# Value of DW MRI of pancreatic tumors : correlation with enhanced MRI

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# Abstract

In our study using combined qualitative analysis of DWIs and quantitative analysis of ADC values we concluded that results of DW MRI are approaching that of contrast enhanced MRI not only in detecting pancreatic neoplasms but also in detection of vascular encasement, tumor necrosis and liver metastasis which are essential information for the clinician that reflects disease prognosis and treatment strategies. However, in view of limited number of cases and other limitations of the study larger studies are needed to confirm these results. We recommend using DWI in conjunction to conventional imaging as a useful modality that aids in assessment of pancreatic neoplasms. In cases with contraindication to contrast administration DW MR imaging can be used as a reasonable alternative technique to contrast-enhanced imaging



Key word

ADC-MR-ERCP- IPMN-PPV

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## LIST OF ABBREVIATIONS.

**CBD** COMMON BILE DUCT

**CHD** COMMON HEPATIC DUCT

**CT** COMPUTED TOMOGRAPHY

**DWI** DIFFUSION WEIGHTED IMAGING

**ERCP** ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY

**FLASH** FAST LOW ANGLE SHOT

**FSE** FAST SPIN ECHO

**GRE** GRADIENT RECALL

**HASTE** HALF FOURIER AQUITION SINGLE SHOT TURBO SPIN ECHO

**IPMN** INTRADUCTAL PAPILLARY MUCINOUS NEOPLASM

**LHD** LEFT HEPATIC DUCT

**MCN** MUCINOUS CYSTIC NEOPLASM

**MNDPDP** MANGANESE DIPYRIDOXYL DIPHOSPHATE

**MPD** MAIN PANCREATIC DUCT

**MPGR** MULTIPLANAR GRADIENT RECALL

**MRA** MAGNETIC RESONANCE ANGIOGRAPHY

**MRCP** MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY

**MRI** MAGNETIC RESONANCE IMAGING

**NPV** NEGATIVE PREDECTIVE VALUE

**PI** PARRALLEL IMAGING

**PPV** positive predictive value

**ROI** region of interest

**RF** radiofrequency

**RHD** RIGHT HEPATIC DUCT

**SCA** SEROUS CYSTADENOMA

**SE** SPIN ECHO

**SI** SIGNAL INTENSITY

**SPT** Solid Pseudopapillary Tumor

**SSFSE** SINGLE SHOT FAST SPIN ECHO

**SNR** SIGNAL TO NOISE RATIO

**T1WI** T1 WEIGHTED IMAGES

**T2WI** T2 WEIGHTED IMAGES

**TE** Echo Time

**TR** TIME OF REPITITION

**TSE** TURBO SPIN ECHO

**US** ULTRASONOGRAPHY

**1.5 T** 1.5 TESLA

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# INTRODUCTION

Pancreatic cancer has an unfavourable overall 5-year survival of about 5% and one major reason is late diagnosis. At the time of diagnosis, less than 10% of patients are candidates for the only curative treatment, surgical resection (Jemal et al 2008).

One crucial consideration in the treatment of patients suspected of having pancreatic tumors is how to proceed diagnostically. So far, ultrasonography (US) and contrast material–enhanced computed tomography (CT) have been widely used to diagnose pancreatic tumors. However, in previous series, differentiating benign lesions from pancreatic cancer was considerably difficult. This dilemma is clinically relevant and to overcome this dilemma, the development of sensitive and specific imaging modalities appears highly desirable. (Hänninen et al,2002 )

More recently the use of magnetic resonance imaging (MRI) for detection of pancreatic tumors was demonstrated. In particular, faster sequences reduced motion artifacts substantially and facilitated successful characterization of pancreatic lesions. In addition, one major advantage of MR imaging is the possibility to examine the pancreatobiliary system non invasively. (Hänninen et al., 2002 )

Diffusion-weighted imaging is based upon the principles of Brownian motion (random thermal diffusion) of small molecules in a tissue. By applying diffusion weighting to a sequence (a combination of pulses and strong gradients) one can measure the apparent diffusion coefficient (ADC) in a given tissue and thus quantify the combined effects of capillary perfusion and water diffusion. The use of DWI as a diagnostic tool in neoplastic diseases is based on the principle that in malignant lesions cells have a larger volume and are more closely aligned to each other. This hypercellularity diminishes the extracellular space leading to restriction

of the free movement of water particles resulting in a depressed ADC and hyperintensity on diffusion-weighted (DW) images. In contrast, benign lesions (such as cysts, hemangiomas) are characterised by expansion of the extracellular space and not by hypercellular populations, which in turn eases the diffusion of water molecules which is displayed as high ADC and hypointensity on DW images. (Robertson et al 2007)

Diffusion-weighted magnetic resonance imaging has been used for diagnosis of diseases of the central nervous system for two decades being a particularly important tool in the diagnosis of ischemic stroke—and the musculoskeletal system for one decade. (Bruegel M et al 2008)

During recent years, DWI of diseases of the lower abdomen, e.g. prostate, urinary bladder, uterus and rectum , has presented promising results. DWI of the upper abdomen has been a technical challenge due to respiration, bowel peristalsis, blood flow and long acquisition times. (Ichikawa T et al 2007)

The implementation of ultrafast imaging techniques, such as parallel imaging, has made DWI of the upper abdomen a feasible option and has been found to be useful in differentiation of malignant from benign liver lesions. Recent studies indicate that DWI is promising also in pancreatic imaging.(MatsukiM et al 2007)

Diffusion-weighted (DW) images can be helpful in detecting the pancreatic carcinoma and accessing the extent of the tumor.The ADC value ($\times 10^{-3}$ $mm^2/s$) in the carcinoma was 1.44 ± 0.20, which was significantly lower compared to that of normal pancreas (1.90 ± 0.06) and tumor-associated chronic pancreatitis (2.31 ± 0.18).(Matsuki et al, 2007 )

## Aim of the work

In view of an increasing use of MRI application in diagnosis and management of the pancreatic malignancies, the purpose of our study is to show the value of DW MRI in the diagnosis of pancreatic cancer and to correlate the results of DW MRI with that of contrast enhanced MRI aiming to use DWI MRI as a reasonable alternative modality especially when contrast administration is contraindicated.

**Chapter 1**

# ANATOMY OF THE PANCREAS

- ***Embryologic Development***

By the 4th week of embryologic growth, ventral (caudal) and dorsal (cranial) outpouchings develop at the junction of the foregut and midgut. The gallbladder, extrahepatic bile ducts (EBDs), central intrahepatic bile ducts (IBDs), and ventral pancreas with its ductal network are derived from the ventral outpouching, the hepatic diverticulum (Fig 1.1). The dorsal bud arises from the dorsal meso-gastrium and is the precursor of the dorsal pancreas and its ductal system. At about this time, the developing ventral pancreas, gallbladder, and bile duct rotate clockwise (when viewed from the top) posterior to the duodenum and join the dorsal pancreas in the retroperitoneum. The ventral pancreatic duct and the CBD are therefore, linked by their embryologic origins, resulting in the adult configuration of their common entrance into the duodenum at the major duodenal papilla **(*Mortele et al, 2006)*.**

At approximately the 7th gestational week, the dorsal and ventral pancreatic ducts fuse in the region of the neck. The territory drained by each system can vary, but in general the dorsal pancreatic ductal system drains the tail, body, and anterior portion of the pancreatic head, whereas the ventral component drains the posterior aspect of the pancreatic head. Both dorsal and ventral ducts variably drain the uncinate process of the pancreatic head. The portion of the ventral duct between the dorsal-ventral fusion point and the major papilla is termed the duct of Wirsung. The portion of the dorsal duct proximal to the dorsal-ventral fusion point is called the main pancreatic duct (MPD); if a segment of the dorsal duct persists distal to the dorsal-ventral fusion point, it is termed the duct of Santorini, or accessory duct. In 30% of individuals, however, the duct of Santorini loses its communication with the minor duodenal papilla and persists only as a branch of the MPD. **(Schulte ,1994)**