

## REVIEW ARTICLE

## What affects mortality after the operative management of hepatic abscess?

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*Department of Gastroenterologic and General Surgery, Mayo Clinic, Rochester, MN, USA***Abstract**

**Background.** Historically, the operative mortality associated with hepatic abscess was >50%. More recently, patients have been treated with percutaneous drainage; however, those failing conservative management are treated operatively. Our aim was to evaluate the outcome of operation for hepatic abscess in those failing conservative treatment or in those presenting as a surgical emergency. **Patients and methods.** This was a retrospective review of patients undergoing operation for hepatic abscess at the Mayo Clinic, Rochester, Minnesota from 1990 to 2003. **Results.** Of 288 patients diagnosed with hepatic abscesses, 32 required operation. Percutaneous drainage was the initial treatment in 15 (47%). The remaining 17 were initially managed with operation. Operative indication was septic shock (41%), failed nonoperative management (31%), and failure to make a diagnosis (28%). Operation was drainage (62%) or resection (38%). The morbidity and mortality rates were 41% and 15.6%, respectively. Factors associated with increased operative mortality were shock ( $p=0.04$ ), INR >1.5 ( $p=0.03$ ), WBC >15 000 ( $p=0.04$ ), AST >150 U/L ( $p=0.01$ ), alkaline phosphatase >500 U/L ( $p=0.03$ ), positive blood cultures ( $p=0.03$ ), total bilirubin >2.0 mg/dl ( $p<0.01$ ), multiple abscesses ( $p=0.01$ ), and second operation ( $p<0.001$ ). Factors not associated were extent of resection ( $p>0.10$ ), peritonitis ( $p>0.10$ ), intensive care admission ( $p>0.10$ ), polymicrobial infection ( $p>0.10$ ), and blood transfusion ( $p>0.10$ ). **Conclusion.** Operative intervention is avoided in 89% of patients with hepatic abscess. Septic shock is the most common reason for operation. Patients with septic shock, INR >1.5, WBC >15 000, AST >150 U/L, total bilirubin >2.0 mg/dl, positive blood cultures, or alkaline phosphatase >500 U/L have increased mortality when undergoing operation for hepatic abscess.

**Key Words:** *Hepatic abscess, pyogenic abscess, percutaneous drainage, operative mortality*

**Introduction**

Hepatic abscess is a rare disease of varying pathophysiology. The original report by Ochsner described a series of pyogenic hepatic abscesses and an associated high mortality rate. The hepatic abscess was most commonly secondary to portal pylephlebitis, usually in association with acute appendicitis [1]. In more recent decades, appendicitis, and the ensuing pylephlebitis, as a cause has decreased, while a biliary source now accounts for about 30% of pyogenic liver abscesses [2–4]. Other sources include direct extension, or via the hepatic artery, or secondary to trauma. A pyogenic abscess is the most common form, accounting for 80% of cases, while amebic and fungal infections collectively comprise about 20% of cases. The causative organism associated with pyogenic abscesses is often gram-negative bacteria alone or with an anaerobic superinfection. *Entamoeba*

*histolytica* is causative of amebic abscess, and 20% of these may have bacterial superinfection [5]. *Candida* species cause the majority of fungal hepatic abscesses.

With improved imaging, antibiotic and surgical therapy, intensive care monitoring, and percutaneous radiologic drainage techniques, the morbidity and mortality rates associated with hepatic abscess have been dramatically decreased. Prior to surgical drainage, a hepatic abscess was always fatal for the patient. The use of surgical drainage and intravenous antibiotics initially reduced the mortality rate to about 50%. Although much progress has been made, over the past two decades, mortality rates have not fallen below 10% [6–8].

Furthermore, percutaneous techniques have become very successful in treating this disease [9–11]. Most cases of hepatic abscess are initially treated by a

radiologist, and perhaps those reaching the general surgeon are later in the progress of the disease, in septic shock, or are more complex patients, such as those with multiple, loculated, or bilobar abscesses. Therefore, surgeons need to be skilled in the management of patients with hepatic abscess, both from a critical care as well as operative standpoint.

### Patients and methods

All patients undergoing operation for hepatic abscess at the Mayo Clinic, Rochester, Minnesota between 1990 and 2003 were included in this retrospective review. Clinicopathologic factors were analyzed to determine those factors that significantly affected morbidity and mortality.

### Results

In all, 288 patients diagnosed with hepatic abscess were admitted to the Mayo Clinic between 1990 and 2003. Operative intervention was required in 32 patients (11%). This population comprised 19 males and 13 females (mean age 54 years).

#### Clinical presentation

A normal physical exam was the most common finding at presentation (10 patients). Peritonitis and hepatomegaly were each present in six patients (19%). Fever and jaundice were seen in four (12.5%) and two (6%) patients, respectively. Septic shock was defined as hypotension requiring aggressive fluid resuscitation or pharmacologic pressors. Likewise, a patient presenting in extremis was categorized with septic shock. Thirteen patients (41%) presented with septic shock. Fifteen patients underwent percutaneous drainage prior to operation (47%). Malignancy had previously been diagnosed in six (19%) patients and four (12.5%) were being treated with oral steroids. Six patients (19%) had undergone previous liver operation. Blood cultures were positive at admission in 13 patients (41%).

#### Laboratory values (Table I)

Microbiologic data were available for 30 of the patients in this series. Eleven patients (37%) were infected with one organism while nine patients (30%) had polymicrobial infections. A sterile abscess was diagnosed in eight patients (27%). Seven gram-positive, 13 gram-negative, and 7 anaerobic organisms were isolated. Of the 24 patients with infected abscesses, the main isolates were *Klebsiella* species (25%), while *Escherichia coli* was found in 12.5%. *Candida* was isolated in one patient.

#### Radiologic data

Plain abdominal radiographs were performed in 26 patients. The majority of these were normal (17, 65%), while a right pleural effusion (6, 23%) or pneumobilia (3, 12%) was diagnosed less frequently. Transabdominal ultrasound (US) and computed tomography (CT) were done in 15 and 28 patients, respectively. Both modalities demonstrated 100% sensitivity. The majority of patients had a single hepatic abscess (22, 69%), although 10 (31%) patients presented with multiple abscess cavities. A right hepatic lobe abscess was diagnosed in 18 patients (56%). A left abscess or bilobar abscesses were found in 11 (34%) and 3 (9%) patients, respectively.

#### Operative data

Thirteen surgeons operated on 32 patients with hepatic abscess during the study period. Reasons for operation were septic shock, occurring in 13 (41%) patients, multiorgan system failure (10%), failure of medical management (36%), and failure to make diagnosis (7%). The most common etiology was a biliary source (15, 47%), either secondary to cholangitis (5) or direct extension secondary to acute cholecystitis (10). Other etiologies include a portal venous source (5, 16%), dental caries (3, 9%), and malignancy (2, 6%). Seven patients (22%) developed a cryptogenic hepatic abscess.

Table I. Laboratory values.

Laboratory value	Units	Normal range	Median	Range	Number abnormal
Total bilirubin	mg/dl	0.1–1.0	1.6	0.1–6.0	11 (34%)
Alkaline phosphatase	U/L	45–115	632	101–2488	30 (94%)
Albumin	g/dl	3.5–5.0	3.3	2.4–4.3	9 (28%)
AST	U/L	12–31	180	13–2131	23 (72%)
Creatinine	mg/dl	0.9–1.4	1.3	0.5–5.0	7 (22%)
WBC count	$\times 10^9/L$	3.5–10.5	15.8	4.3–51.3	24 (75%)
Hemoglobin	g/dl	13.5–17.5	11.1	7.9–14	29 (91%)
INR			1.3	0.9–2.5	4 (12.5%)

AST, aspartate aminotransferase; INR, international normalized ratio; WBC, white blood cell.

Percutaneous drainage was the initial management in 15 (47%) of the 32 patients; 9 (60%) of these required operative intervention secondary to uncontrolled sepsis. The most common operative treatment consisted only of abscess drainage (20, 62%); however, hepatic resection was performed in 12 patients (38%). Resections included five non-anatomic segmentectomies, four left hepatectomies, and three right hepatectomies.

#### Morbidity and mortality (Table II)

The mean length of hospital stay was 18 days (range 5–102). Seventeen patients (53%) required intensive care admission. Thirteen patients (41%) required blood transfusions during the operation or hospital course. Complications occurred in 13 patients (41%) and 8 of those patients developed multiple complications. Six patients developed multiorgan system failure. Bile leak occurred in two patients and two developed wound complications. Reoperation was necessary in six patients (19%).

The operative mortality rate while in hospital or within 30 days of operation was 15.6% (five patients). These patients were compared to the group of survivors in order to determine which factors were associated with increased operative mortality. Factors associated with increased operative mortality were septic shock ( $p=0.04$ ), an international normalized ratio (INR)  $>1.5$  ( $p=0.03$ ), white blood cell (WBC) count  $>15\,000$  ( $p=0.04$ ), aspartate aminotransferase (AST)  $>150$  U/L ( $p=0.01$ ), alkaline phosphatase

$>500$  U/L ( $p=0.03$ ), positive blood cultures ( $p=0.03$ ), total bilirubin  $>2.0$  mg/dl ( $p<0.01$ ), multiple abscesses ( $p=0.01$ ), and need for a second operation ( $p<0.001$ ). Factors not associated with increased surgical mortality included extent of resection ( $p>0.10$ ), peritonitis ( $p>0.10$ ), intensive care unit (ICU) admission ( $p>0.10$ ), polymicrobial infections ( $p>0.10$ ), and blood transfusion ( $p>0.10$ ). Also, immunosuppression (defined as oral steroid use or presence of malignancy) did not significantly affect survival ( $p>0.10$ ).

#### Discussion

Hepatic abscess is a disease with varying and evolving pathophysiology and has been solely treated operatively until the last two decades. Originally described as a disease secondary to pyogenic portal spread [1], this has shifted and, as in this series, a biliary source is now the cause of hepatic abscess in the majority of cases [2–4,10,11]. A portal source was found in only 16% of cases and the source was cryptogenic in 22%, which is similar to other series published in the literature [12]. A polymicrobial infection was seen in 30% of cases, while a single bacterial or fungal agent was seen in 37%. Most of the infections were gram-negative, although some were also fungal, amebic, gram-positive, or anaerobic. While this variety is seen throughout the literature, most operative series focus on pyogenic hepatic abscesses. The series presented demonstrates that surgeons should be aware of different causative factors for hepatic abscess as well as their most successful treatments.

Patients with hepatic abscess present to medical care by a variety of paths. In this series, the majority of patients presented with a normal physical exam; however, a significant percentage presented with signs or symptoms of sepsis or an abdominal surgical emergency. As surgeons, attention needs to be directed at those patients presenting with physical signs warranting imaging or invasive therapies. Laboratory values are often abnormal in those with hepatic abscess. The 41% of patients in this series that presented with positive blood culture were significantly more likely to be an operative mortality ( $p=0.03$ ). Also, those with elevated liver enzymes, specifically total bilirubin ( $p<0.01$ ), AST ( $p=0.01$ ), and alkaline phosphatase ( $p=0.02$ ) and those with septic shock ( $p=0.04$ ), occurring in 41%, were more likely to be an operative mortality. Based on these findings, we conclude that when a patient presents with hepatic abscess, along with septic shock, positive blood cultures, or increased liver enzymes, surgeon involvement and acuity of care should be raised.

Radiologic imaging at presentation varied depending on the severity of the patient's condition. The majority of plain radiographs were normal. CT was most commonly performed, although about half of

Table II. Factors evaluated for operative mortality in patients with hepatic abscess.

Factor	Number of patients	$p$ value
INR $>1.5$	4	0.03
WBC $>15\,000$	14	0.04
AST $>150$ U/L	5	0.01
AP $>500$ U/L	12	0.03
Positive blood culture	13	0.03
Septic shock	13	0.04
Total bilirubin $>2.0$ mg/dl	11	$<0.01$
Multiple abscesses	10	0.01
Second operation	6	$<0.001$
Extent of resection		$>0.10$
Drainage	20	
Segmentectomy	5	
Left hepatectomy	4	
Right hepatectomy	3	
Peritonitis	6	$>0.10$
ICU admission	17	$>0.10$
Polymicrobial abscess	9	$>0.10$
Blood transfusion	13	$>0.10$
Percutaneous drainage	15	$>0.10$
Immunosuppression	10	$>0.10$

AP, alkaline phosphatase; AST, aspartate aminotransferase; ICU, intensive care unit; INR, international normalized ratio; WBC, white blood cell.

the patients underwent transabdominal US. Both of these modalities had 100% sensitivity in the diagnosis of hepatic abscess. Excellent results with diagnosis and management of hepatic abscess have also been documented in the literature [13]. During the past two decades, improvements in radiologic imaging and percutaneous techniques have allowed a significant percentage of hepatic abscesses to be treated without operation [6–8,13,14]. As seen in this series, most patients were initially managed with percutaneous drainage. This treatment was vastly successful, in that of the 288 patients diagnosed with hepatic abscess, only 32 eventually required operation. Conversely, of the 32 undergoing operative management, 60% failed percutaneous treatment. Attempt at percutaneous treatment was not predictive of operative mortality ( $p=0.32$ ).

The hepatic abscess was most often found in the right hepatic lobe (56%), and a left lobe abscess or bilobar abscesses were found in 34% and 9%, respectively. This trend is similar to that reported previously [15]. The majority of patients presented with a single cavity, but 31% had multiple abscesses diagnosed, and this trend is reflected in the literature [15]. In this study, the presence of multiple abscesses ( $p=0.01$ ) was associated with increased operative mortality. The operative management consisted of evacuation and external drainage in the majority of cases (62%), but the remainder required resection. A segmentectomy or wedge resection was performed in five patients, and formal right or left hepatectomies were performed in three and four patients, respectively. Extent of operation did not affect the mortality rate ( $p>0.10$ ). Therefore, if the abscess is adequately relieved with percutaneous drainage, operative drainage, or operative excision, outcome is good.

Following operative management of hepatic abscess, the patients experienced a significant complication rate (41%). Of these, 62% developed multiple complications and 46% developed multi-organ failure. Reoperation was necessary in 19%, and this was associated with increased mortality ( $p<0.001$ ), likely secondary to the poor physiologic condition of the patient. However, the need for blood transfusion ( $p>0.10$ ) and intensive care admission ( $p>0.10$ ) were not associated with increased mortality.

The Center for Patient Oriented Research at the Mayo Clinic was utilized for statistical analysis in this review. Due to small sample size in the operative mortality group, it was not possible to achieve a multivariate analysis of significant factors. We understand that this is a weakness of this review and, once larger numbers are accrued, a multivariate model will be established.

## Conclusion

Hepatic abscess is a disease of varying pathophysiology. Advancements in radiologic imaging and minimally invasive therapies have reduced the morbidity and mortality associated with hepatic abscess. However, as in this series, a significant amount of patients will present with diffuse disease, in septic shock, or have a physical exam consistent with a surgical emergency. According to the data presented, elevation of hepatic enzymes, bilobar or multiple abscesses, septicemia, septic shock, and need for a second operation were associated with operative mortality. Patients with these findings need to be aggressively monitored and early surgical consultation and intervention is warranted.

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