Biliary Motor Function in Gallstone Patients Evaluated by Fatty-Meal MR Cholangiography

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Introduction

Impairment of biliary motor function, including decreased gallbladder contractility and obstruction of the bile duct, may cause important clinical problems. Postprandial changes in the biliary system may be assessed by scintigraphic and ultrasonographic methods to determine biliary motility (1-3). However, the former method induces substantial radiation exposure and the latter is highly operator-dependent. MR cholangiography (MRC) is established as a method to assess the morphology of the entire biliary system and may offer objective functional information with no radiation exposure when combined with the ingestion of fatty meal. In this study, we performed MRC before and after fatty meal ingestion in healthy subjects and patients with gallstones. The aim of this study was to determine normal findings of fatty-meal MRC and to evaluate the usefulness of fatty-meal MRC in assessing biliary motor function.

Methods

Twenty healthy volunteers and 19 patients with gallstones were studied using a 1.5T MR unit (Signa Horizon, GE Medical Systems) and a phased-array torso coil. Four gallstone patients also had choledochal stones. After overnight fasting, baseline MRC was performed using a single shot fast spin echo (SSFSE) sequence during a single breath hold. Multiple thin-slice MRC images covering the gallbladder were obtained in the axial or coronal plane, and multiple thin-slice or single thick-slice MRC images covering the extrahepatic bile duct were obtained in the coronal plane. Following the ingestion of 250 ml milk, the same set of MRC images were acquired every 10 min for 60 min. Scan parameters for multiple thin-slice MRC were effective TE = 187 msec, field of view = 32 x 24 cm, slice thickness = 3-5 mm, no gap, and matrix size = 256 x 256. Parameters for single thick-slice MRC were effective TE = 667-674 msec, field of view = 32 x 24 cm, slice thickness = 15-35 mm, and matrix size = 256 x 256.

High-intensity areas representing bile juice were demarcated on the MRC images covering the gallbladder, and the gallbladder volume was estimated excluding the volume of the gallstones. Gallbladder ejection fraction was calculated using the volumes at baseline and at maximal contraction, and the lower limit of normal gallbladder ejection fraction was determined as mean - 2SD in the control subjects. The bile duct diameter was measured on the MRC images covering the extrahepatic bile duct, and postprandial dilation was defined as more than 1-mm increase in bile duct diameter from the baseline value. Postprandial dilation at 60 min after milk ingestion was considered to indicate persistent biliary obstruction (1). The differences between the controls and gallstone patients were estimated by unpaired t-test, and p < 0.05 was considered statistically significant.

Results

There was no significant difference in fasting gallbladder volume in the controls (22.4 ± 10.7 ml, mean ± SD) and gallstone patients (24.9 ± 17.2 ml). Substantial contraction was observed even at 10 min after milk ingestion (Fig. 1). Postprandial gallbladder volume expressed as a percentage of the baseline value was significantly lower at 20-60 min after milk ingestion in the gallstone patients than in the controls. The gallbladder ejection fraction was significantly decreased in the gallstone patients (45.6% ± 20.8%) when compared with the controls (66.8% ± 14.5%). The lower limit of normal gallbladder ejection fraction was calculated at 37.8%, and gallbladder contractility was judged as abnormally low in six patients with gallstones (Fig. 2).

In two patients with choledochal stones, postprandial dilation associated with transient stone impaction at the ampulla was observed. The impaction was relieved spontaneously in both patients, and the duct diameter decreased. No subjects showed postprandial dilation at 60 min after milk ingestion.

Discussion

Fasting gallbladder volume and gallbladder ejection fraction in healthy subjects estimated by MRC were similar to those reported using ultrasonography (2,3). Fatty-meal MRC detected decreased gallbladder contractility in patients with gallstones, and appeared to aid in predicting the effect of dissolution therapy. The MR technique demonstrated transient postprandial dilatation of the extrahepatic bile duct, indicating transient obstruction, caused by stone impaction at the ampulla. Biliary obstruction in patients with choledochal stones may occur due to dysfunction of the sphincter of Oddi other than stone impaction. Unlike ultrasonography, MRC visualizes the distal portion of the bile duct and appears to demonstrate the cause of obstruction. The results of this study suggest the feasibility of fatty-meal MRC and its potential usefulness in evaluating biliary motor function in addition to biliary morphology. Significant differences in gallbladder volume at 20-60 min after milk ingestion were observed between the normal subjects and gallstone patients. Instead of serial imaging, a single addition of MRC after the ingestion of fatty meal may be useful as an adjunct to a routine MRC examination.

References