

High b-value diffusion-weighted MR images of biliary tumors and tumor-like lesions

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[Introduction] Malignant biliary tumors such as gallbladder cancers and bile duct cancers (cholangiocarcinomas) may infiltrate along the walls of gallbladder or bile ducts without massive tumor-formation, and occasionally it may be difficult to differentiate from benign inflammatory diseases or tumor-like pathologies such as chronic cholecystitis, adenomyomatosis, xanthogranulomatous cholecystitis, and benign strictures of bile ducts due to inflammation. The purpose of this study is to evaluate malignant biliary tumors by high b-value diffusion-weighted images (DWI) and corresponding isotropic ADC maps for the differentiation of benign and malignant pathologies.

[Materials and Methods] Twenty malignant biliary tumors including ten bile duct cancers (seven hepatic hilar cholangiocarcinomas and three extra-hepatic bile duct cancers) and ten gallbladder cancers were evaluated. Eight benign strictures of the bile ducts, and twelve benign gallbladder pathologies with focal or diffuse wall thickening including five chronic cholecystitis, five adenomyomatosis, and two xanthogranulomatous cholecystitis were also evaluated. DWI with high b-value ($b=800 \text{ sec/mm}^2$) was performed in all subjects with a spin-echo, single-shot EPI sequence on a system with a 1.5-T superconducting unit (Signa Excite, General Electric, Milwaukee, WI) with 8ch body-array torso coils. The parallel image-encoding techniques (the array spatial sensitivity encoding techniques: ASSET, General Electric, Milwaukee, WI) were employed. Signal intensity on DWI (black and white inversion) was visually evaluated by two radiologists. The isotropic apparent diffusion coefficients (ADCs) of the pathologies were measured from ADC maps. Maximum intensity projection (MIP) of DWI (black and white inversion) was also reconstructed for the extra-hepatic bile duct cancers. MR Cholangiopancreatography (MRCP) based on heavily T2-weighted sequences, and/or fast T2-weighted coronal images with single shot fast spin-echo (SSFSE) sequence, or with fast imaging employing steady state acquisition (FIESTA) sequence were also obtained for the evaluation of biliary system.

[Results] All ten gallbladder cancers and eight of ten bile duct cancers showed very high intensity (Fig. 1), and two of ten bile duct cancers showed slight high intensity on DWI. The ADC in gallbladder cancers was $1.01 \pm 0.25 \times 10^{-3} \text{ mm}^2/\text{sec}$, and the ADC in bile duct cancers was $1.32 \pm 0.30 \times 10^{-3} \text{ mm}^2/\text{sec}$. MIP of DWI can clearly demonstrate tumor extent in extra-hepatic bile duct cancers, and MRCP or fast T2-weighted coronal images in combination with DWI provided the three-dimensional entire biliary tract imaging with the extension of tumors (Fig. 2). One benign inflammatory stricture of the bile duct with marked lymphocyte infiltration showed slight high intensity. None of the other seven benign strictures showed high signal intensity on DWI. Six benign gallbladder lesions with active inflammatory changes (four cholecystitis, one adenomyomatosis, and one xanthogranulomatous cholecystitis) showed slight high intensity on DWI (Fig. 3). None of the other six benign gallbladder lesions showed high signal intensity on DWI. Four adenomyomatosis showed inhomogeneous high intensity on T2-weighted images and on MRCP, reflecting intramural enlarged Rokitsansky-Aschoff sinuses, and showed no signal increase on DWI with high ADC values ($3.20 \pm 0.43 \times 10^{-3} \text{ mm}^2/\text{sec}$).

[Conclusion] High b-value DWI may be useful in tumor detection in patients with malignant biliary tumors, and in differentiation from benign bile duct strictures or benign gallbladder wall thickening. The combination of MIP of DWI and MRCP or fast T2-weighted coronal images is useful in tumor detection and in evaluation of tumor extent in the biliary tracts.



Fig.1

Fig. 1. Gallbladder cancer: CE-CT (left) and DWI (right). Both small gallbladder tumor and lymphadenopathy show very high intensity on DWI.

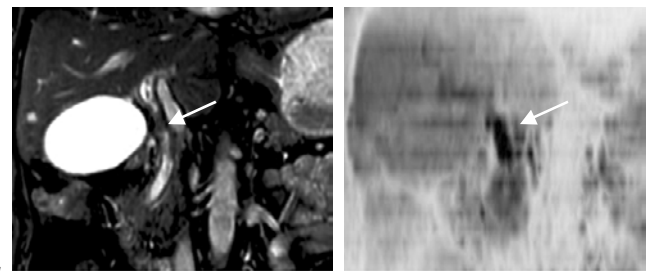


Fig.2

Fig. 2. Bile duct carcinoma: Coronal T2-WI with FIESTA (left) and MIP of DWI (right). The tumor extent in the biliary tract is well visualized.

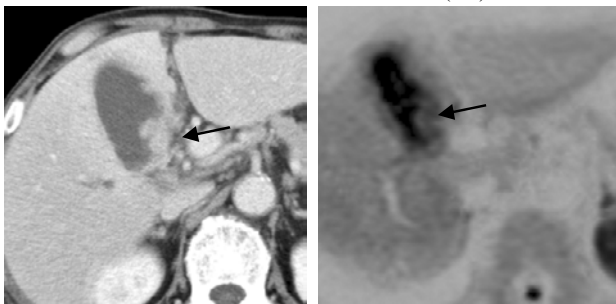


Fig.3

Fig. 3. Xanthogranulomatous cholecystitis: CE-CT (left) and DWI (right). Irregular thickened gallbladder wall shows slight high intensity on DWI. Pyogenic fluid collection within the gallbladder lumen shows very high intensity on DWI.