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CASE REPORT

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Hepatic transplant complicated by hepatic artery thrombosis and bile duct necrosis: case report and potential application of contrast-enhanced MR cholangiography following intravenous mangafodipir trisodium in the emergency room setting

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Abstract Biliary tract strictures and leaks are the second most common complications following orthotopic liver transplantation. Nonanastomotic bile duct complications are most often caused by hepatic artery thrombosis and can result in fulminant hepatic necrosis, bile duct strictures, and bile duct leaks that increase the risk of cholangitis, sepsis, and abscess. The emergency physician and radiologist should strongly suspect biliary disease in a post-transplant patient presenting with elevated liver function tests, jaundice, fever, and/or abdominal pain in order to achieve diagnosis and treatment rapidly. We present the case of a liver transplant patient who developed bile duct necrosis and hepatic infarction secondary to hepatic artery thrombosis 5 months after surgery. In addition, we discuss a new contrast-enhanced MR cholangiographic technique that has the potential to be performed in the emergency setting as the only diagnostic test prior to appropriate therapy.

Keywords Hepatic transplantation · Magnetic resonance cholangiopancreatography · Bile duct necrosis · Mangafodipir trisodium

Introduction

Orthotopic liver transplantation is the definitive therapy for end-stage liver disease. With improved surgical techniques and postoperative care, the survival rate after transplantation has increased to 80% at 1 year and 75% at 5 years [1]. Complications that occur after liver transplantation usually are related to rejection, biliary abnormalities (leaks and strictures), and vascular complications. The clinical presentation is not specific since patients with these complications present with similar signs and symptoms that include malaise, abdominal pain, jaundice, and/or elevated liver function tests.

Percutaneous biopsy of the allograft can provide a specific diagnosis of rejection. However, biliary and vascular complications require imaging for diagnosis. Many patients undergo a multitude of imaging studies to arrive at a diagnosis, including cross-sectional imaging (ultrasound, computed tomography), magnetic resonance (MR) or standard contrast cholangiography, hepatobiliary scintigraphy, and/or MR or standard contrast angiography. These tests add cost and can potentially delay diagnosis and treatment, thereby increasing the risk of secondary complications (abscess, sepsis, hepatic necrosis) in these immunocompromised patients. The emergency radiologist may be able to help reduce the number of unnecessary studies and thus shorten the time to diagnosis and treatment if he/she understands the standard approach to common complications of the hepatic allograft before consulting with the referring physician.

In this case report, we present the case of a patient with bile duct necrosis and hepatic infarction secondary to hepatic artery thrombosis after liver transplantation. We discuss the etiology, work-up, and treatment of such patients. In addition, we describe a new contrast-enhanced MR cholangiographic technique that we have used in the emergency setting. This technique has the potential to be the first and only imaging test performed prior to therapy in patients with suspected biliary complications, possibly leading to improvement in patient outcome.

Case report

A 64-year-old woman presented with abdominal distention, jaundice, and elevated liver function tests 5 months following orthotopic liver transplantation for end-stage liver disease secondary to hepatitis C. Ultrasonography of the liver revealed areas of decreased echogenicity suggesting edema or infarcts. Cholangiogram showed a high-grade stricture at the site of the anastomosis of the native and transplanted common bile duct with intrahepatic bile duct dilatation. In addition, multiple strictures of the intrahepatic

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bile ducts were noted (Fig. 1a). Delayed images showed a bile leak arising from the hepatic hilum (Fig. 1b). Doppler ultrasonography demonstrated no flow within the hepatic artery. Computed tomography (CT) showed large areas of decreased attenuation in the right and left hepatic lobe consistent with infarction (Fig. 2).

The diagnosis of hepatic infarction and bile duct necrosis was established. Because of the extent of disease, the only therapeutic option was retransplantation. However, because of the patient's age and recurrence of hepatitis C, it was judged that she should not undergo this procedure.

Discussion

Biliary tract complications, usually in the form of strictures and leaks, are the second leading cause of liver failure in transplant recipients, and are responsible for considerable morbidity (8–35%) and mortality (2–7%) [2, 3, 4]. They usually occur in the first few weeks following transplantation, but late complications can also occur.

Post-transplantation strictures can be classified into anastomotic and nonanastomotic varieties. Most anastomotic strictures are extrahepatic ductal strictures due to iatrogenic trauma with resultant ischemia and scar formation. If the diagnosis is not made, ascending cholangitis can develop with formation of intrahepatic bile

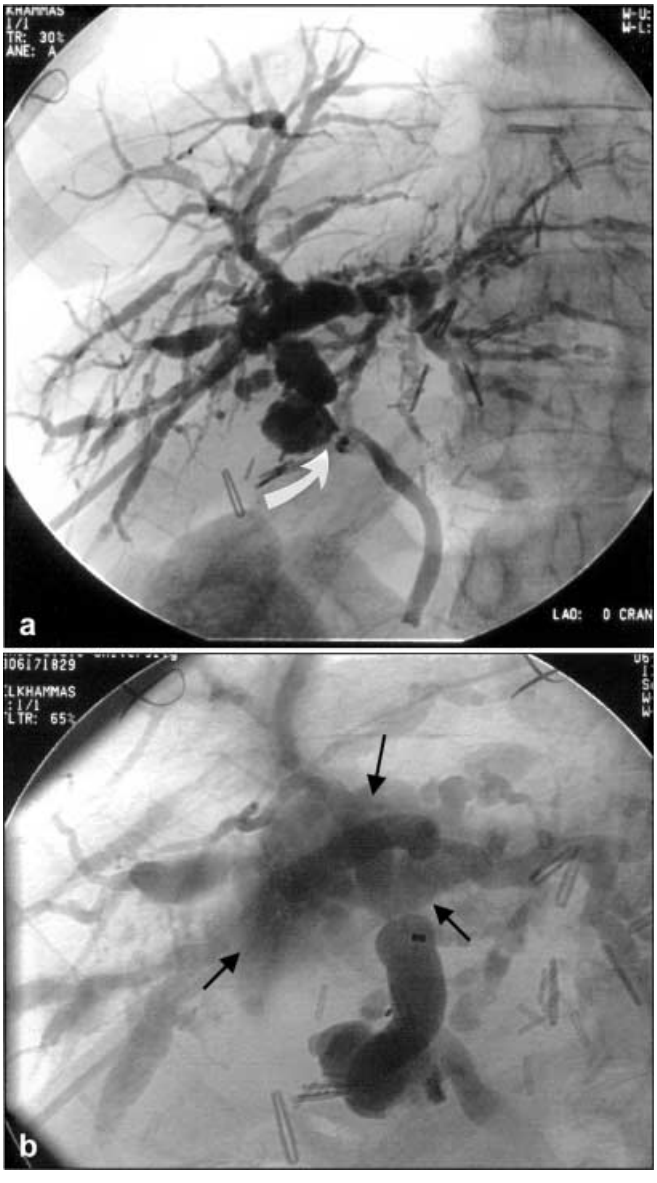

Fig. 1. a Percutaneous cholangiogram demonstrates multiple intrahepatic bile duct strictures and irregularity. A high-grade extrahepatic bile duct stenosis was also noted at the anastomotic site (*curved arrow*). **b** Delayed image shows contrast extravasation (*arrows*)

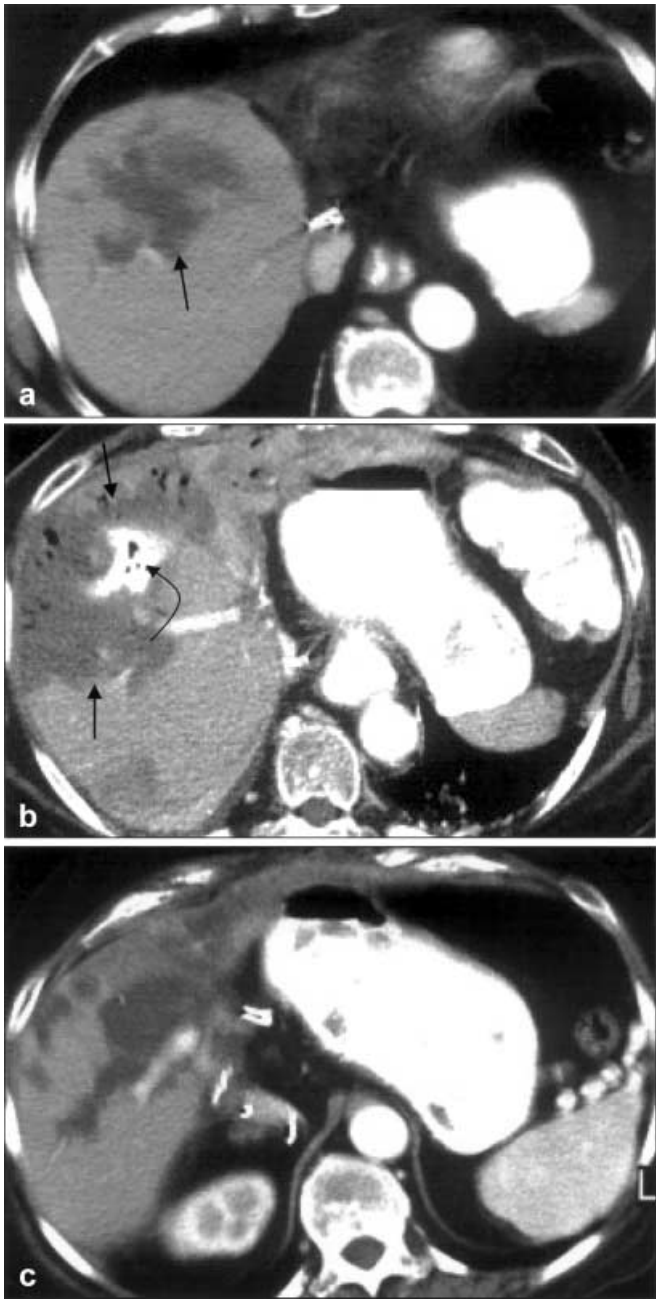

Fig. 2a–c. Contrast-enhanced CT following the percutaneous cholangiogram demonstrates segmental hepatic infarction (*arrows*) and contrast extravasation (*curved arrow*)

duct strictures that simulate primary sclerosing cholangitis.

Most nonanastomotic strictures are due to ischemia unrelated to iatrogenic bile duct injury, and 50% are due to hepatic artery thrombosis, the most common vascular complication following liver transplantation. Causes of hepatic artery thrombosis include long cold ischemic time, hypercoagulability, and rejection [5]. After transplantation, the bile ducts are entirely dependent on the hepatic artery for perfusion. Therefore, any deficiency of hepatic arterial supply places the transplanted liver at risk of ischemia, which can result in fulminant hepatic necrosis, bile duct strictures, bile duct leak, abscess, and sepsis. Other, less common causes of nonanastomotic bile duct strictures in the liver transplant, including prolonged preservation time, bacterial or viral cholangitis, rejection, recurrent primary sclerosing cholangitis, and cholangiocarcinoma, should also be excluded.

The work-up in these patients usually begins with CT and/or ultrasonography. Both modalities can determine the presence of fluid collections which would suggest a bile duct leak or abscess, and biliary dilatation. Doppler ultrasonography can also detect vascular patency. However, these cross-sectional studies cannot accurately determine the cause of obstruction (e.g., stricture, stone) or whether a fluid collection represents an active bile duct leak. Therefore, patients with suspected bile duct abnormalities usually undergo hepatobiliary scintigraphy and/or standard contrast cholangiography (endoscopic retrograde cholangiography, percutaneous transhepatic cholangiography). Hepatobiliary scintigraphy is very sensitive and specific for detecting bile duct leaks, but usually cannot indicate the location of the leak, strictures, or stones. Standard contrast cholangiography is the gold standard imaging modality for detecting biliary disease and can accurately detect the presence and location of leaks, strictures, and stones. Although these tests are accurate, they add cost and risk to the patient, since they are invasive studies. In addition, many surgeons are reluctant to perform endoscopic cholangiography in the first month after transplantation because of friability of the anastomosis. If nonanastomotic bile duct strictures and/or a bile duct leak are detected by these tests, Doppler ultrasonography is usually performed to assess for hepatic artery thrombosis, and conventional arteriography is usually reserved for equivocal cases. Therefore, it is common for patients with biliary disease after liver transplantation to undergo a multitude of diagnostic imaging tests. This can delay diagnosis and treatment in these immunocompromised patients who are already at an increased risk of developing infectious complications and of death.

Contrast-enhanced MR cholangiography with intravenous mangafodipir trisodium (Amersham Health; Princeton, New Jersey) is a new technique under investigation, which can provide functional information in a similar way to hepatic scintigraphy, anatomic information similar to contrast cholangiography, and cross-sectional information similar to CT and ultrasound [6, 7, 8]. After the intravenous administration of mangafodipir, manganese from a DPDP ligand is excreted primarily via bile and produces increased signal on gradient-echo sequences [9]. Recent work has shown that by using a gradient-echo (GRE) technique, contrast-enhanced MR cholangiography produces better contrast and spatial resolution than standard MR cholangiography [7]. In addition, Vitellas et al. showed that this technique can be used for detecting bile duct leaks [6]. Furthermore, a recent prospective study at our institution involving 12 patients with suspected bile duct leaks following cholecystectomy demonstrated that contrast-enhanced MR cholangiography was more accurate than both contrast cholangiography and hepatobiliary scintigraphy for detecting bile duct leaks (Vitellas et al., unpublished data). In that study, all bile duct leaks were detected between 1 and 2 h following the intravenous administration of mangafodipir trisodium.

Recently, we have been asked by our transplant surgeons to perform contrast-enhanced MR cholangiography in two liver transplant patients presenting to the emergency department with suspected leaks following removal of a T-tube. In both patients, we accurately demonstrated the presence and location of the leaks shortly after the admission to the emergency room (Fig. 3). In addition, we have been successful in dem-

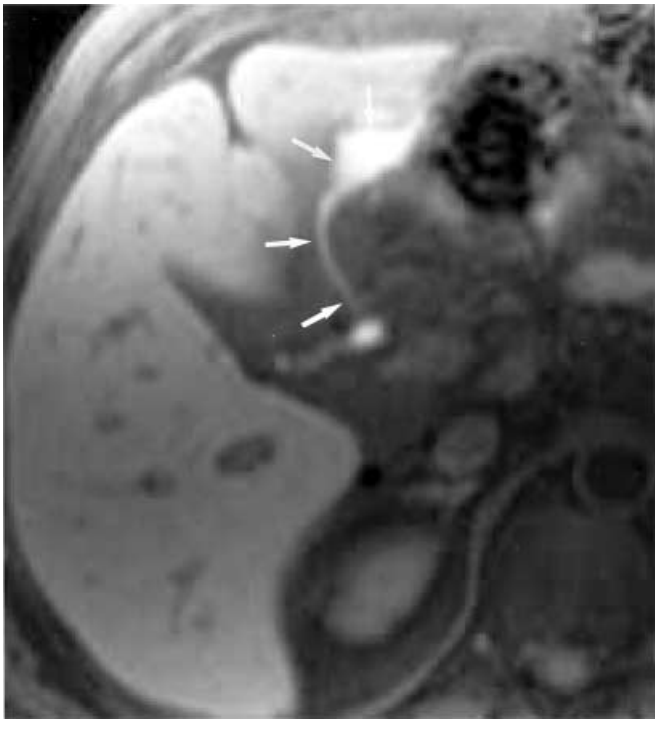

Fig. 3. A 48-year-old male 5 months status post liver transplantation presented to the emergency department with abdominal pain 2 days after removal of a T-tube. Axial fat-saturated GRE image obtained 1 h after intravenous administration of mangafodipir trisodium demonstrates contrast extravasation from the common bile duct at the site where the T-tube had been (*arrows*)

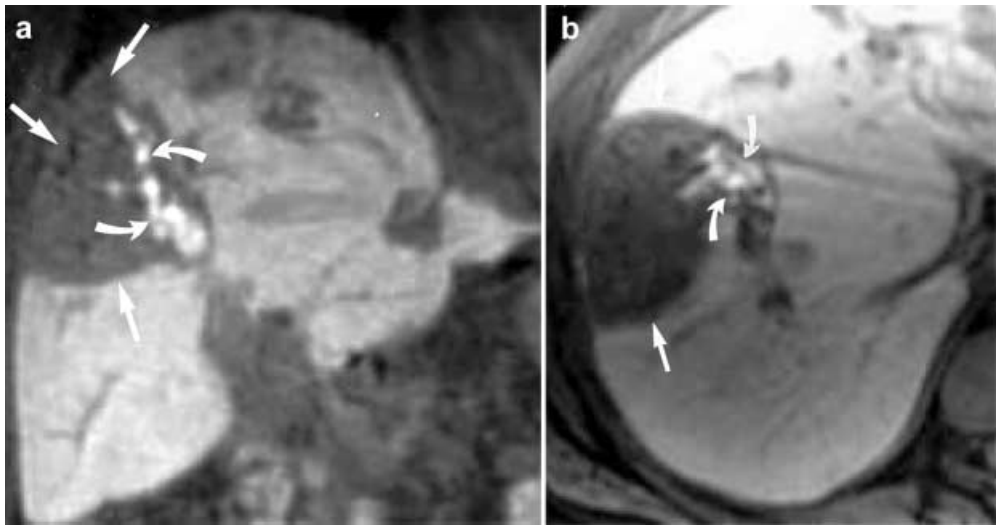

Fig. 4a,b. A 46-year-old male 2 months following liver transplantation complicated by hepatic artery thrombosis and bile duct necrosis. Coronal (**a**) and axial (**b**) fat-saturated GRE images obtained 2 h after intravenous administration of mangafodipir shows contrast extravasation from the anterior segment right hepatic duct (*curved arrows*). The geographic area of decreased signal is compatible with hepatic necrosis and biloma (*arrows*)

onstrating bile duct leaks and necrosis in two transplant patients with hepatic artery thrombosis (Fig. 4).

Contrast-enhanced MR cholangiography in the emergency setting can potentially be the first and only diagnostic test carried out to determine the presence of biliary disease. This can result in a decrease in cost and a potential decrease in the morbidity and mortality associated with delay in diagnosis as well as reducing the utilization of unnecessary invasive procedures. For example, the 12 patients in our recent study with suspected bile duct leaks following cholecystectomy underwent a total of 28 imaging tests to arrive at a diagnosis. This resulted in a total cost of $41,434.66 dollars and an average time to therapy of 3 days (Vitellas et al., unpublished data). If these patients had undergone contrast-enhanced MR cholangiography as the first imaging test, there would have been a cost savings of $29,135.74, and therapy could potentially have been instituted on the same day as the study.

The treatment of bile duct necrosis involves percutaneous biliary drainage of bile duct obstruction and leaks, dilatation of biliary strictures, antibiotics, and percutaneous peritoneal or intrahepatic catheter drainage of bilomas and abscesses. Retransplantation is the only definitive cure.

References

1. Spirt MJ (1998) Liver transplantation. In: Spirt MJ (ed) Acute care of the abdomen. Williams and Wilkins, Baltimore, pp 378–391
2. Margarit C, Hidalgo E, Lazaro JL, Murio E, et al (1998) Biliary complications secondary to late hepatic artery thrombosis in adult liver transplant patients. Transpl Int 11(Suppl 1):S251–S254
3. Lerut J, Gordon RD, Iwatsuki S, Esquivel CO, Todo S, Tzakis A, Starzl TE (1987) Biliary tract complications in human orthotopic liver transplantation. Transplantation 43:47–51
4. Zajko AB, Campbell WL, Bron KM, Schade RR, Koneru B, Van Thiel DH (1988) Diagnostic and interventional radiology in liver transplantation. Gastroenterol Clin North Am 17:105–143
5. Nghiem HV (1998) Imaging of hepatic transplantation. Radiol Clin North Am 36:429–443
6. Vitellas KM, El-Dieb A, Vaswani K, Bennett WF, Fromkes J, Steinberg S, Bova JG (2001) Detection of bile duct leaks using magnetic resonance cholangiography with mangafodipir trisodium (Teslascan). J Comput Assist Tomogr 25:102–105
7. Lee VS, Rofsky NM, Morgan GR, et al (2001) Volumetric mangafodipir trisodium-enhanced cholangiography to define intrahepatic biliary anatomy. AJR Am J Roentgenol 176:906–908
8. Mitchell DG, Alam F (1999) Mangafodipir trisodium: effects on T2- and T1-weighted MR cholangiography. J Magn Reson Imaging 9:366–368
9. Wang C, Gordon PB, Hustvedt SO, et al (1997) MR imaging properties and pharmacokinetics of MnDPDP in healthy volunteers. Acta Radiol 38:665–676