
Oral Contrast-Enhanced CT Cholangiography - an initial Experience

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Abstract

Objective: To describe our experience of CT (Computed tomographic) Cholangiography examination for detection of choledocholithiasis at the Aga Khan University Hospital (AKUH) Karachi Pakistan.

Methods: Seven patients underwent helical CT cholangiography for suspected choledocholithiasis. Iopanoic acid (6grams) was administered orally 8-12 hours before acquisition of a helical CT cholangiogram. Three-dimensional reconstructions and curved multiplanar reformations were generated from a set of axial source images.

Results: Our patients had no adverse reactions to iopanoic acid. The degree of biliary opacification was sufficient to perform three-dimensional and curved planar reformations in 5 patients. In two patients, the biliary tree was not opacified. Both of these studies were considered failures. Findings on CT cholangiography in the remaining 5 patients were the following: cholelithiasis with normal bile duct (n=2), choledocholithiasis (n=1), stone in gallbladder remnant with long cystic duct (n=1) and infiltrating adenocarcinoma of the gallbladder (n=1).

Conclusion: Spiral CT cholangiography is a safe, non-invasive, and cost effective alternative test and, in a carefully selected patient population can play a role in the diagnostic work-up of patients with suspected choledocholithiasis (JPMA 54:8;2004).

Introduction

Noninvasive methods that have also been used for diagnosis of bile duct stones including grey-scale sonography, conventional computed tomography (CT), helical CT without contrast, magnetic resonance(MR) cholangiography and helical CT cholangiography.

Although figures of sensitivity and specificity for detection of choledocholithiasis of these tests vary, most studies report rates in the range of 40-70% for sonography^{1,2} and around 80% for conventional CT.³

More recently, MR cholangiography has been shown to be highly sensitive and specific for evaluation of bile duct

stones. Because most clinical MR scanners offer the possibility of generating an MR cholangiogram of diagnostic quality, the technique is used commonly for non-invasive evaluation of biliary tract disorders. Results of multiple series evaluating the diagnostic performance of MR cholangiography in patients with choledocholithiasis show that the sensitivity (88-100%) and the specificity (85-95.8%) of the method is high.⁴⁻⁹ However, the technology of MR imaging is not always available. Its use is further limited in patients with claustrophobia, and in those not compatible with MR imaging such as cardiac pacemaker and certain aneurysm clips. Therefore, an alternative, noninvasive, safe test with a high sensitivity and specificity for diagnosis of bile duct stone would be useful.

In an attempt to increase the sensitivity of CT for detection of bile duct stones, various investigators have used exogenous contrast material to opacify the bile ducts. Pretorius et al¹⁰ and Greenberg et al¹¹ used oral cholecystographic agents in conventional CT to image the gallbladder and biliary tree. More recent studies have combined helical CT with the use of intravenous cholangiographic contrast agent to generate two and three-dimensional cholangiographic images of opacified bile ducts.¹²⁻¹⁴ Intravenous contrast agent in many cases caused serious adverse reactions, including death.¹⁵

In order to overcome this problem, an orally administered biliary contrast medium, "iopanoic acid" has been used in the past for evaluation of gallbladder disease.¹⁶ The triiodobenzene ring compound increases the density of the bile allowing visualization of the biliary tree and the gall bladder on CT. This fat-soluble contrast agent is absorbed in the jejunum and transported to the liver where it is conjugated with glucuronic acid and excreted in the bile. It is safe and well tolerated by most patients.¹⁶ Using ERCP as the gold standard the sensitivity and specificity of oral contrast enhanced CT cholangiography were 92% and the results were comparable with MR cholangiography. We describe our experience of CT cholangiography for detection of choledocholithiasis at the Aga Khan University Hospital (AKUH) Karachi.

Patients and Method

During the period January 2001-December 2002, 7 patients (4 males and 3 females) were subjected to CT cholangiography. Age range was 34-74 years with mean age of 54 years. Written informed consent was obtained after explanation of the procedure. Patients with a known allergy to iodinated contrast material, known hyperuricemia, renal insufficiency (creatinine >1.3md/dl) and severe hepatic dysfunction and hyperbilirubinemia (bilirubin level >5mg/dl) were excluded.

Technique

Patient Preparation

The patients were given 6 grams of iopanoic acid orally the night before the CT examination. They were instructed to eat a high fat meal (which contained approximately 50 grams of fat) no later than 8 p.m. and then to take 3 grams of iopanoic acid at 10p.m. and the remaining 3 grams at 12 a.m. The following morning, CT cholangiography was performed 8-12 hours after administration of the contrast agent. In an attempt to induce physiologic contraction of gallbladder and improve opacification of the common bile duct another fatty meal (which contained approximately 50 grams of fat) was given to the patients after an initial scan. A repeat CT scan was performed 30 minutes after the fatty meal. Post examination, the patients were encouraged to drink abundant fluids for 4 days to decrease the risk of renal tubular deposition of uric acid, due to iopanoic acid.

CT Protocol

All CT examinations were performed with a single slice helical scanner (General Electric Medical System, High-speed Pro). To determine the location of the lower end of the common bile duct (CBD) a series of five 10mm-thick contiguous transverse scans were obtained with a low dose technique (100mA, 100kv) through the second lumbar vertebra. After localization of the CBD the scan was performed in a cephalocaudal direction using the following parameters: 3mm collimation ,a pitch of 1:1, 180 degree interpolation 140 Kvp, 170-220mA. Images were acquired during an exposure of 20-40 seconds for a single breath hold from the base of lungs to the tip of right hepatic lobe.

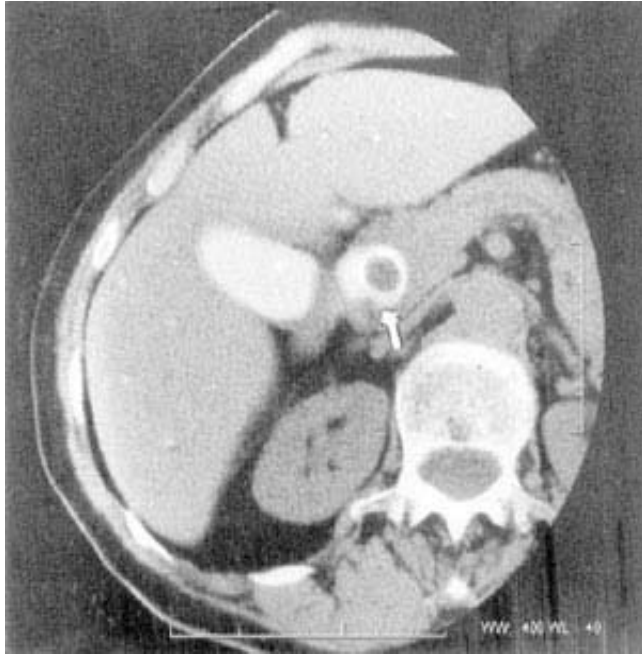
Image processing

The transverse source images were transferred to the workstation where curved multiplanar reformation images, multiplanar imaging and 3D reconstructions that consist of maximum intensity projections were formed.

Curved multiplanar reformations were created using manual tracing algorithm marker placed along the cystic duct and common bile duct created a projection based on connectivity. Maximal intensity projections (MIP) were also produced. These preferentially showed the voxels with the highest CT attenuation numbers Unwanted structures were electronically eliminated by trimming and altering the window and level parameters. 3D reconstructions depicted that the outer surface of billiary tree and gall bladder could rotate in all directions.

Results

The oral contrast agent and imaging protocol were well tolerated. No adverse reactions to oral iopanoic acid were encountered. In two patients, the biliary tree was not opacified. Both of these studies were considered failures. In both patients, high attenuation contrast material was present in the bowel, indicating the contrast agent had been ingested but was either not absorbed by the enterohepatic circulation or not excreted in the biliary tree. Two other patients were



demonstrated to have cholelithiasis but well-opacified ductal systems, which were normal, and this was confirmed by peroperative cholangiography at the time of cholecystectomy. The three other cases are described below.

Case 1

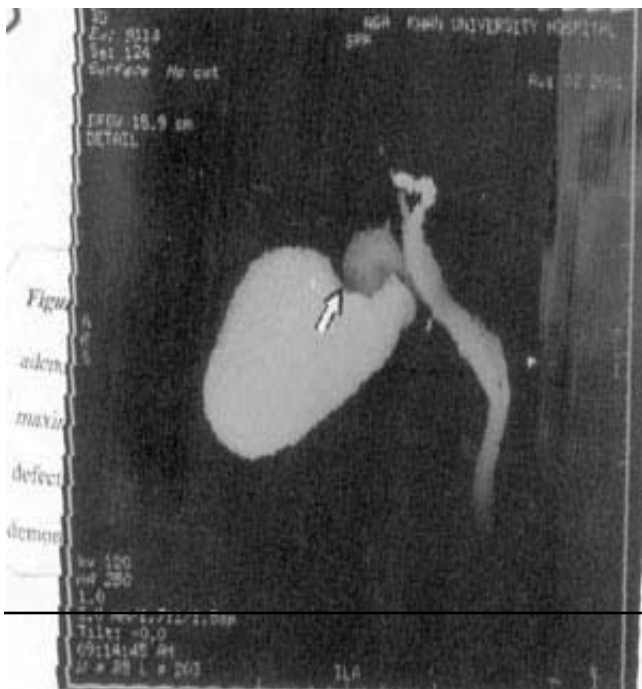
A 79-year-old female presented with complaints of right upper quadrant pain for many years, increasing in frequency for the last one year. It was accompanied by vomiting and fever with chills. An ultrasound examination done previously revealed a single gallstone for which she refused surgery. Repeat ultrasound failed to demonstrate any gallstone. With strong clinical suspicion of choledocholithiasis and in view of the previous ultrasound, CT cholangiogram was performed which revealed a



3x2.5cm calculus in the mid part of CBD with moderate intrahepatic and extrahepatic biliary dilatation proximal to the calculus (Figure 1). The patient underwent peroperative cholangiogram examination, which confirmed the findings of CT cholangiogram, and a single stone was successfully removed from the common bile duct. T-tube cholangiogram examination performed on the tenth postoperative day was negative for choledocholithiasis.

Case 2

A 58-year-old male patient presented with severe abdominal pain radiating to the epigastrium and right



shoulder tip for the previous two years. Laparoscopic cholecystectomy in 1998 revealed multiple gallstones. Initial laboratory values, which included a complete blood cell count and results of liver function tests, were normal. An ultrasound examination was negative. Due to recurrent abdominal pain a CT cholangiogram examination was performed. On pre-fatty meal examination, a subtle laminated calcific density was seen in the gall bladder fossa (Figure 2A). The post-fatty meal study demonstrated contrast adherence to the wall of the gallstone, enhancing its conspicuity (Figure 2B) Further, a long cystic duct with low insertion was demonstrated. The common bile duct was normal. At surgery, a thick walled gall bladder remnant containing a calculus was removed. Peroperative cholangiogram examination showed a long cystic duct running parallel to the common bile duct with low insertion. The common bile duct was normal.

Case 3

A 59-year-old male patient with known diabetes mellitus and ischemic heart disease had a history of high-grade fever with chills for one-month previously. Ultrasound performed at the time of presentation suggested a mass in the region of the gallbladder neck. No stone disease was identified. With antibiotic treatment the patient became asymptomatic. Due to the strong association of cholelithiasis with gall bladder malignancy, a CT cholangiogram examination was performed and a 2 cm filling defect was demonstrated in the region of the gall bladder neck (Figure 3). There was no evidence of a calculus in the gallbladder or the common bile duct.

Radical cholecystectomy was performed with excision of lymph nodes at the portahepatis. Histopathology confirmed infiltrating adenocarcinoma of the gall bladder with full thickness muscle involvement. The removed lymph nodes were negative for metastasis.

Discussion

Endoscopic retrograde cholangiopancreatography (ERCP) has long been the gold standard in biliary tract imaging. However it is an expensive and invasive method with a technical failure rate of 10% and reported complication rate of 0.6% to 5.0%.¹⁷ Percutaneous transhepatic cholangiography (PTC) shares these disadvantages. Unfortunately, conventional non-invasive imaging techniques also have serious drawbacks. Ultrasound of the liver is operator dependent and is often confounded by overlying bowel gas. Conventional CT frequently cannot resolve non-dilated ducts from other tissues and structures and in 80% of cases stones are isointense with bile and the surrounding tissues. MR cholangiography, another non-invasive imaging technique,

is an effective and accurate technique but is limited by availability, cost and patient's acceptance.

Oral contrast enhanced CT cholangiography provides a noninvasive, safe, accurate and cost-effective, alternative test with high sensitivity and specificity in the diagnosis of bile duct stones and other biliary tract pathologies. To our knowledge, it is not being performed in Pakistan.

Also three-dimensional spiral CT cholangiogram might be useful in delineation of biliary anatomy after cholecystectomy. We were able to detect a long cystic duct remnant in one of our patients after cholecystectomy. A cystic duct remnant longer than 1cm has been considered to increase the likelihood of symptoms and problems after surgery.¹⁸

Soto et al¹⁹ demonstrated specificity and sensitivity of oral-contrast enhanced CT cholangiography for detection of choledocholithiasis greater than 92%. Our experience suggests that this test is safe and useful in the diagnosis of common bile duct stones and other biliary tract pathologies. However, CT cholangiography is limited by the requirement of hepatic uptake, conjugation and excretion of the contrast agent to obtain adequate opacification of the bile duct. Insufficient excretion of the bile may occur in patients with elevated bilirubin levels (>5mg/dl) and renal insufficiency (creatinine level >1.3 mg/dl). Therefore, there must be good coordination between the radiologist and the referring physician. Proper patient selection must be based upon a high index of clinical suspicion supported by mildly deranged liver function tests. In our experience, a bilirubin level beyond 5mg/dl is the most common limitation of CT cholangiography. However, other causes of failure include absence of meticulous attention to detail in patient preparation, and instructions. The patient must be cooperative.

In conclusion despite the limitations of the procedure, our experience is that spiral CT cholangiography is a safe, non-invasive and cost effective alternative test and, in a carefully selected patient population can play a role in

the diagnostic work-up of patients with suspected choledocholithiasis.

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