Detection of bile flow and differentiation of bile flow artifact from true biliary stone: A Newly-developed Black-blood T2-weighted SE-EPI imaging

Y. Watanabe[1], M. Nagayama[1], A. Okumura[1], T. Tabuchi[1], H. Mitsui[1], N. Morimoto[1], K. Nakada[1], M. Kumashiro[1], T. Kiyono[1], Y. Amoh[1], S. Nakashita[1], M. Van Cauteren[2], Y. Dodo[1]

[1]Department of Radiology, Kurashiki Central Hospital, Kurashiki, Okayama, Japan, [2]Philips Medical Systems, Best, DA, Netherlands

Purpose: To investigate the feasibility of black blood T2-weighted SE-EPI imaging of the biliary tract for the detection of bile flow and the differentiation of bile flow artifact from a biliary stone at MRCP.

Introduction: MR cholangiopancreatography is a useful, noninvasive imaging technique to diagnose the biliary stone. However, various diagnostic pitfalls of MRCP have been reported to simulate a biliary stone. Jet flow of bile can be a source of false defect, which has been very difficult to be distinguished from a biliary stone at MRCP. The detection of bile flow could allow for accurate differentiation of artifact of bile jet flow from a biliary stone.
Motion-probing gradient (MPG) makes the sequences very sensitive to flowing fluid such as blood and bile, which allows to completely eliminate signals from flowing fluid. The disadvantage of the MPG is reduction of signal-to-noise ratio and image distortion. Therefore, we applied MPG with very low b-factor (b=8) for the SE-EPI sequence to obtain black-blood T2-weighted image under a single breathhold.
The purpose of this study is to investigate the feasibility of this newly-developed black-blood T2-weighted SE-EPI imaging in the evaluation of bile flow.

Materials and Methods

Patients

This study included 104 patients who underwent MRCP and black-blood T2-weighted SE-EPI imaging. The final diagnoses were gallbladder stone (8 patients), CBD stone (2 patients), choledochal cyst (3 patients), extrahepatic bile duct cancer (2 patients), post-cholecystectomy biliary dilatation (4 patients), pancreatic cyst (12 patients), chronic pancreatitis (3 patients), mucin-producing pancreatic tumor (1 patients), pancreatic cancer (4 cases), chronic viral hepatitis(18 patients), normal (24 patients) other hepatobiliary diseases (23 patients).

MR Imaging

MR imaging was performed with 1.5 T units (ACS-NT, Intera; Philips). All the images were obtained with a synergy body coil. MR cholangiopancreatography was performed with single-slice MRCP (single-shot TSE) and multi-slice MRCP (heavily T2-weighted TSE). Then, Transaxial heavily T2-weighted TSE images and black-blood SE-EPI images were obtained using SENSE (sensitivity encoding).
Black-blood SE-EPI imaging was performed by applying MPG (b=8) for single-shot T2-weighted SE-EPI sequences with effective TE 90 during a single breath hold. Five sets of images were obtained without MPG(b=0), with b-factor 8 applied in each three direction and summation of all the three. The imaging parameters for black-blood SE-EPI (TE-90) were TR 2400, effective TE90, EPI factor59, 150×256 matrix, 330mmFOV, and 16 sections with slice thickness/gap10/1.0mm. Acquisition time of 5 image sets was 14 seconds . Fat signal was suppressed by chemical shift-selective fat suppression technique.

Assessment of bile flow

The criteria used for diagnosis of bile flow was a focal defect which was detected on black-blood SE-EPI image (b=8) but not detected on SE-EPI image (b=0). When the bile flow showed a defect on multi-slice MRCP or heavily T2-weighted images, it was diagnosed as pseudodefect caused by artifact from bile flow.

Results

1. In 28 of 104 patients (27 %), bile flow was detected at 40 sites with black-blood SE-EPI images. In 8 of 104 patients (6 %), pseudodefect caused by artifact from bile jet flow was found at MRCP.
2. Among the 40 sites where bile flow was detected, the most common sites of detection of bile flow was the confluent of bile duct and cystic duct (33 %), followed by the lower common bile duct (20 %), the common hepatic duct (18 %), gallbladder neck (18 %), and hepatic duct (13 %).
3. The pattern of bile flow was central type (96 %), and marginal rim type (4 %).

Conclusion: Application of MPG with very low b-factor gives excellent image contrast to T2-weighted SE-EPI images. This newly-developed MR imaging will allow to detect bile flow and differentiate artifact of bile jet flow from a biliary stone accurately.

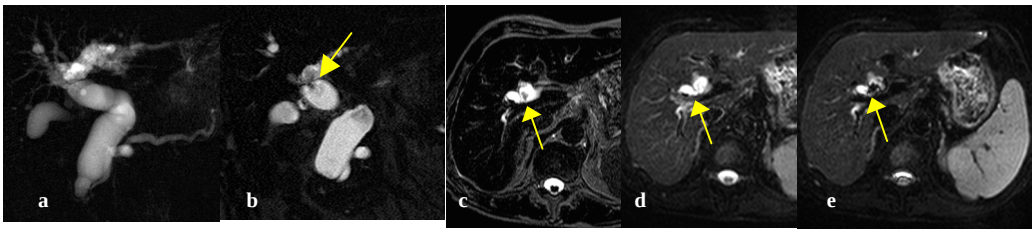

Fig. 1 Pseudodefect on MRCP caused by bile flow artifact in a patient with choledochocele and choledochal cyst.
a:single-slice MRCP
b:source image of multi-slice MRCP
c: heavily T2-weighted TSE,
d:SE-EPI(b=0)
e: black-blood SE-EPI (b=8)

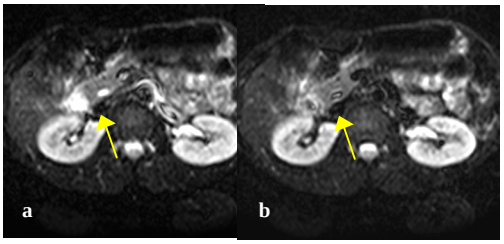

Fig. 2
Marginal rim pattern of bile flow in a patient with pancreatic cyst.
a: SE-EPI (b=0),

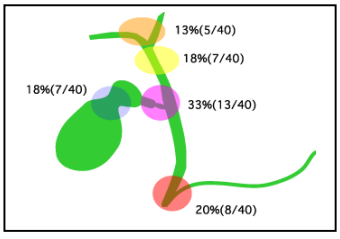

Fig. 3
Frequency of anatomical sites where bile flowwas detected.