Percutaneous Hepatic Abscess Drainage: Do Multiple Abscesses or Multiloculated Abscesses Preclude Drainage or Affect Outcome?

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PURPOSE: To compare the effectiveness of percutaneous abscess drainage in patients with pyogenic liver abscesses of the following types: single, single multiloculated, multiple, and multiple multiloculated.

MATERIALS AND METHODS: One hundred nine patients with 149 liver abscesses who underwent percutaneous drainage during an 11-year period were divided into a single abscess group and a multiple abscess group. Of the 109 patients, 54 had multiloculated abscesses and were divided into single and multiple multiloculated abscess groups. Technical success was defined as the ability to place the catheter within the abscess cavity and clinical success was defined as improvement in the patient's symptoms. Clinical findings, management strategy, complication rate, and success rate were analyzed.

RESULTS: Technical success rates were 96% (82 of 85) for a single abscess and 96% (23 of 24) for multiple abscesses ($P = 1.0$). Clinical success was achieved in 74 of 85 patients (87%) with a single abscess and 22 of 24 patients (92%) with multiple abscesses ($P = .729$). Technical success rates were 94% (32 of 34) for a single multiloculated abscess and 95% (19 of 20) for multiple multiloculated abscesses ($P = 1.0$). Clinical success was achieved in 30 of 34 patients (88%) with a single multiloculated abscess and 18 of 20 patients (90%) with multiple multiloculated abscesses ($P = 1$). No significant difference in hospital stay was seen between single and multiple abscess groups ($P = .373$) or between single multiloculated and multiple multiloculated abscess groups ($P = .180$). There were no major complications or mortality related to the procedure.

CONCLUSIONS: Percutaneous drainage is a safe and effective procedure in the treatment of pyogenic liver abscess, regardless of abscess complexity and/or multiplicity.


SINCE the 1950s, percutaneous aspiration has been applied successfully to treatment for pyogenic liver abscess (1). Percutaneous transhepatic abscess catheter drainage and percutaneous transhe-
MATERIALS AND METHODS

Patient Demographics and Medical Record Review

The institutional human studies review committee granted approval for this retrospective review, with a waiver of informed consent. The study was compliant with the Health Insurance Portability and Accountability Act.

From July 1995 to October 2006, 113 consecutive patients with liver abscess(es) were admitted and underwent percutaneous catheter drainage at our hospital. Four patients with amebic liver abscess were excluded. The remaining 109 patients (mean age, 58.4 years; age range, 11–89 y) had a total of 149 pyogenic liver abscesses. Diagnosis of the pyogenic abscess was proved by aspiration or microbiologic findings in all patients.

Definition of Type of Abscesses Drained

The interpretation of radiologic studies was based on consensus of two abdominal radiologists with 5 and 20 years of experience in abdominal imaging, respectively. Abscesses were categorized as single, single multiloculated, multiple, and multiple multiloculated abscesses. The distinction between single and multiple abscesses was based on the presence of normal intervening liver parenchyma separating multiple abscesses and/or evidence that the abscesses were in different segments of the liver. Unilocular abscess was defined as a simple abscess without enhancing internal septations on unenhanced and contrast-enhanced computed tomography (CT) before percutaneous catheter drainage. Multiloculated abscess was defined as an abscess with enhancing internal septations. Several features were analyzed to differentiate single from single multiloculated and multiple from multiple multiloculated collections. This included retrospective review of all ultrasound and CT images as well as dictated reports. If septations were seen on the original imaging and more than one catheter was placed for drainage, it was assumed that the collections could not be drained by a single catheter as determined by the interventional radiologist performing the procedure.

Percutaneous Transhepatic Abscess Drainage Procedure

Percutaneous catheter drainage was performed with CT (n = 62) or sonographic (n = 47) guidance at the discretion of the radiologist performing the procedure. For the procedure of percutaneous catheter drainage, the patient was first positioned according to the proposed route of approach. Local anesthesia was given with 10 mL of lidocaine hydrochloride 1% (Hospira, Lake Forest, Illinois); intravenous sedation was administered with droperidol (Inapsine; Akorn, Decatur, Illinois) until 2001, when it became unavailable, or meperidine (Demerol; Abbott Laboratories, North Chicago, Illinois) during the procedure for patient comfort.

Seldinger or trocar technique was used to introduce the drainage catheter into the abscess cavity depending on the choice of the attending radiologist (10,11). The size of drainage catheter was dependent on the attending radiologist, the size of the abscess cavity, and thickness of pus.

Regardless of technique, catheter drainage was similar after the catheter was placed. The contents of the abscess were aspirated. Subsequently, aggressive irrigation was performed. By definition, multiple doses of sterile saline solution at a volume of 10–20 mL (depending on abscesses size) were irrigated at low pressure and low volume until the returning material was clean. Then, the position of the tip of the catheter and the size of the lesion after drainage were rechecked by sonography or CT to assure good positioning. If residual collection was noted on postprocedural imaging after the injection was performed, a second catheter was placed. The catheter was then attached to a drainage bag via a three-way stopcock connecting system so that flushing could be performed on the floor. Initially, no contrast material was injected via the drainage catheter.

Aspirated pus was immediately sent to the laboratory for culture. Broad-spectrum antibiotics were usually administered for all patients before the procedure until results of the laboratory tests were available. After the results of the laboratory tests were obtained, specific antibiotics were obtained for the causative organisms.

Definition of Technical and Clinical Success

Technical success was defined as the ability to place the catheter appropriately within the abscess cavity with drainage of some fluid and some decrease in the size of the abscess(es). Clinical success was defined as improvement in all the patient’s symptoms with decreased temperature if they had fever before the drainage, decreased white cell count if they had leukocytosis before the drainage, no subsequent need for surgery or drainage treatment, and resolution of abscess(es) on imaging.

Treatment Course and Follow-up

The patients were followed by daily records to evaluate their clinical response. If the white blood cell count did not decrease and there was no improvement of clinical symptoms, a repeat CT examination was performed to determine if there were residual abscesses. The amount of drainage over time was followed. If drainage exceeded 50 mL/d, imaging of the abscess was performed to determine possible biliary communication. Patients were sent home with catheters that were removed in referring doctor’s offices; hence, the accurate catheter drainage duration was not available.

Statistical Analysis

Data are expressed as means ± SD. The differences in qualitative variables were analyzed by the Fisher exact test. Differences between mean measurements in the two groups were analyzed by Student t test. Statistical significance was defined by a P value less than .05.

RESULTS

Demographics

Details of the patients’ demographics are shown in Tables 1 and 2. There were 85 patients with a single abscess and 24 patients with multiple abscesses (two to five lesions per patient; mean, 2.8 ± 1.07). Neither age nor sex were significantly different between these two groups (P = .528 and P = .086, respectively; Table 1).
Thirty-four of 85 patients had multiloculated lesions in the single abscess group (40%), versus 20 of 24 patients in the multiple abscess group (83%), which represented a significant difference ($P < .001$). Neither age nor sex were significantly different between the single and multiple multiloculated abscess groups ($P = .180$ and $P = .072$, respectively; Table 2).

### Abscess Size and Location

Details of abscess characteristics are shown in Tables 1 and 2. Mean abscess size in the single abscess group was 8.3 cm ± 4.01 (range, 3.3–22 cm), compared with 6.7 cm ± 3.56 (range, 2.7–20 cm) in the multiple abscess group, which represented a significant difference ($P = .018$). Abscess location was not significantly different between these two groups ($P = .437$; Table 1).

Mean abscess sizes were 8.6 cm ± 3.26 (range, 6–20 cm) in the single multiloculated abscess group and 7.0 cm ± 3.76 (range, 2.7–20 cm) in the multiple multiloculated abscess group, which represented a significant difference ($P = .044$). Abscess location was not significantly different between these two groups ($P = 1$; Table 2).

### Technical and Clinical Success

The technical success rates of percutaneous catheter drainage in the single and multiple abscess groups were 96.5% (82 of 85) and 95.8% (23 of 24), respectively (Figs 1, 2), which were not significantly different ($P = 1.0$; Fisher exact test; Table 3). In the single multiloculated and multiple multiloculated abscess groups, the technical success rates of percutaneous catheter drainage were 94.1% (32 of 34) and 95% (19 of 20), respectively, which were not significantly different ($P = 1.0$; Fisher exact test; Table 3). Clinical success was achieved in 87% of patients with a single abscess (74 of 85) and 92% of patients with multiple abscesses (22 of 24). The clinical success rate was higher in the multiple abscess group than in the single abscess group, but the difference was not significant ($P = .729$; Fisher exact test). In the single and multiple multiloculated abscess groups, clinical success was achieved in 88.2% of patients (30 of 34) and 90% of patients (18 of 20), respectively, which were not significantly different ($P = 1.0$; Fisher exact test).

One to five abscesses per patient were treated with percutaneous catheter drainage in the multiple abscess group (mean, 2.1). In the single abscess group, catheter sizes included 8 F ($n = 16$), 10 F ($n = 44$), 12 F ($n = 34$), and 14 F ($n = 16$), respectively, in the single abscess group. In the multiple abscess group, 11 catheters were 8 F, 29 were 10 F, 37 were 12 F, and four were 14 F. The use of larger drainage catheters (ie, 12 and 14 F) was no more common in either group (50 of 110 [45%] vs 41 of 81 [51%]; $P = .480$).

Durations of hospital stay were 17.8 days ± 17.82 (range, 2–85 d) in the single abscess group and 21.2 d ± 15.73 (range, 2–63 d) in the multiple abscess group. In the single multiloculated abscess group and multiple multiloculated abscess group, hospital stay durations were 15.9 d ± 16.45 (range, 2–85 d) and 22.5 d ± 16.26 (range, 5–63 d), respectively.

### Etiology of Abscess

Of the 85 patients with a single abscess, 20 abscesses (23.5%) were caused by a primary or secondary biliary pathologic process, including postbiliary surgery ($n = 11$), pancreatic carcinoma ($n = 5$), biliary stone disease ($n = 3$), or cholangiocarcinoma ($n = 1$). An additional 14 patients had a postoperative abscess following resection of hepatic malignancy ($n = 10$), liver transplantation ($n = 2$), or extrahepatic abdominal surgery ($n = 2$). Other less common causes of abscesses in the single abscess group were liver metastases with tumor necrosis ($n = 3; 3.5\%$), liver injury ($n = 2; 2.4\%$), and empyema ($n = 1; 1.2\%$).

Etiology was not specifically determined in the remaining patients, but 11 patients had co-existing conditions that may have been predisposed to ab-

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### Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Single Abscess ($n = 85$)</th>
<th>Multiple Abscess ($n = 24$)</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>57.2 ± 18.67 (11–89)</td>
<td>59.5 ± 14.62 (27–81)</td>
<td>.528</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>60/25</td>
<td>12/12</td>
<td>.086</td>
</tr>
<tr>
<td>Total abscesses drained</td>
<td>85</td>
<td>52</td>
<td>NA</td>
</tr>
<tr>
<td>Abscess size (cm)</td>
<td>8.3 ± 4.01 (3.3–22)</td>
<td>6.7 ± 3.56 (2.7–20)</td>
<td>.018</td>
</tr>
<tr>
<td>Abscess location (right/left lobe)</td>
<td>64/21</td>
<td>16/8</td>
<td>.437</td>
</tr>
<tr>
<td>Multiloculated abscess</td>
<td>34</td>
<td>20</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Lesion with biliary system connection</td>
<td>13</td>
<td>6</td>
<td>.399</td>
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<tr>
<td>Biloma</td>
<td>7</td>
<td>1</td>
<td>.682</td>
</tr>
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</table>

Note.—NA = not available. Values presented as means ± SD (range) where applicable.

### Table 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Single Multiloculated Abscess</th>
<th>Multiple Multiloculated Abscess</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>56.0 ± 18.86 (19–89)</td>
<td>62.1 ± 13.87 (27–81)</td>
<td>.180</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>26/8</td>
<td>10/10</td>
<td>.072</td>
</tr>
<tr>
<td>Abscess size (cm)</td>
<td>8.6 ± 3.26 (6–20)</td>
<td>7.0 ± 3.76 (2.7–20)</td>
<td>.044</td>
</tr>
<tr>
<td>Abscess location (right/left lobe)</td>
<td>24/10</td>
<td>14/6</td>
<td>1</td>
</tr>
</tbody>
</table>

Note.—Values presented as means ± SD (range) where applicable.
Of these 11 patients, seven had diabetes mellitus, two had dental work before discovery of the abscess, one had HIV infection, and one patient was an alcoholic.

In the multiple abscess group ($n=24$), biliary origin was also the most common cause of abscess ($n=11; 45.8\%$), followed by diverticulitis ($n=2; 8.3\%$). Other less common causes of abscess in the multiple abscess group were liver metastases with tumor necrosis ($n=1; 4.2\%$), Crohn disease ($n=1; 4.2\%$), bacterial endocarditis ($n=1; 4.2\%$), recent dental work ($n=1; 4.2\%$), and recent abdominal surgery ($n=1; 4.2\%$).

**Bacteriology Findings of Abscess**

Among the 85 patients with a single abscess, bacteriologic study of cultures had positive findings in $78.8\%$ of patients ($n=67$). The remaining abscesses were diagnosed based on increased white blood cell count in the aspirated fluid but had negative findings on culture. *Streptococcus* species were the main bacteria isolated ($n=25$), followed by *Enterococcus* species ($n=12$), *Escherichia coli* ($n=8$), *Klebsiella* species ($n=5$), and *Escherichia coli* ($n=3$).

**Complications and Mortality**

No patient had any major complications after percutaneous catheter drainage. There were five minor local complications among 109 patients in the population ($4.6\%$). These included small pneumothorax in four cases and mild intraabdominal hemorrhage in one. All patients recovered completely without surgery for further treatment. The mortality rate among patients with a single abscess drained successfully was $3.5\%$ (ie, three of 85). In all three cases, mortality was related to the patient’s underlying disease and not to the percutaneous catheter drainage procedure. No patients died in the multiple abscess group after percutaneous catheter drainage.

**Biliary Communication**

Thirteen patients in the single abscess group had liver abscesses with biliary communication, compared with six in the multiple abscess group ($P = 359$; Fisher exact test). In the single abscess group, three patients with abscesses with biliary communication also had biliary obstruction; only one patient had a liver abscess with biliary communica-
tion and obstruction in the multiple abscess group.

**DISCUSSION**

For the past 20 years, percutaneous catheter drainage has often been performed instead of surgery in the management of pyogenic liver abscesses. Nevertheless, there remains some controversy whether percutaneous drainage can be successful treatment for multiple and/or multiloculated liver abscesses. This report describes 11 years of experience with percutaneous transhepatic abscess drainage with catheters in the treatment of pyogenic liver abscesses and compares the effectiveness of percutaneous catheter drainage in patients with single, single multiloculated, multiple, and multiple multiloculated abscesses.

Because of advances in imaging modalities, critical care, and antibiotic treatment, and refinement of techniques for percutaneous procedures, the mortality rate associated with hepatic abscess has decreased in the past 10 years (1,4,12). Despite these advances, percutaneous catheter drainage still has high reported failure rates, ranging from 15% to 36% in the literature (3,7,13–15). In fact, several studies describe the presence of multiple abscesses (ie, multiple multiloculated abscesses) as reasons for percutaneous drainage failure (4,7,13–15). However, the present series showed a low mortality rate (2.7%; three of 109) among patients with liver abscesses and a low clinical failure rate of 12% (13 of 109).

In comparison, Tan et al (7) reported that large abscesses, especially those that are multiloculated or contain thick viscid pus, are difficult to drain completely with a percutaneous approach, with a failure rate 27.8% (10 of 33). In the present study, multiloculated abscesses were found in 40% of patients in the single abscess group (34 of 85; Fig 1) and 83% in the multiple abscess groups (20 of 24; Fig 2). Only two patients with a multiloculated abscess in the single abscess group (6%) and one in the multiple abscesses group (5%) had a failed percutaneous drainage procedure and subsequently had to undergo surgery. CT guidance and catheter placement in residual collections during the initial percutaneous catheter drainage procedure can provide better success rates for the

<p>| Table 3 |
| Treatment Course and Percutaneous Catheter Drainage Outcome for Single Versus Multiple Abscesses and Single Multiloculated Versus Multiple Multiloculated Abscesses |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Abscesses</th>
<th>Multiloculated Abscesses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single</td>
<td>Multiple</td>
</tr>
<tr>
<td>Hospital duration (d)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.8 ± 17.82 (2–85)</td>
<td>21.2 ± 15.73 (2–63)</td>
<td>.373</td>
</tr>
<tr>
<td>Mean catheters per case (range)</td>
<td>1.3 (1–6)</td>
<td>3.4 (1–18)</td>
</tr>
<tr>
<td>Technical success (%)</td>
<td>96.5 (82/85)</td>
<td>95.8 (23/24)</td>
</tr>
<tr>
<td>Clinical success (%)</td>
<td>87 (74/85)</td>
<td>92 (22/24)</td>
</tr>
<tr>
<td>Mortality (%)</td>
<td>3.5 (3/85)</td>
<td>0 (0/24)</td>
</tr>
</tbody>
</table>

Note.—Values presented as means ± SD (range) where applicable.
treatment of multiple and multiloculated liver abscesses. Sommario et al (16) reported an idiopathic multiloculated and multiseptated liver abscess involving the entire left lobe in which needle aspiration failed and surgical drainage was required. This occurred in two of our patients who presented with large multiloculated abscesses with multiple septations and needed hepatectomy for treatment after failed percutaneous catheter drainage.

Chou et al (4) reported 29 of 62 patients (38.7%) with multiple liver abscesses in whom percutaneous catheter drainage failed. In the present study, our clinical success rates for percutaneous catheter drainage were 87% (74 of 85) in the single abscess group and 92% (22 of 24) in the multiple abscess group. Our definition of multiple and multiloculated (single and multiple) abscesses are based on a retrospective review of imaging and results at the time of drainage. For example, in our institution, after a catheter has been placed and the purulent material is aspirated, aggressive irrigation is performed. In our experience, unilocular cavities are well drained by this method. In addition, we tended to place most of our catheters by the trocar method, but there is no proof that one method—trocar or Seldinger technique—is superior to the other. The concept that multiloculated abscesses can be drained more effectively by placing a guide wire in a cavity and vigorously rotating the wire to disrupt septae has never been scientifically proven. In our experience, some abscesses that appear multiloculated on imaging can be drained by one catheter because, in fact, the septum seen on imaging is incomplete. This is why we relied on real-time reports by the interventionalist that a second catheter was placed because the cavity was not drained in the original placement.

Liver abscess with biliary communication has been reported as another factor associated with treatment failure after percutaneous catheter drainage. Continuous output of bile into the abscess cavity via the communicating tract is likely to prevent the tract from closing and healing, which may lead to treatment failure. Sugiyama and Atomi (17) reported that none of 10 hepatic abscesses with biliary communication and obstruction were completely cured with drainage alone, compared with three of 10 (30%) with biliary communication but no obstruction. In the current study, 19 patients had liver abscesses with biliary communication. Drainage was successful in 14 of 19 patients (73.7%) who had liver abscesses with biliary communication without obstruction (Fig 1). Among the remaining five patients in whom percutaneous catheter drainage failed, one had an echinococcal cyst with superinfection and the other four had liver abscesses with biliary communication and obstruction (Fig 3). The present study suggests that percutaneous catheter drainage is an effective modality for treatment of liver abscess with biliary communication without obstruction.

Of the 13 patients whose percutaneous catheter drainage was classified as a clinical failure, nine patients’ abscesses were technically well drained, but symptoms did not improve clinically. The causes of clinical failure in these nine patients were abscesses resulting from tumor in seven (Fig 3) and abscess with necrotic tissue and fibrosis in two. Johnson et al (6) described that infected necrotic tumors may regress for short periods, but often recur because the underlying cancer is still present.

Branum et al (18) reported that the primary determinant of percutaneous catheter drainage outcome was the underlying disease—eg, malignancy or immunocompromised status—rather than single versus multiple abscesses. Tazawa et al (1) and Ogawa et al (3) also showed that the mortality associated with percutaneous catheter drainage was related to underlying disease. In the present study, three patients with a single abscess who died after percutaneous catheter drainage had pancreatic tumor with or without liver metastases as an underlying disease.

One of the limitations of the present study is that it was performed as a retrospective single-center study with no control group for comparison, such as patients treated with surgical drainage or needle aspiration. Another limitation is that abscess imaging was not performed in all patients before removal of the drainage catheter. The lack of this imaging follow-up is related to the fact that some patients were sent home with catheters in stable condition and the drainage catheters were removed on an outpatient basis. The duration of catheter drainage was not available in the present study.

In conclusion, percutaneous catheter drainage is effective in the treatment of pyogenic liver abscesses, regardless of whether they are multiloculated.

References


