

Hepatic Abscesses in the Immunocompromised Patient: Role of CT in Detection, Diagnosis, Management, and Follow-Up

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Abstract. Newer cytotoxic and immunosuppressive agents and more aggressive oncologic treatment protocols have resulted in an increased incidence of opportunistic infections in the immunocompromised host. Clinical symptoms and laboratory data are often nonspecific and definitive diagnosis may be difficult to establish. The role of CT in the detection, diagnosis, management, and follow-up of various hepatic opportunistic infections in 9 immunocompromised hosts is presented.

In 5 of 6 patients, CT-guided needle aspiration resulted in definitive diagnosis. In 3 patients, surgical intervention was obviated by abscess drainage using CT guidance. There is clearly a role for CT not only in the detection but also in the definitive diagnosis, treatment, and follow-up of abscesses in the immunocompromised host.

Key words: Liver, abscess – Liver, computed tomography.

A new spectrum of opportunistic infections has been introduced into current clinical practice with the increasing use of steroids, cytotoxic drugs, other immunosuppressive agents, and antibiotics, particularly in the immunocompromised host [1, 2]. In many instances, the clinical symptoms in these patients are nonspecific, resulting in a delay in diagnosis and increased morbidity and mortality. We present here our experience utilizing computed tomography (CT) in the detection, definitive diagnosis, treatment, and follow-up of hepatic abscesses in the immunocompromised host.

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Materials and Methods

The medical records and CT findings in 9 immunocompromised hosts with proven hepatic abscesses were analyzed retrospectively. Four patients were male and 5 were female; they ranged in age from 15 to 65 years. Underlying disease processes included acute myelogenous leukemia in 3 patients, chronic granulomatous disease in 3 children, and diabetes mellitus in 3 other patients.

All patients were scanned using either a GE 8800 or 9800 CT/T scanner, using contiguous 10-mm sections. Scans were obtained after administration of oral and intravenous contrast material (bolus injection of 75–100 cc meglumine iohalamate 60%, followed by rapid drip infusion of meglumine iohalamate 30%).

The diagnosis was established by percutaneous needle aspiration in 6 patients (5 with CT-guided biopsies and 1 with unguided liver biopsy), surgical biopsy in 2 patients, and autopsy in 1 patient. In 3 patients, surgical intervention was obviated by abscess drainage under CT guidance.

Results

The symptoms, clinical and laboratory data, and CT findings are listed in Table 1. In most instances, the clinical presentation and liver function abnormalities were nonspecific. The interval between the onset of symptoms and the establishment of a definitive diagnosis varied from 1 to 12 weeks and averaged 6 weeks.

Disseminated fungal microabscesses were demonstrated in 3 patients with acute myelogenous leukemia. These microabscesses were seen on CT as multiple rounded areas of diminished attenuation scattered throughout the splenic and liver parenchyma, ranging in size from 2 to 20 mm (Fig. 1). In 1 patient, “target lesions” were seen: a small, higher-attenuation nidus (probably mycelial) centrally located within the low-attenuation, necrotic, zone. Disseminated candidal infection was the causative agent in 2 patients, while 1 patient had disseminated aspergillosis. One of the patients with

Table 1. Clinical findings in 9 patients

Patient	Age (yrs)	Sex	Underlying disease process	Symptoms	Liver function tests	CT findings	Proof	Final diagnosis
1	26	F	Acute progranulocytic leukemia	Fever, right upper quadrant pain	SGOT 2 SGPT 4 LDH 122 Alk. phos. 59	Multiple low-attenuation areas in liver and spleen, 2–8 mm	CT-guided aspirate	Candidiasis
2	53	F	Acute myelomonocytic leukemia	Fever	SGOT 14 SGPT 36 LDH 578 Alk. phos. 309	Multiple low-attenuation areas in spleen and liver, 10–20 mm	Autopsy	Disseminated aspergillosis
3	29	F	Acute myelogenous leukemia	Persistent fever	SGOT 26 SGPT 45 LDH 150 Alk. phos. 348	Multiple low-attenuation areas in spleen and liver, 2–10 mm	Surgical biopsy	Candidiasis
4	71	F	Diabetes mellitus	Disorientation and fever	SGOT 120 SGPT 175 LDH 281 Alk. phos. 469	Large abscess without air, 8 × 6 × 6 cm	CT-guided aspirate and drainage	Mixed organisms including <i>E. coli</i> and <i>S. aureus</i>
5	38	F	Diabetes mellitus	Right upper quadrant pain, fever, nausea	SGOT 11 SGPT 9 LDH 153 Alk. phos. 520	Air-containing abscess right lobe, 7 cm	CT aspiration and drainage	<i>E. coli</i> , and clostridium species
6	22	F	Chronic granulomatous disease	Fevers, right upper quadrant pain	SGOT 16 SGPT 8 LDH 305 Alk. phos. 334	Multiple low-attenuation areas, 2–8 cm, larger 1 containing gas in addition to multiple calcifications	Surgical	<i>S. aureus</i> and mixed flora
7	17	M	Chronic granulomatous disease	Pain upper abdomen	SGOT 12 SGPT 11 LDH 124 Alk. phos. 166	Low-attenuation area in lateral segment of left lobe of liver, 3 cm	CT-guided aspirate	<i>S. aureus</i>
8	17	M	Chronic granulomatous disease	Pain and fever	SGOT 10 SGPT LDH Alk. phos.	Multiple calcifications and low-attenuation areas, 2–5 cm	CT-guided aspirate	<i>S. aureus</i>
9	45	M	Diabetes and prior splenectomy	Right upper pain and fever	SGOT 1 SGPT 3 LDH 149 Alk. phos. 347	Multiple masses in all lobes, 10–20 mm	Unguided liver aspirate	Actinomycosis

Normal levels: SGOT, 2–35 IU/L; SGPT, 2–35 IU/L; LDH, 60–200 IU/L; Alk. phos., 30–97 IU/L.

candidiasis proven by open liver biopsy had undergone previous CT-directed and undirected liver biopsies; these specimens were not diagnostic. In another patient, the diagnosis of disseminated candidal infection was established by CT-directed liver biopsy following examination of multiple undirected liver biopsy specimens, which were negative. Disseminated aspergillosis was confirmed at autopsy in the third patient (Fig. 2).

Three patients with chronic granulomatous disease of childhood had liver abscesses diagnosed using CT; 2 of these patients have been documented in a previous report [3]. Hepatic calcifications were demonstrated in all 3 patients, and multiple hepatic abscesses were seen in 2 (Fig. 3). In the third patient, a solitary hepatic abscess was successfully drained percutaneously using CT guidance. Cultures from the abscesses in all 3 patients

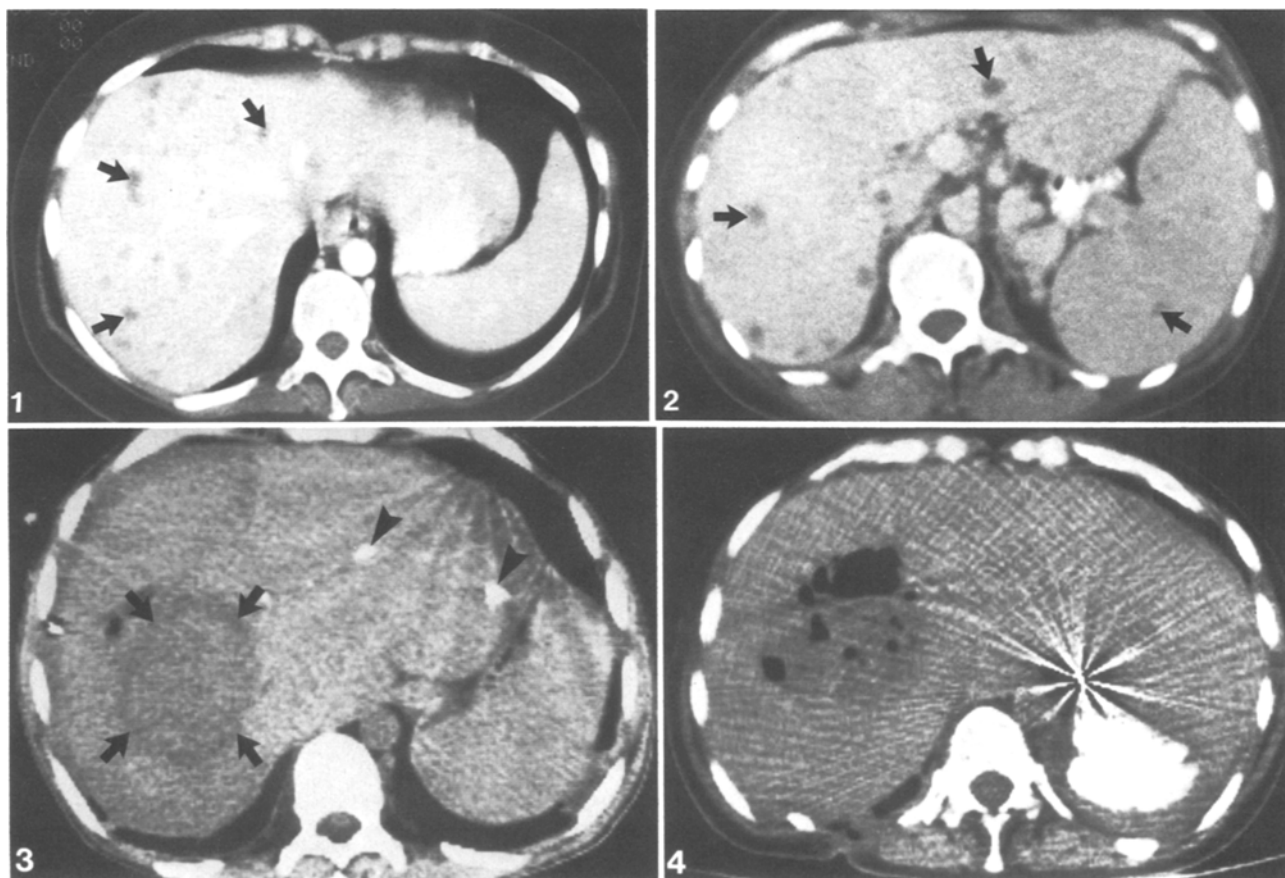


Fig. 1. Contrast-enhanced scan demonstrates numerous low-attenuation areas (*arrows*) throughout the liver parenchyma in a patient with acute myelogenous leukemia. Open liver biopsy following nondiagnostic CT-guided biopsy revealed hepatic candidiasis.

Fig. 2. Low-attenuation lesions seen in liver and spleen (*arrows*) in a patient with acute myelogenous leukemia. At autopsy, disseminated aspergillosis was proven.

Fig. 3. Hepatomegaly, calcifications (*arrowheads*), and large, hepatic abscess (*arrows*) in a child with chronic granulomatous disease. Multiple abscesses were also present on other scans. Surgical drainage was performed, and cultures from these abscesses grew mixed flora including *Staphylococcus aureus*.

Fig. 4. Clostridial liver abscess with gas bubbles in a diabetic patient was initially drained percutaneously using CT guidance. Surgical intervention was necessary later for recurrent hepatic abscess and associated empyema.

grew multiple organisms including *Staphylococcus aureus*.

Three patients with hepatic abscesses and underlying diabetes mellitus were included in the study. In 2, solitary hepatic abscesses, including a large gas-containing clostridial abscess (Figs. 4 and 5), were drained under CT guidance. Another diabetic patient, who previously underwent distal pancreatectomy with splenectomy for chronic pancreatitis, had persistent abdominal pain and non-specific abnormalities of liver enzymes. Multiple echogenic masses were demonstrated on the sonogram, which, however, did not have the characteristic features of cavernous hemangiomas on CT (Fig. 6). Unguided liver biopsy performed to exclude metastatic disease yielded the diagnosis of hepatic actinomycosis.

Discussion

The advent of newer cytotoxic drugs, immunosuppressive agents, and increased use of antibiotics, particularly in the immunocompromised host, has led to an increase in the incidence of opportunistic infections. These infections are usually due to organisms indigenous to the host or found frequently in the environment which do not produce significant disease in normal individuals. Infections in the immunocompromised host are often occult, and the delay in diagnosis contributes to increased mortality. These opportunistic infections are the result of a variety of underlying factors (Table 2), which include defects in anatomical areas such as the skin and mucous membranes and a host of inherited and acquired disorders of the host de-

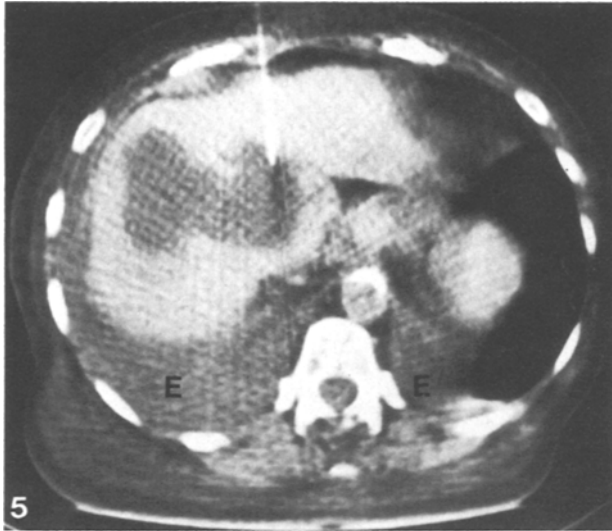


Fig. 5. Multilocular abscess in a diabetic patient. Percutaneous needle aspiration and definitive drainage under CT guidance. Tip of 18-gauge needle is seen within the medial aspect of the abscess. E, sympathetic pleural effusions.

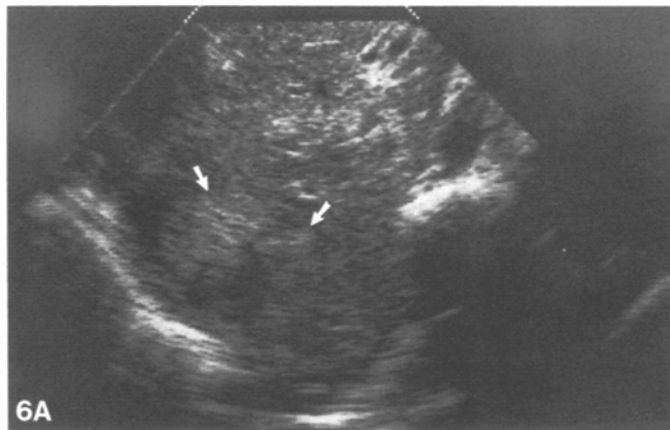


Fig. 6. **A** Transverse real-time sonogram through right hepatic lobe demonstrates multiple echogenic lesions (*white arrows*). **B** Contrast-enhanced CT demonstrates multiple low-attenuation areas (*black arrows*). Unguided needle aspiration biopsy yielded the diagnosis of hepatic actinomycosis.

fense system. The major predisposing causes in the latter group include immunosuppression, underlying malignancy, organ transplantation, diabetes mellitus, uremia, collagen diseases, and, in children, chronic granulomatous disease.

In the last 2 decades, an increasing incidence of disseminated fungal infections has been reported in compromised hosts by various authors [4, 5]. The increasing incidence of disseminated candidiasis largely reflects the recent, more aggressive approach to the treatment of leukemia. Remission is induced by establishing marrow aplasia, followed by repopulation of the marrow with normal nonneoplastic hematopoietic tissue, resulting in a period of prolonged granulocytopenia [5]. While the other effects of cytotoxic drugs and antibiotics, such as a decrease in macrophage function and suppression of cellular and humoral immunity, play a role, prolonged granulocytopenia may be the major predisposing factor to opportunistic infections [5]. Although *Candida* is responsible for

most disseminated fungal infections, other types of disseminated infection include aspergillosis, mucormycosis, cryptococcosis, and histoplasmosis [1, 4]. In patients with disseminated candidiasis, GI tract involvement is very common, especially in patients with leukemia; and there is a high frequency of hepatic and splenic involvement as well [5]. The role of CT in the detection, diagnosis, and follow-up of hepatic and splenic microabscesses from disseminated fungal infections has been reported previously [6–9]. As in our patients, these lesions usually appear as multiple, low-attenuation lesions of varying size in the liver and spleen. Rarely, one may see the central nidus of mycelia with surrounding necrosis resulting in the “target” lesions. These “target” lesions may be more commonly seen on ultrasonography than on CT and were seen in only 1 patient in our study. While this appearance in the immunocompromised host is highly suggestive of hepatic fungal microabscesses, it is by no means specific. Recently, a

Table 2. Opportunistic infection in patients with inherited and acquired disorders

Predisposing causes	Suggested mechanisms
Chronic granulomatous disease	Impaired production of H ₂ O ₂ with defective bactericidal function
Chediak-Higashi syndrome	Defective bactericidal activity, impaired chemotaxis, neutropenia
Splenic insufficiency	Defective opsonization; defective clearing of organisms
Humoral immunodeficiency syndrome (predominantly B cell defects)	Reduced phagocytic efficiency; failure of lysis and agglutination of bacteria; inadequate neutralization of bacterial toxins
Cellular immunodeficiency syndromes (predominantly T cell defects)	Absence or impaired delayed hypersensitivity response; absent T cell cooperation for B cell synthesis of antibodies to T-cell-specific antigens
Cancer	Granulocytopenia; decreased neutrophil chemotaxis; decreased bactericidal activity of neutrophils; lymphopenia, defective cell-mediated immunity; impaired antigenic response to challenge
Immunosuppression	Dependent upon agent used
Diabetes mellitus	Impaired phagocytic activity; decreased serum opsonizing capacity; decreased chemotaxis of neutrophils
Collagen diseases	Probably related to use of immunosuppressive agents; may relate to involvement of reticulo-endothelial system

similar appearance has been reported in patients with staphylococcal hepatic microabscesses [10]. The assessment of response to therapy is difficult in these patients due to their nonspecific clinical symptoms and results of laboratory tests. Therefore, serial scans may be essential for assessing response to therapy. In 2 of these 3 patients, CT was useful in this setting by demonstrating a decrease in number and size of hepatic and splenic lesions after institution of antifungal therapy.

Hepatic abscesses in infancy are uncommon and are usually secondary to omphalitis or umbilical vein catheterization [11–14]. Children with chronic granulomatous disease are at an increased risk for developing hepatic abscesses. A review of the literature suggests that 40% of hepatic abscesses in persons under the age of 20 occur in children with chronic granulomatous disease [11]. Other common sites of infection in patients with granulomatous disease include the skin, respiratory tract, lymph nodes, and bones. Recurrent infections in

these children are secondary to an inability of polymorphonuclear leukocytes to destroy certain ingested bacteria and fungi. Defective hydrogen peroxide formation due to a variety of enzymatic abnormalities is the underlying defect [15, 16]. The most common organism appears to be *Staphylococcus aureus*, as was the case in all 3 patients in this study. Two of these patients had multiple abscesses; the third had a solitary left lobe abscess.

Patients with diabetes mellitus have decreased resistance to bacterial and fungal infections. Possible causative factors include sluggish polymorphonuclear leukocyte response to infection, ineffective phagocytosis, lack of fibroblast production, and a decrease in the opsonizing capacity of serum [17, 18]. Fungal infections, particularly by mucormycosis and candidiasis, have been reported with greater frequency in diabetic children than in the normal host, but this is probably related to the repeated use of antibiotics in the former [19]. Two of 3 patients with diabetes in our study had solitary hepatic abscesses including a large clostridial abscess, and the other diabetic patient, who had previously undergone splenectomy and distal pancreatectomy, developed hepatic actinomycosis.

Actinomycosis is an unusual infection in current clinical practice in the United States and is more common in the noncompromised host than in the compromised host. Common sites of involvement include the neck, face, thorax, and abdomen. Chronic inflammatory processes as well as surgical procedures or perforation of the GI tract are common predisposing factors. The organism commonly involves the liver, spleen, brain, and ovaries. Liver involvement is probably via portal vein seeding after penetration through the bowel wall [20, 21]. Patients with a prior splenectomy have an increased risk of developing infectious processes, although usually their susceptibility is influenced by the underlying disease for which the splenectomy was performed [22, 23]. The increased susceptibility to actinomycosis in the patient in our study might have been related to a combination of previous splenectomy and underlying diabetes.

Ultrasonography and CT are not only of value in the detection of hepatic abscesses but can also be utilized to guide interventional procedures for definitive diagnosis and treatment [24–27]. This is necessary, since although the CT and ultrasound appearances of disseminated fungal infection are highly suggestive of the diagnosis, they are not entirely specific, and a definitive diagnosis (based on either histologic examination or culture) is required before therapy can be instituted because of the significant side effects of antifungal drugs.

Also, pyogenic abscesses may not have a typical appearance and can be confused with a variety of benign and malignant hepatic lesions [28].

Seven patients underwent percutaneous needle aspiration biopsy (6 using CT guidance and 1 unguided biopsy), 2 surgical biopsy, and in 1 the diagnosis was established at autopsy. A definitive diagnosis was established in 5 of 6 patients (83%) who underwent CT-guided aspiration. One false-negative result occurred in a patient with disseminated fungal sepsis, and that diagnosis was subsequently established by open surgical biopsy. Unguided liver biopsy was utilized to establish the diagnosis of hepatic actinomycosis. Open surgical aspiration and drainage was performed in 2 patients with chronic granulomatous disease and multiple hepatic abscesses.

Drainage guided by CT was performed in 3 of 10 patients; 2 patients had diabetes mellitus and the other had chronic granulomatous disease. This treatment was definitive in 2 of 3 patients; the patient with a large clostridial hepatic abscess required surgical drainage of the abscess and an associated empyema.

In conclusion, the increasing use of newer cytotoxic drugs, immunosuppressive agents, steroids, and antibiotics, along with aggressive radical surgical procedures and intensive irradiation, has resulted in an increase in the incidence of opportunistic infections. Computed tomography is capable of detecting and diagnosing sites of infection and guiding subsequent intervention including abscess drainage. We recommend the early use of CT in patients with suspected opportunistic infections to minimize the significant morbidity and mortality associated with untreated disease.

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