Article published online: 2022-05-21

Original article

Tc-99m Mebrofenin Hepatobiliary Scan in Obstructive Hepatobiliary Disease: Determining Causes with Early and Late Delayed Imaging

Robert Matthews, Mera Goodman, Pryanka Relan, Elham Safaie, Dinko Franceschi

Department of Radiology, Stony Brook University Medical Center, Stony Brook, NY, United States of America

Abstract

Hepatobiliary radionuclide imaging is typically performed to detect cholecystitis. Infrequently, imaging reveals an obstructive pattern. Although delayed hepatobiliary imaging is commonly used to differentiate between intrahepatic (IH) and extrahepatic (EH) obstruction in the newborn; there is room to clarify the use of delayed imaging in the adult population. A retrospective review was performed of adult patients demonstrating a complete obstructive pattern on initial Tc-99m mebrofenin hepatobiliary imaging. Delayed imaging was divided into early delayed (ED) (<10 h) and late delayed (LD) (≥10 h) imaging. Two physicians qualified the presence of intestinal radiotracer (negative, low to high) on delayed images. Determination of EH or IH pathology was obtained from chart review. A total of 24 patients demonstrated an obstructive pattern using delayed Tc-99m mebrofenin hepatobiliary imaging, with delayed imaging ranging from 4 to 30 h. EH pathologies (choledocholithiasis, stricture, other) represented 63% of cases (n = 15), IH pathologies (cirrhosis, hepatitis, other) represented 33% cases (n = 8) and 1 case was indeterminate. 67% of EH cases showed intestinal activity on delayed imaging (67% on ED and 67% on LD imaging), whereas 63% of IH cases showed intestinal activity on delayed imaging (67% on ED imaging and 60% on LD imaging). The presence of intestinal activity on the both the early and delayed images did not differentiate between the IH and EH pathology groups. Subdividing the groups into ED imaging and LD imaging was also not predictive of determining location of obstructive pattern on the initial 1 h of imaging. This data suggests that delayed hepatobiliary scintigraphy has little or no role in determining the cause of obstructive pathology.

Keywords: Hepatobiliary obstruction, hepatobiliary scan, Tc-99m mebrofenin

Introduction

Hepatobiliary radionuclide imaging is typically performed to assess for acute or chronic cholecystitis. Occasionally, initial 1 h imaging reveals an obstructive pattern of radiopharmaceutical distribution with non-visualization of the hepatic or extrahepatic (EH) bile ducts, gallbladder and small intestinal activity.[1] Determining whether the obstructive cause on the initial hepatobiliary imaging is intrahepatic (IH) in origin that is treated medically, or EH, usually managed surgically is troublesome at best. Such difficulty is exasperated by hepatobiliary imaging failing to differentiate between primary hepatocellular dysfunction and secondary hepatocellular dysfunction as a result of bile duct obstruction.[2] Although 24 h delayed imaging is commonly used in the assessment of bile patency and biliary atresia in the pediatric population, there is not sufficient information available to clarify delayed imaging in the adult population.[3]

In this study, we sought to retrospectively evaluate the role of delayed hepatobiliary imaging in patients with an obstructive pattern in determining IH or EH causes. We wanted to determine if delayed hepatobiliary scan could play a part in effectively managing patients who may have either medical or surgical hepatobiliary disease.

Access this article online

Quick Response Code:

Website: www.wjnm.org

DOI: 10.4103/1450-1147.136692

Address for correspondence:
Dr. Robert Matthews, Department of Radiology, Health Sciences Center, L4, Room 120, Stony Brook, NY 11794-8460, United States of America.
E-mail: robert.matthews@sbumed.org

Materials and Methods

This study obtained an exempt status from our Institutional Review Board to retrospectively review cases with hepatobiliary imaging.

For this study, we performed a retrospective review of medical records from January 1st, 2004 to December 31, 2009 for patients at Stony Brook University Medical Center. The inclusion criteria comprised all patients with both an initial and delayed Tc-99m mebrofenin hepatobiliary scan that demonstrated an obstructive pattern on initial 1 h of imaging during this time period. The definition of obstructive pattern was demonstration of hepatic radiotracer uptake with lack of visualization of IH and EH bile systems, gallbladder and small intestinal activity [Figure 1]. Patients with severe hepatocellular dysfunction as evident by persistent blood pool activity after 1 h following radiotracer injection were excluded from the study. Twenty-four patients met these criteria including 7 men and 17 women; aged 25-77 years (mean age, 52 years). The average time interval for the delayed images measured from radiotracer injection time until image completion was 11.4 h with a range between 4 and 30 h [Table 1].

Hepatobiliary scans were performed following fasting for at least 4 h before radiotracer administration. No patient in the study had fasted longer than 24 h. Patients were injected with 5.0-6.8 mCi Tc-99m mebrofenin intravenously. Immediate dynamic images were obtained in all patients for 1 h in the anterior position overlying the abdomen. Delayed images were also obtained in dynamic mode for 10 min in the anterior position over the abdomen.

Each hepatobiliary scan was interpreted by two experienced nuclear medicine physicians concurrently with a consensus reached. They were blinded to the patient's history. Initial images were examined for the presence of an obstructive pattern, as defined above and delayed images were qualified on the amount of intestinal radiotracer in terms of absent, small, moderate, or large. In addition, we divided the delayed imaging into early delayed (ED) (<10 h) and late delayed (LD) (≥10 h) imaging. All patients had either early or delayed imaging, but not both. The hospital records for all patients were reviewed for surgical history, medical findings and additional radiological studies that could explain the obstructive pattern to be caused by either IH or EH cause.

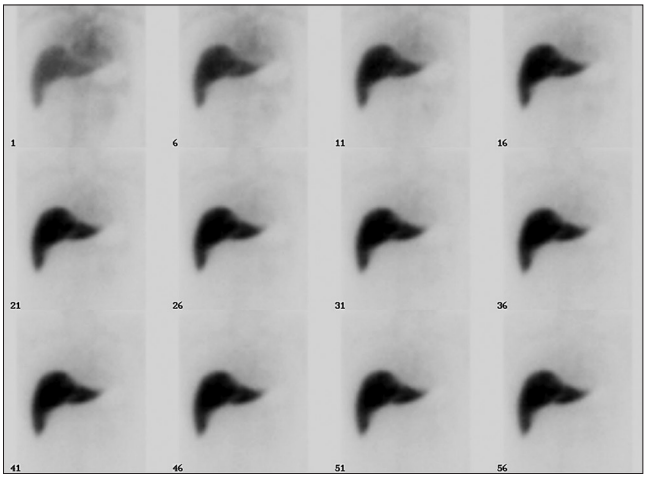

Figure 1: Hepatobiliary scan demonstrating an obstructive pattern after 1 h of imaging time with lack of visualization of intrahepatic and extrahepatic bile systems, gallbladder and small intestinal activity

Results

A total of 24 patients demonstrated an obstructive pattern on Tc-99 m mebrofenin hepatobiliary imaging with lack of IH and EH bile activity on initial 1 h of imaging. Thirteen of these patients had ED imaging (mean 4.3 h, range between 4 and 5 h), whereas eleven patients had LD imaging (mean 19.8 h, range between 10 and 30 h).

IH pathology accounted for 33% of the obstructive pattern cases (n = 8) seen on hepatobiliary imaging. The causes of IH obstruction consisted of hepatitis (n = 3), cirrhosis (n = 3), lymphomatous involvement of the liver (n = 1) and fungemia (n = 1). EH pathology represented 63% of the obstructive pattern case (n = 15) with the majority of the causes due to choledocholithiasis (n = 11). Other causes include common bile duct stricture (n = 2), cholangitis (n = 1) and biliary fistula (n = 1). One cause of obstruction pattern could not be determined since after imaging, the patient refused any further medical care. The data distribution is summarized in Table 2.

All patients that demonstrated intestinal activity on either the ED or LD images had moderate or large amount of intestinal activity. In the EH pathology

Table 1: Patient characteristics (n=24)

Characteristics	Values
Sex (n)	
Male	7
Female	17
Age	
Range	25-77
Mean	52
Amount of radiotracer administered	
Range	5.0-6.8 mCi
Average	5.6 mCi
Interval for early delayed imaging	
Range	4-5 h
Average	4.3 h
Interval for late delayed imaging	
Range	10-30 h
Average	19.8 h

Table 2: Patient data distribution (*n*=24)

	Number of patients
Intrahepatic (IH) Pathology (*n*=8; 33%)	
Hepatitis	3
Cirrhosis	3
Lymphoma	1
Fungicemia	1
Extrahepatic (EH) Pathology (*n*=15; 63%)	
Choledocholithiasis	11
Bile duct stricture	2
Cholangitis	1
Biliary fistula	1
Indeterminate Pathology (*n*=1; 4%)	

group, 10 out of 15 patients (67%) showed intestinal activity on delayed imaging, that characterized 6 out of 9 (67%) on ED imaging and 4 out of 6 (67%) on LD imaging. In the IH pathology group, 5 out of 8 patients (63%) demonstrated intestinal activity on delayed imaging representing 2 out of 3 patient (67%) on the ED imaging and 3 out of 5 patients (60%) on the LD imaging.

Discussion

In the newborn, the presence of radiotracer within the small intestines on delayed imaging can readily distinguish between neonatal hepatitis, an IH cause and biliary atresia, an EH cause.[4] In the adult population, the differentiation between IH and EH obstruction is much more difficult. The absence of IH and EH bile activity on 4-h delayed hepatobiliary imaging is highly predictive of total obstruction of the common bile duct; however, partial obstruction of the bile duct is not easily identifiable.[5] Correspondingly, predicting EH obstruction by adding total serum bilirubin levels to the interpretation of hepatobiliary imaging has also not yielded good results since hepatocyte dysfunction does not directly correlate with the flow of bile into the biliary system.[2,6] In our adult population, the presence of intestinal activity on the both the early and delayed images did not differentiate between the IH and EH pathology groups. Subdividing the groups into ED imaging and LD imaging was also not predictive of determining location of obstructive pattern on the initial 1 h of imaging.

More importantly, in evaluating the causes of EH obstruction, it cannot be assumed that only common bile duct stones account for the obstructive pattern. Choledocholithiasis only accounted for 11 of the 15 cases (73%). Others causes include common bile duct structure, cholangitis and biliary fistula which would have different therapeutic approaches. Likewise, determining obstruction to be IH in origin would also not lead to a common therapeutic approach since hepatic disease varied significantly from hepatitis, cirrhosis, metastatic disease and fungicemia.

In our population determining the cause of obstructive pattern involved an assortment of diagnostic tests including laboratory values, clinical history, computed tomography of the liver, right upper quadrant ultrasound, magnetic resonance cholangiopancreatography and endoscopic retrograde cholangiopancreatography. The hepatobiliary imaging was only useful in uncovering bile obstruction that may not have been suspected clinically. Most notably, although evaluating for gallbladder disease was usually the clinical indication for the hepatobiliary scan, determining the presence of cholecystitis was severely limited since the obstructive pattern obscured the results.

Limitations of this study included relatively small sample size that was sufficient for our central argument, but was insufficient for additional analysis. Other limitations include that there was no set time for delayed imaging and that patients did not obtain two sets of delayed images for comparison. Finally, the study was retrospective so different patient received different diagnostic work-ups of their respective pathologies.

References

1. Noel AW, Velchik MG, Alavi A. The "liver scan" appearance in cholescintigraphy. A sign of complete common bile duct obstruction. Clin Nucl Med 1985;10:264-9.
2. Egbert RN, Braunstein P, Lyons KP, Miller DR. Total bile duct obstruction. Prompt diagnosis by hepatobiliary imaging. Arch Surg 1983;118:709-12.
3. Roca I, Ciofetta G. Hepatobiliary scintigraphy in current pediatric practice. Q J Nucl Med 1998;42:113-8.
4. Nadel HR. Hepatobiliary scintigraphy in children. Semin Nucl Med 1996;26:25-42.
5. Lecklitner ML, Austin AR, Benedetto AR, Growcock GW. Positive predictive value of cholescintigraphy in common bile duct obstruction. J Nucl Med 1986;27:1403-6.
6. Mahlstedt J. Scintigraphic diagnostics in cholestasis. Hepatogastroenterology 1982;29:220-6.

How to cite this article: Matthews R, Goodman M, Relan P, Safaie E, Franceschi D. Tc-99m Mebrofenin Hepatobiliary Scan in Obstructive Hepatobiliary Disease: Determining Causes with Early and Late Delayed Imaging. World J Nucl Med 2013;12:54-6.

Source of Support: Nil, **Conflict of Interest:** None declared