Visualization of Noncalcified Gallstones on CT Due to Vicarious Excretion of Intravenous Contrast

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ABSTRACT

We present a case where low attenuation gallstones are visible on CT only on delayed imaging secondary to gallbladder opacification from vicarious excretion of contrast. We discuss heterotopic accumulation of contrast in the gallbladder and its potential diagnostic utilization in the detection of occult pathology.

INTRODUCTION

Vicarious excretion of water-soluble contrast media by the liver, resulting in opacification of the gallbladder, is a well recognized phenomenon on delayed CT (1). Modern intravascular contrast agents are rapidly concentrated and excreted by the kidneys. Extrarenal routes can be the major pathways for excretion in patients with reduced renal function or renal obstruction. Vicarious excretion of contrast media is mainly biliary but can also occur in the small intestine. This can result in opacification of the gallbladder and colon on radiographic examinations secondary to the ability of these organs to absorb water concentrating the contrast (2, 3). While vicarious excretion occurs more frequently in patients with renal insufficiency, it is also common in individuals with normal creatinine levels (4, 5). Improved visualization of pathology on delayed CT from vicarious excretion of contrast has rarely been reported (6), but to our knowledge, revelation of otherwise occult pathology on CT due to vicarious excretion has not been discussed. Presented here is a case in which low attenuation gallstones are detectable by CT only on delayed imaging due to opacification of the gallbladder from vicarious excretion of contrast.

CASE REPORT

A 39 year-old man with a past medical history of hypertension and renal insufficiency was admitted for evaluation of chest and abdominal pain. Pertinent admission laboratory results were BUN = 11 mg/dl; serum creatinine = 1.5 mg/dl; and total bilirubin = 0.4 mg/dl. Aortic dissection was suspected and CT angiography of the chest and abdomen was performed during rapid intravenous administration of 150 ml of iodixanol (iodine concentration of 320 mgI/mL, Visipaque-320, GE, Milwaukee, Wisconsin). The study revealed a type B aortic dissection extending to the abdominal aorta. The gallbladder appeared normal (Fig. 1). The patient developed worsening chest pain and follow-up CT angiography was performed approximately 12 hours later to evaluate for progression of the dissection. On the second study the aortic dissection was unchanged. However, gallstones were visible as low attenuation filling defects in the gallbladder as the gallbladder was opacified from vicarious excretion of contrast given during the initial study (Fig. 2). The presence of gallstones was subsequently confirmed on ultrasound examination (Fig. 3). The patient had also developed contrast-associated nephropathy following the first CT scan as his serum creatinine increased to 2.6 mg/dl while his estimated GFR decreased from about 60 ml/min to about 33 ml/min. The second CT scan was performed despite the serum creatinine values as it was deemed the only viable option to evaluate the patient's life-threatening condition. Approximately 48 hours later, renal function returned to baseline.

DISCUSSION

Opacification of the gallbladder on CT from vicarious excretion of intravenously administered water-soluble contrast agents is a common phenomenon (1). While binding to serum albumin allows preferential hepatic uptake and biliary excretion of contrast agents, modern contrast media demonstrate minimal protein binding. These agents are rapidly excreted by glomerular filtration but about 1% of the administered dose can be excreted through the biliary system in normal patients (7). The degree of biliary excretion is also a function of the plasma concentration and the length of time

that concentration is maintained. Therefore, heterotopic accumulation of contrast in the gallbladder is favored in individuals with decreased renal function, high dose of administered contrast and absence of gallbladder emptying (as in fasting patients). The gallbladder also absorbs water further concentrating the excreted material (3). While contrast induced nephropathy may have contributed to the gallbladder opacification in the case we present, visualization of vicariously excreted contrast in the gallbladder on CT can occur in normal patients and does not necessarily indicate renal or hepatobiliary disease (1, 8). The time interval between administration of contrast and maximum opacification of the gallbladder from vicarious excretion has not been established. Past reports have shown gallbladder opacification occurring from as little as 20 minutes to as long as 72 hours after contrast administration (7).

Gallstones can occur anywhere within the biliary tree including the gallbladder. Cholelithiasis affects approximately 10 % of the adult population in the United States. Incidentally detected gallstones on imaging studies are clinically significant as approximately one third of asymptomatic patients with gallstones progress to develop associated complications (9).

Gallstones can be classified as cholesterol, mixed, or pigment stones. In western countries, approximately 75% of gallbladder stones are of cholesterol stones (10). Detectability of gallstones on CT is affected by their chemical composition. The amount of calcium phosphate or calcium carbonate within gallstones correlates with their visibility on CT (10-12). Pigment stones have a higher affinity for calcium carbonate and calcium bilirubinate and generally have higher CT attenuation values. Pure cholesterol stones on the other hand, are lower in attenuation and not as readily detected by CT (4,11-13).

Regarding ultrasonographic characteristics of gallstones, sonographic criteria for cholesterol stones are stones that float in the gallbladder or stones that produce acoustic shadows without internal echoes from the stones (14). In a study conducted by Good et al. no correlation was found between gallstone type or calcium content and acoustic shadowing. Acoustic shadowing was found to be related to the size of the gallstone. Stones 4mm or greater in diameter are much more likely to produce distinct sonic shadows compared to smaller stones regardless of composition (15).

In the case we present the patient likely had pure cholesterol stones given the sonographic finding of floating stones and the fact that the stones were similar in attenuation to the surrounding bile on CT. While such stones are usually invisible on CT, our case illustrates that the hepatobiliary system should be examined carefully if intravenous contrast was given for a recent prior study as vicarious excretion may disclose otherwise occult pathology.

TEACHING POINT

The hepatobiliary system should be examined carefully on CT if intravenous contrast was administered for a recent prior study as vicarious excretion may disclose otherwise occult pathology.

ABBREVIATIONS

CT: Computed tomography
BUN: Blood Urea Nitrogen
GFR: Glomerular filtration rate

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FIGURES

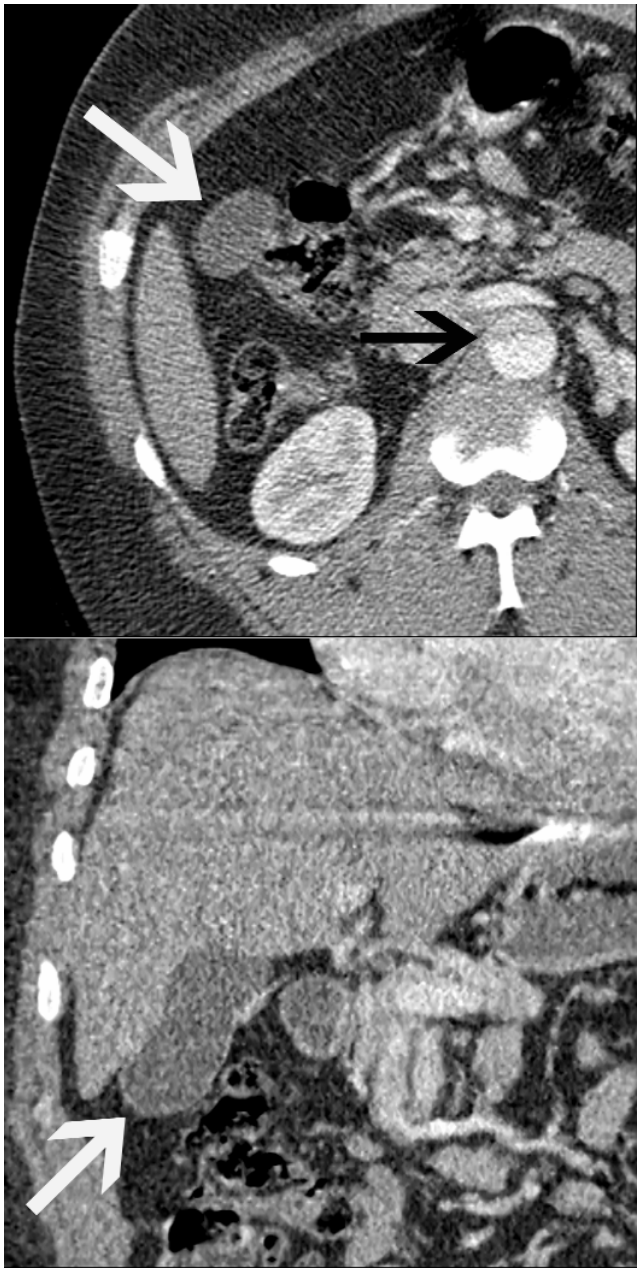

Figure 1: Axial image (top) and coronal reformatted view (bottom) from initial contrast enhanced CT scan show normal appearing gallbladder (white arrows). An intimal flap, from aortic dissection, is visible within the lumen of the abdominal aorta (black arrow).

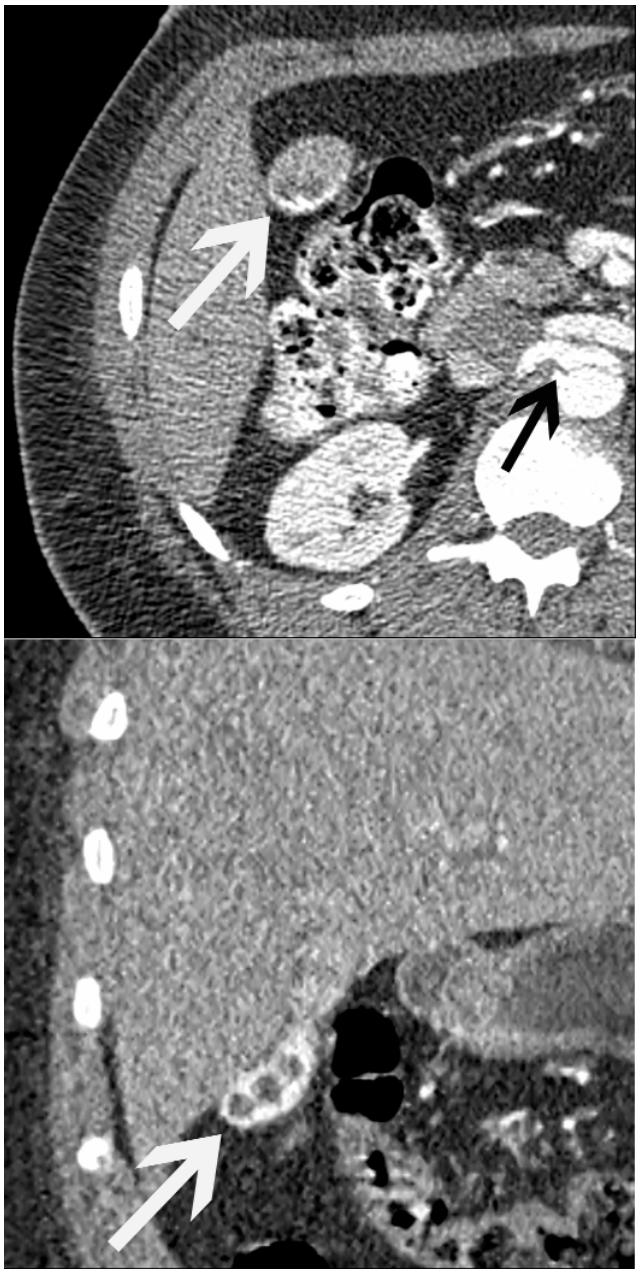

Figure 2: Axial image (top) and coronal reformatted view (bottom) from follow-up contrast enhanced CT study, performed 12 hours later, shows opacified gallbladder (arrows) with dependent filling defects representing low attenuation gallstones. The aortic dissection was unchanged (black arrow)**.**

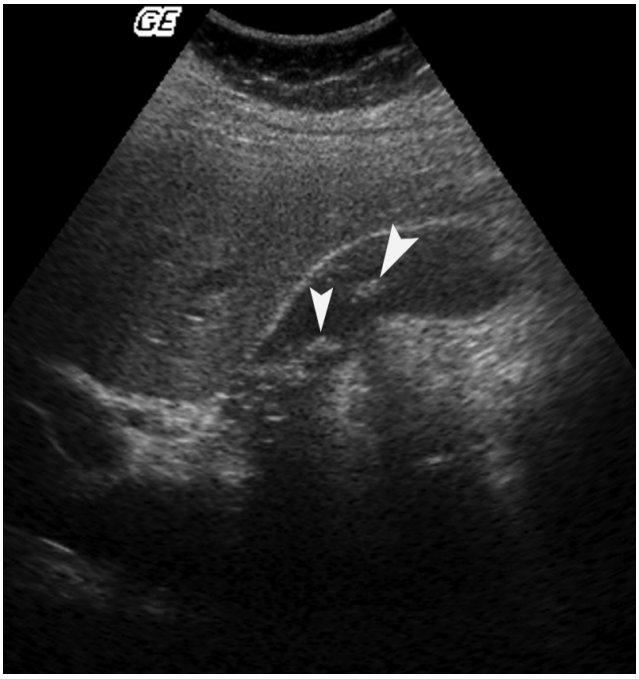

Figure 3: Subsequent ultrasound examination of gallbladder confirms presence of gallstones (arrowheads). One stone is seen floating in the gallbladder consistent with a cholesterol stone.

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