

## Dumbbell Gallbladder Cholecystitis on Tc-99m Diisopropyliminodiacetic acid Hepatobiliary Imaging

### Abstract

We present a case of a 79-year-old immunocompromised female admitted for abdominal pain and sepsis, who had an abdominal computed tomography (CT) showing distal gallbladder fundus wall thickening, pericholecystic edema, and a right posteroinferior hepatic abscess. Subsequent hepatobiliary scintigraphy with Tc-99m diisopropyliminodiacetic acid showed gallbladder filling of the proximal gallbladder fundus, yet no radiotracer filling of the distal gallbladder fundus. Further correlation with the initial CT showed a partial gallbladder stricture and a resultant altered morphology resembling a dumbbell-shaped gallbladder. Percutaneous cholangiogram also confirmed this dumbbell morphology. Nonfilling of radiotracer into the distal end of the dumbbell gallbladder correlating with CT findings of focal gallbladder inflammation indicated that there was a focal inflammation suggesting a distal dumbbell gallbladder cholecystitis. This case demonstrates a unique finding of focal inflammatory pathology involving an anatomic variant - the dumbbell-shaped gallbladder, and the challenges this anatomic variant presents in hepatobiliary scintigraphy image interpretation.

**Keywords:** Cholecystitis, dumbbell gallbladder, gallbladder stricture, hepatobiliary imaging, Tc-99m diisopropyliminodiacetic acid

### Introduction

Acute cholecystitis remains a major cause of morbidity, yet despite the improved accuracy of diagnostic imaging, can sometimes be misdiagnosed.<sup>[1]</sup> Hepatobiliary scintigraphy is a reliable and noninvasive method for accurately diagnosing acute cholecystitis.<sup>[2]</sup> The characteristic features of acute cholecystitis on hepatobiliary scintigraphy are transit of the radiotracer from intrahepatic biliary tree into the small bowel, without filling of the gallbladder.<sup>[1]</sup> Because an inflamed gallbladder will not fill with radiotracer, this physiologic imaging modality is highly specific for acute cholecystitis.<sup>[2]</sup>

However, an incomplete gallbladder filling on hepatobiliary scintigraphy presents an interesting challenge for image interpretation. Benign etiologies of this finding may include layering cholelithiasis or biliary sludge, which by accumulating in the dependent portions of the gallbladder result in an inability of radiotracer to fill these portions of the gallbladder.<sup>[3]</sup> Another such benign physiological cause

of incomplete filling is the presence of retained bile within the gallbladder due to a prolonged fasting state, which prevents radiotracer filling in a similar manner.<sup>[3]</sup> Mass effect from rare gallbladder malignancy has also been demonstrated. Finally, focal inflammatory disease of the gallbladder in anatomic variant gallbladders has also been suggested, namely, Phrygian cap acute cholecystitis.<sup>[4]</sup> Here, we present a case of inflammatory pathology of an alternative anatomic variant resulting in incomplete gallbladder filling – a focal inflammation of the distal end of a dumbbell-shaped gallbladder.

### Case Report

We present a case of a 79-year-old Caucasian female with myalgias who had a recent spontaneous bowel diverticula perforation requiring resection and ileostomy. Surgical pathology resulted in a diagnosis of polyarteritis nodosa which was then being treated with corticosteroids and immunosuppressants. The patient was now admitted to the medical Intensive Care Unit with severe acute on chronic abdominal

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pain and sepsis 3 months postoperatively. Initial workup included an abdominal computed tomography (CT) which showed gallbladder fundus wall thickening, pericholecystic edema, dependent cholelithiasis, and a right posteroinferior hepatic abscess [Figures 1 and 2].

A hepatobiliary scan was performed using 188.7MBq (5.1 mCi) of Tc-99m diisopropyliminodiacetic acid (DISIDA) to rule out acute cholecystitis [Figure 3]. The scan revealed incomplete gallbladder filling, with no radiotracer filling of the distal gallbladder fundus. Because gallbladder was

partially visualized, this incomplete filling was thought to be related to gallbladder sludge or cholelithiasis, and thus, was interpreted as negative for acute cholecystitis.

The patient had a prolonged hospital course following initial hepatobiliary scintigraphy including catheter intervention for the hepatic abscess, which was found to grow *Escherichia coli*, and the development of metastatic septic arthritis and osteomyelitis. Due to persistent bacteremia, there remained a concern for acute cholecystitis. A second Tc-99m DISIDA hepatobiliary scan was performed, which revealed nonfilling of the gallbladder at 4 h consistent with acute cholecystitis. Appropriate subsequent surgical and medical management resulted in improvement in the patient's condition.

Careful inspection of the initial CT showed a partial gallbladder stricture and a resultant altered morphology resembling a dumbbell-shaped gallbladder. Percutaneous cholangiogram also confirmed this dumbbell morphology, with contrast filling both ends of the dumbbell gallbladder [Figure 4]. We propose that the nonfilling of the distal end of the dumbbell gallbladder, distal to the partial stricture, suggested a focal inflammation suggestive of a dumbbell gallbladder cholecystitis. Initial CT findings of focal gallbladder wall thickening with focal pericholecystic edema were congruent with this diagnosis as well.

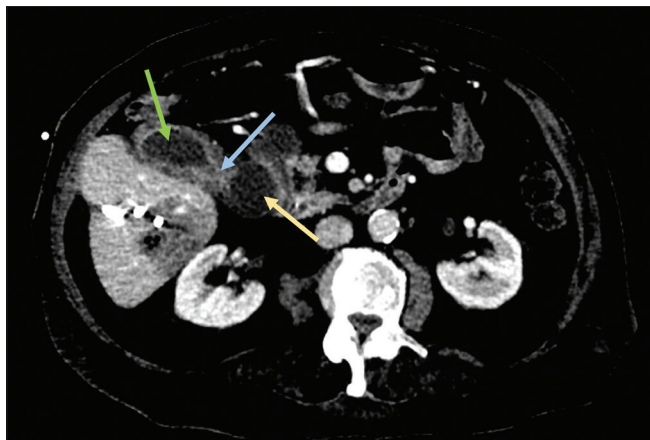


Figure 1: Transaxial section from abdominal computed tomography showing dumbbell gallbladder with a partial stricture (blue arrow) creating a proximal end (yellow arrow) and distal end (green arrow). Posteroinferior hepatic abscess is also demonstrated



Figure 2: Coronal sections from anterior to posterior showing proximal end (yellow arrow in a) and distal end (green arrows in b and c) of the dumbbell gallbladder. Gallbladder wall thickening and pericholecystic edema of the distal end are also seen

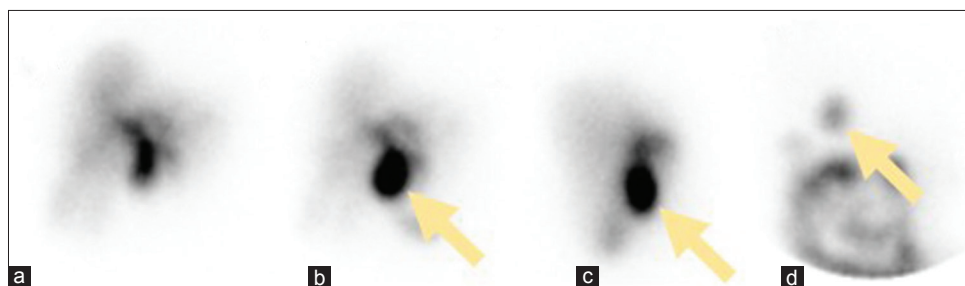
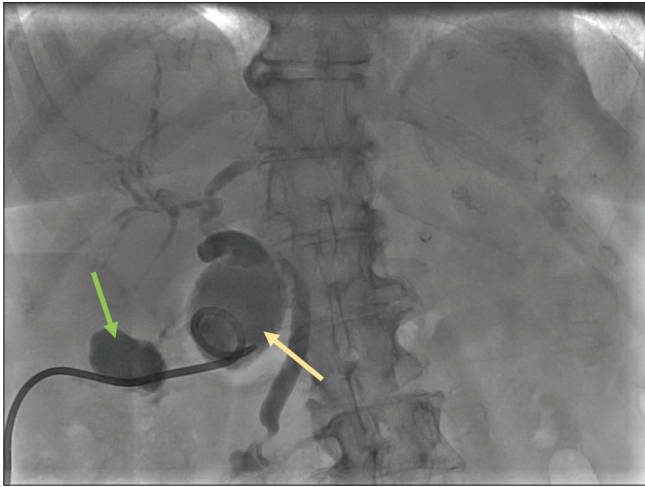


Figure 3: Tc-99m diisopropyliminodiacetic acid planar hepatobiliary scintigraphy showing anterior projections at 30 min (a), 60 min (b), right lateral projection at 60 min (c), and anterior projection at 4 h (d), yellow arrows indicate radiotracer filling in the proximal end of the dumbbell gallbladder at 60 min (b and c), and 4 h (d). There is absent filling of the distal end of the dumbbell gallbladder



**Figure 4: Percutaneous cholangiogram showing contrast filling within the proximal end (yellow arrow) and distal end (green arrow) of the dumbbell gallbladder**

## DISCUSSION

Gallbladder duct stricture is a rare phenomenon that can be either acquired or congenital.<sup>[5]</sup> Gallbladder strictures have also been reported to create a dumbbell-shaped gallbladder with a proximal and distal ends.<sup>[6]</sup> This altered morphologic configuration of the gallbladder can result in altered extravasation of bile from the gallbladder into the common bile duct, and likely stasis of bile in the distal end. The exact pathogenesis of cholecystitis remains uncertain; however, some theories suggest inflammation may be secondary to retained concentrated bile, which is a noxious substance, or ischemia. In this patient, the findings may have been related to a combination of these phenomena; ischemia secondary to sepsis and prolonged stasis of bile secondary to gallbladder stricture.<sup>[7]</sup> A similar phenomenon has been described in Phrygian cap acute cholecystitis.<sup>[4]</sup> The altered dynamics due to stricture in a dumbbell gallbladder can certainly confound the interpretation of hepatobiliary scintigraphy, and without careful anatomic correlation, can result in misdiagnosis.

In this case, an incomplete filling of the gallbladder was seen with filling of the proximal gallbladder fundus, and absent filling of the distal gallbladder fundus. Benign etiologies for this finding of absent filling of the distal gallbladder fundus were initially considered, however, in retrospect seem less likely. For example, the patient had eaten a meal 10 h before the administration of radiotracer making the possibility of retained bile from prolonged fasting state less likely.<sup>[8]</sup> Correlation with CT imaging revealed a small layer of increased density in the distal gallbladder fundus attributable to either small amount of layering cholelithiasis or sludge, another potential benign etiology of our scintigraphic findings. However, the amount of sludge was not enough to explain entirely absent filling of this portion of the gallbladder.<sup>[9]</sup> Finally, there was no sonographic, endoscopic, or radiographic evidence of tumor to suggest a mass effect.

Careful correlation with anatomic imaging reveals the dumbbell morphology of the gallbladder secondary to partial gallbladder stricture. Incomplete filling of the gallbladder might be explained by a complete gallbladder stricture; however, flow through the stricture was confirmed on percutaneous cholangiogram [Figure 3]. Therefore, the most likely explanation, given the focal inflammatory changes in only the distal end of the dumbbell gallbladder on CT, is dumbbell gallbladder cholecystitis. Furthermore, the presence of hepatic abscess adjacent to the distal end of the dumbbell gallbladder, in this immunocompromised patient, supports that the cholecystitis is secondary to underlying sepsis.<sup>[10]</sup> The findings of cholecystitis also help explain the acute on chronic upper abdominal pain in this patient, may have been superimposed on symptoms from the hepatic abscess.

This patient may have benefitted from accurate initial diagnosis on the initial hepatobiliary scintigraphy, as there would have been earlier intervention. We conclude that, although this phenomenon is relatively uncommon, familiarity with gallbladder stricture can allow for appropriate initial diagnosis and timely intervention.

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### *Conflicts of interest*

There are no conflicts of interest.

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