

# **Diagnostic Role of Diffusion Weighted MRI in Characterization of Pancreatic Tumors**

Essay

Submitted for partial fulfillment of  
Master Degree in Radiodiagnosis

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2016

## **ABSTRACT**

Pancreatic cancer remains the fourth cause of cancer death worldwide. Early diagnosis and staging of pancreatic cancer is important to yield a better prognosis.

There are multiple modalities for diagnosis such as Multislice CT, Ultrasonography and MRI.

DWI images can be helpful in detecting the pancreatic carcinoma and assessing the extent of the tumor.

Fusion of diffusion images with conventional images obtained in the same MR session can improve the diagnostic value compared with each imaging technique alone.

So, it is recommended to use DWI in conjunction to conventional imaging as a useful modality that aids in assessment of pancreatic neoplasms.

## **Key Words**

Pancreatic cancer- Multislice CT- MRI- DWI

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## Abbreviations

2D	Two dimensional
3D	Three dimensional
3T	3 Tesla
ACC	Acinar cell carcinoma
ADC	Apparent diffusion coefficient
AO	Aorta
CA	Contrast agent
CBD	Common bile duct
CHES	Chemical shift selective suppression
$D^*$	Pseudodiffusion coefficient
DLBCL	Diffuse large B-cell lymphoma
$D_{slow}$	Slow component of diffusion
DTI	Diffusion tensor imaging
DWI	Diffusion-weighted imaging
DW-MRI	Diffusion-weighted magnetic resonance imaging
EC	Enterochromaffin cell
EPI	Echo-planar imaging
ERCP	Endoscopic Retrograde Cholangiopancreatography
EUS	Endoscopic Ultrasound
TE	Echo time
$f$	Perfusion fraction
FIVIM	Flowing blood volume fraction
FOV	Field-of-view
FLASH	Fast low-angle shot
FSE	Fast spin echo

FMRI	Functional imaging
GB	Gallbladder
Gd.	Gadolinium
GRAPPA	GeneRalized Autocalibrating Partially Parallel Acquisitions
GRE	Gradient recalled echo
HASTE	Half-Fourier acquisition single-shot Turbo spin-echo
IPMN	Intraductal papillary mucinous neoplasm
ITPN	Intraductal tubulopapillary neoplasm
IV	Intravenous
IVC	Inferior vena cava
LN	Lymph node
MCN	Mucinous cystic neoplasm
MDCT	Multidetector Computed Tomography
MEN-1	Multiple endocrine neoplasm syndrome like
MIP	Maximum intensity projection
MPD	Main pancreatic duct
MPGR	Multiplanar gradient-recalled
MPR	Multiplanar reconstruction
MnDPDP	Manganese dipyridoxyl diphosphate
MRCP	Magnetic Resonance Cholangiopancreatography
MRI	Magnetic resonance imaging
NET	Neuroendocrine tumors
NHL	Non-Hodgkin's lymphomas
NOS	Not Othsenic Specified
PanIN3	Pancreatic intraepithelial neoplasia, grade 3
PWI	Perfusion weighted imaging
PV	Portal vein

RARE	Rapid acquisition with relaxation enhancement
ROI	Regions of interest
s/mm <sup>2</sup>	seconds per square millimeter
SAR	Specific absorption rate
SCA	Serous cystadenoma
SE	Spin-echo
SENSE	Sensitivity Encoding
SI	Signal intensity
SMV	Superior mesenteric vein
SNR	Signal-to-noise ratio
SPAIR	Spectral pre-saturation attenuated with inversion recovery
SPT	Solid Pseudopapillary Tumor
SS	Single shot
SSFSE	Single-shot fast spin-echo
STIR	Short tau inversion recovery
T1WI	T1-weighted image
T2W	T2-weighted image
TR	Repetition time
TSE	Turbo spin echo

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## **INTRODUCTION AND AIM OF WORK**

## INTRODUCTION AND AIM OF WORK

The pancreas is a retroperitoneal organ situated deep within the abdomen and not easily accessible by physical examination. Pancreatic pathologies have a variety of presentations, which make their diagnosis challenging to physicians. Imaging plays a critical role in the evaluation of pancreatic diseases and provides valuable information to clinicians (*Quencer et al 2013*).

Pancreatic cancer remains a leading cause of cancer death. Stage of the disease greatly affects the prognosis of the disease that makes early diagnosis crucial in the management of pancreatic cancer (*Quencer et al 2013*).

Despite recent advances in cross-sectional imaging, such as multidetector computed tomography (MDCT) or magnetic resonance imaging (MRI) techniques, advanced disease at time of initial presentation results in a low rate of surgical interventions (10–20%) which is the cause of high mortality. Endoscopic ultrasound (EUS) is regarded as the modality of choice in patients with a high index of clinical suspicion and negative MDCT, but is invasive and operator dependent (*Taouli et al 2011*).

Although contrast enhanced CT achieves generally high sensitivity and specificity for the detection of pancreatic carcinoma, for staging and determination of resectability of the tumor, it is less specific in differentiating benign and malignant lesions. The differentiation of pancreatic adenocarcinoma from mass-forming pancreatitis is difficult because both share morphological characteristics at imaging. There is a compelling need for establishing an imaging technique as a cancer-screening method to provide high sensitivity for the detection and characterization of pancreatic tumors, and for the differentiation of tumors from benign inflammatory processes.

Diffusion Weighted Magnetic Resonance Imaging (DW-MRI) is a recently developed imaging technique that has shown preliminary but promising results for detecting most types of malignancies outside the brain (*Taouli et al 2011*).

Diffusion weighted Imaging (DWI) has been helpful for the detection and characterization of pancreatic conditions. The DWI technique serves as an excellent adjunct to routine abdominal MRI, is noninvasive in contrast to EUS and ERCP, and does not employ ionizing radiation like CT (*Tang et al 2015*).

Diffusion is thermodynamic in origin and is usually quantified by the apparent diffusion coefficient (ADC), which describes the amount of water diffusion in the intracellular, extracellular, intravascular, and transmembranous compartments, as well as microcapillary perfusion. The increased cell density in tumors results in decrease of extracellular space, and a subsequent decrease in proton mobility leading to the restricted diffusion. DWI is quite different from conventional imaging techniques, in that it can detect and quantify water motion in tissues that reflect tissue cellularity and cell membrane integrity (*Taouli et al 2011*).

Popular research studies reflect the value of DWI in the diagnosis of pancreatic cancer. Moreover, compared to the other techniques, the sensitivity and specificity for the diagnosis of pancreatic cancer is valuable (*Tang et al 2015*).

### *Aim of the Work*

*The aim of this work is to study the diagnostic value of DW-MRI in characterization of pancreatic tumors.*

# **ANATOMY OF PANCREAS**

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## ANATOMY OF PANCREAS

The pancreas is situated on the posterior abdominal wall at approximately L1 level; it is over 15 cm long (*Ryan et al.2011*).

It is a retroperitoneal organ located in the anterior pararenal space posterior to the stomach and bounded by the C-loop of duodenum on the right side (*Quencer et al. 2013*).

### *Embryologic Development*

By the 4<sup>th</sup> week of embryologic growth, ventral (caudal) and dorsal (cranial) outpouchings develop at the junction of the foregut and midgut. Ventral pancreas with its ductal network is derived from the ventral outpouching (**Fig 1.1**). The dorsal bud arises from the dorsal mesogastrium and is the precursor of the dorsal pancreas and its ductal system. At about this time, the developing ventral pancreas, gallbladder(GB), 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 common bile duct (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 7<sup>th</sup> 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*).