)
Abscess size (length), mean	8.45 cm	7.3 cm
Abscess size (width), mean	6 cm	5.5 cm
EUS puncture location	Stomach (27) Duodenum (3)	NA
Type of stent: plastic or metal	Metal (30)	Plastic drain (44)
Size of stent or drain (diameter × length), mm	10 × 80 (14) 10 × 100 (13) 8 × 100 (1) 15 × 10 (1) 10 × 10 (1)	10F (44)
Metal stent features	Fins (7) LAMS (2) Partially covered (20)	NA
Technical success	Yes (30, 100%)	Yes (44, 100%)

LAMS: lumen-apposing metal stent.

included in a dedicated registry. Demographics, clinical data preprocedure and postprocedure, abscess characteristics, procedural data, adverse events, and postprocedure care were collected based on review of electronic medical records, endoscopy reports, and pathology reports. Results are reported as mean or median (range) for quantitative variables and percentages for categorical variables. The Student *t* test for independent means and χ^2 test (or Fisher exact test if required) for categorical variables were conducted to compare the groups. Two-sided $P < 0.05$ was considered statistically significant. All descriptive and statistical analyses were conducted using MedCalc V18.9 (MedCalc Software, Ostend, Belgium).

EUS techniques

All patients had cross-sectional imaging before EUS or percutaneous drainage with either magnetic resonance imaging or computed tomography imaging. For those patients who underwent EUS-guided drainage, the abscess cavity was visualized endosonographically in the left lobe of the liver. Color Doppler flow was utilized to rule out any intervening vessels. The collection was punctured with a 19-gauge needle, and a 0.035-inch guidewire was coiled in the abscess cavity. Placement of a metal stent was performed after balloon dilation or directly if using a cautery-enhanced lumen-apposing metal stent (Axios; Boston Scientific, Natick, MA). For those patients who underwent PCD, the abscess cavity was visualized with transabdominal ultrasound. The Seldinger technique was utilized. The area of skin at the site of intended puncture was injected with a local anesthetic. The abscess cavity was punctured with a needle, and pus was aspirated to confirm location. A guidewire was introduced into the abscess, and the tract was dilated up to 10F. A 10F pigtail catheter was then advanced over the wire into the abscess cavity, and the catheter was sutured to the skin.

Technical success was defined as the ability to access and drain the abscess. Clinical success was interpreted as complete resolution of clinical symptoms with disappearance or at least a >50% reduction of the abscess size on repeat imaging.

RESULTS

A total of 74 patients were included in the study with a mean age of 63.9 years. Forty-five percent of the patient were male [Table 2]; 30 patients were included in the EUS-guided group and 44 patients were included in the interventional radiology-guided group. Preprocedure Charlson Comorbidity Index score was 4.3 for both groups. The median abscess size was 8.45 × 6 cm (length × width) in the EUS group *versus* 7.3 × 5.5 cm in the percutaneous group. All of the abscesses in the EUS group were located in the left lobe of the liver, whereas the percutaneous groups contained both left- and right-sided abscesses (29 and 15, respectively).

Technical success was 100% in both groups. Twenty-eight of 30 patients in the EUS group were drained with a 10-mm-diameter stent. One 8-mm stent and one 15-mm stent were utilized in 2 separate cases. All patients in the percutaneous group had placement of a 10F pigtail catheter. In the EUS group, only metal stents were used and included 2 lumen-apposing metal stents, 7 fully covered self-expanding metal stents with antimigratory fins, and 20 partially covered self-expanding metal stents.

The duration to resolution of symptoms from the initial procedure was 10.9 days less in the EUS group compared with the IR group (28.7 *vs*. 39.6 days; $P < 0.00001$) [Table 3]. Hospital length of stay was shorter in the EUS group by 5.2 days (10.8 *vs*. 16 days; $P = 0.000126$). The EUS group had significantly fewer numbers of repeat sessions: mean of 2 *versus* 7.7 ($P < 0.00001$) and trended toward fewer number of procedure-related readmissions: 10% *versus* 34%. The IR-guided group had a significantly higher number of adverse events ($n = 27$ [61%]) when compared with the EUS group ($n = 5$ [17%]; $P = 0.0001$) [Table 2]. All of the adverse events in the EUS group were within 24 hours of the procedure and included 3 patients with pain and 2 patients with self-limited bleeding. In the percutaneous group, there were 13 immediate (within 24 hours) adverse events including 9 patients with pain, 3 patients

Table 3

Postprocedure data.

Time to resolution of symptoms of abscess from procedure, mean, d	28.7	39.6
Hospital readmission for abscess or procedure-related reason (*n*, %)	Yes (3, 10%)	Yes (15, 34%)
Recurrence of abscess (*n*, %)	Yes (2, 7%)	Yes (4, 9%)
Need for repeat sessions (*n*, %)	Yes (5, 17%)	Yes (10, 22.7%)
Total no. procedures (including IR change, check, imaging), mean	2 sessions	7.7 sessions
Total length of hospital stay from endoscopy procedure to discharge, mean, d	10.8	16
Longest follow-up time, mean, wk	36.7	37

with self-limited bleeding, and 1 patient with a dislodged drain. There were no delayed (>24 hours from procedure) adverse events in the EUS group. The percutaneous group had 14 delayed adverse events including 9 clogged drains that required replacement and 5 skin infections that required antibiotic treatment.

DISCUSSION

Percutaneous drainage has been the main modality of treatment for hepatic abscesses for many years.[2,6,33] Upon review of the largest PCD studies in the literature [Table 4] with large cohorts (n = 50, 88, 116, and 272), clinical success rates range from 86.3% to 96.6%. Abscess recurrence after PCD was documented in 2 of the reviewed studies, ranging from 2.2% to 9.1%.[34,37] In our study, there were 2 recurrences (7%) after EUS-guided drainage and 4 recurrences (9%) after PCD.

Although there is a large amount of literature and data regarding PCD of liver abscesses, there are only 19 case reports/case series and 4 retrospective studies describing EUS-guided drainage [Table 1]. A standard technique for EUS-guided abscess drainage is described in all reported cases. The choice of endoprosthesis for transluminal drainage is variable. In the earlier reported cases, 7F to 10F double-pigtail stents and/or 5F to 7F nasocystic drains were used more frequently. Since 2013, fully covered self-expandable metal stents have been used preferably over plastic stents for liver abscess drainage.[16–18,20–27,29–31] In the current literature, most abscesses drained by EUS guidance were located in the left hepatic lobe. Transgastric drainage is the most common approach, although 21% of cases in the literature do describe a transduodenal approach. Transesophageal drainage has also been reported in 4 patients in 2020 by Rana et al.[29] In our cohort, all 30 abscesses were located in the left hepatic lobe. Twenty-seven (90%) of these abscesses were drained from the stomach, and 3 (10%) were drained from the duodenum.

Technical and clinical success of EUS-guided hepatic abscess drainage was 100% in every reported study, apart from the retrospective study by Carbajo et al,[26] where the success rate was 88.9%. The 2 cases that were unsuccessful in that study were due to an inaccessible hepatic abscess in segment VIII of the liver and a stent dislodgement requiring removal and closure of gastric defect with an over-the-scope clip.

Table 4

Studies evaluating percutaneous liver abscess drainage.

Study	Year	N	Success rate	Relapses	Adverse events
Vakamacawai et al.[34]	2019	88	86.3%	9.1%	1.1% Self-limited bleeding with resulting anemia 4.5% Bile leak, resolved spontaneously
Xu et al.[35]	2020	116	96.6%	None	7.8% Catheter clogging 4.3% Catheter dislodgement 3.4% Septic shock and death
Surya et al.[36]	2020	50	92%	None	2% Peritonitis
Ahmed et al.[37]	2021	272	96.2%	2.2%	3.8% Ruptured abscess, needed surgery 0.22% Subcapsular hematoma

Reported adverse events using EUS-guided drainage are scarce, but they include stent migration, dislodgement of nasocystic catheter, gastrointestinal bleeding (usually self-limiting), and perforation (oftentimes managed endoscopically).[16,20,26] Catheter clogging, catheter dislodgement, septic shock, bleeding, bile leakage, peritonitis, abscess rupture, and even death were complications secondary to PCD of liver abscesses.[34–37] Hospital readmission for abscess or procedure-related reasons occurred in 3 (10%) of the cases in the EUS-drainage cohort and in 15 (34%) of the PCD cohort in our study.

One of the main strengths of our present study is the inclusion of the largest cohort of EUS-guided liver abscess drainage published to date in comparison to a large cohort of PCDs. Our study demonstrated a quicker resolution of symptoms, shorter length of hospital stay, fewer adverse events, lower hospital readmission rate for abscess/procedure related reasons, and fewer repeat procedures in the EUS-guided liver abscess drainage cohort. This implies that for those institutions with significant therapeutic EUS expertise, left-sided liver abscesses may benefit from EUS-guided drainage. One of the potential reasons such a drastic difference in outcomes was seen between the 2 groups is the large-diameter metal stents used for EUS-guided drainage. The median diameter size of stent used in the EUS group was 10 mm, whereas that in the PCD group was 10F or 3.33 mm.

It is important to note that all of the patients in the PCD cohort were drained with a 10F pigtail catheter, which is relatively small. It is unclear if a larger-caliber percutaneous drain may have led to comparable outcomes with the EUS-drainage cohort. Also, patients with right-sided liver abscesses are usually not able to be drained by EUS; therefore, their management would not change. These patients would still require percutaneous drainage for management, although there are a few case studies of right-sided abscesses drained by EUS.[21,25,26] Our study did not include any right-sided liver abscesses drained by EUS guidance. This study demonstrates that EUS-guided liver abscess drainage is a viable, efficacious, and safe option for left-sided hepatic abscesses when compared with percutaneous drainage. This minimally invasive procedure can also be an alternative option to surgery for left lobe or caudate lobe abscesses, which are inaccessible by interventional radiology. However, further large, randomized, prospective studies are needed to validate the outcomes seen in our study.

Conflicts of Interest

Amy Tyberg is consultant for Ninepoint Medical, Endogastric Solutions, Obalon Therapeutics. Avik Sarkar has done consulting work for US Endoscopy and Obalon Therapeutics. Haroon Shahid has done consulting work for US Endoscopy. Michel Kahaleh has received grants support from Boston Scientific, Fujinon, W. L. Gore, Apollo Endosurgery, Cook Endoscopy, GI Dynamics, Merit Medical, Interscope Med, Olympus, ERBE, and MI Tech. He is a consultant for Boston Scientific and Laboratories Inc, AbbVie. None of this funding was related to this article. Monica Gaidhane is consultant for 3D Matrix. The other authors declare that they have no financial conflict of interest with regard to the content of this report. Everson L. Artifon and Michel Kahaleh are Assocated Editors of the journal. This article was subject to the journal's standard procedures, with peer review handled independently of the editors and their research groups.

Author Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by

Monica Gaidane and Michel Kahaleh, MD. The first draft of the manuscript was written by Noah Y. Mahpour, MD and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Declaration of Patient Consent

All patients were consented for all procedures described in the manuscript.

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