Role of Diffusion weighted MRI in the evaluation of pancreatic tumors

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List of abbreviations

ADC	**Apparent diffusion coefficient**
CA 19-9	**Cancer Antigen 19-9**
CBD	**Common Bile Duct**
CE T1WI	**Contrast Enhanced T1Weighted Imaging**
CT	**Computed Tomography**
DWI	**Diffusion Weighted Imaging**
FLASH	**Fast Low Angel Shot**
FSE	**Fast Spin Echo**
GRE	**Gradient Recalled Echo**
G-CSF	**Granulocyt Colony Stimulating Factor**
HASTE	**Half Four Single Shot Turbo Spin Echo**
IPMNs	**Intraductal Papillary Mucinous Neoplasms**
IV	**intravenous**
LDH	**Lactate Dehydrogenase Enzyme**
MPD	**Main Pancreatic Duct**
MCN	**Mucinous cystadenoma**
MPGR	**Multiplanar gradient recalled**
MRI	**Magnetic Resonance Imaging**
MnDPDP	**Manganese Dipyridoxyl Diphosphonate**
MDCT	**Multi-Detector CT**
MFFP	**Mass Forming Focal Pancreatitis**
NET	**Neuro-Endocrine Tumors**
PET/CT	**Positron Emission Tomography/ Computed Tomography**
ROI	**Region Of Interest**
SCA	**Serous cystadenoma**
SCC	**Squamous Cell Carcinoma**
SE	**Spin Echo**
SI	**Signal intensity**
SPD	**Small Pancreatic Duct**
SPT	**Pseudopapillary Tumor**
SMA	**Superior Mesenteric Artery**
SNR	**Signal to Noise Ratio**
SSFSE	**Single Shot Fast Spin Echo**
T1W	**T1 Weighted**
T2W	**T2 Weighted**
TE	**Time to echo**
TR	**Time to Repeat**
TSE	**Turo Spin Echo**

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Abstract

In our study demonstrating role of combined qualitative analysis of DWIs and quantitative analysis of ADC values we concluded that approaching 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 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-DWI- IPMN-

Pancreatic cancer is one of the most lethal human cancers and continues to be a major unsolved health problem at the start of the 21st century **(Li et al.,2004).**

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

Although much effort has been devoted to increase the sensitivity for detecting early stage pancreatic adenocarcinomas with conventional imaging techniques, such as ultrasonography, CT, or MRI, but the sensitivity to detect pancreatic cancer is still insufficient **(Li et al.,2004).**

More recently the use of magnetic resonance imaging (MRI)for detection of pancreatic tumors was demonstrated.In particular, faster sequences reduced motion artifacts substantially facilitated successful characterization of pancreatic lesions**(Hänninen et al., 2002).**

Diffusion-weighted magnetic resonance imaging is a technique that has traditionally been used in neuro-imaging for the detection of acute ischemia and other intracranial disease. However, it is increasingly being used in body applications. It is well known that

diffusion is caused by random translational molecular motion, also known as brownian water motion. DWI is the only imaging method that can be used to evaluate the diffusion process in vivo. The speed with which water molecules diffuse differs in extracellular and intracellular components of tissues. In the intracellular component, diffusion is relatively slow because of the presence of cellular membranes**(Ichikawa et al., 2007).**

Thus, ADCs, which are quantitative expressions of the diffusion characteristics of tissues, are related to the proportion of extra-cellular and intracellular components. ADC values tend to decrease with increased tissue cellularity or cell density. On the other hand, the cell density may be indicative of tumor aggressiveness; the results of several clinical studies suggest an increased metastatic capacity of tumors with high cellularity**(Ichikawa et al., 2007).**

DW MRI is being increasingly utilized in abdominal imaging to qualitatively and quantitatively assess tissuecellularity and cell membrane integrity. In the pancreas, DWI appears to be a promising adjunct for net diagnosis **(Christine Schmid et al.,2013).**

DW MRI represents a valuable adjunct to T2w images and is comparable to CE T1w images in pancreatic NET detection. DW MRI also allows quantitative differentiation of NET from normal pancreatic tissue with ADC values **(Brenner R. et al., 2012) .**

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) **(Matsukiet al., 2007).**

Also in favor DWI can be easily performed as an adjunct to a conventional MRI study. Furthermore, DW images can be fused with conventional MR images, like the fusion images obtained with PET/CT scanners, to achieve better anatomic resolution. (**Hosten N et al**., **lancet 2000).**

Aim of the work

To illustrate the usefulness of Diffusion weighted MRI in differentiating benign from malignant pancreatic lesions.

Gross anatomy of the pancreas

The pancreas is compound gland {both exocrine an d endocrine} located in the upper part of the abdomen w here it lies within the anterior pararenal compartment of retroperitoneum **(Barbi et al., 2012).**

On average the pancreas measures 15-20 cm in le ngth, is about 3 cm wide, and has a thickness of about 1-1 .5 cm in adult **(Moo et al., 2009).**

There is a gradual decrease in the size of the pancr eas with age. Its anteroposterior dimensions in persons 5 1–60 years of age are as follows: 24 mm (+- 3.6 mm) for t he head, 16 mm (+- 2.0 mm) for the body, and 15.1 mm (+- 1.9 mm) for the tail **(Mortele´ et al., 2006).**

Embryology:

Ventral (caudal) and dorsal (cranial) outpouchings develop at the junction of the foregut and midgut during the fourth week of gestation (**Figure 1.1**). The dorsal div erticulum forms the dorsal portion of the pancreas, and t he ventral diverticulum forms the liver, gallbladder, bile ducts, and ventral pancreas. As the foregut elongates, the

developing ventral pancreas, gallbladder, and bile duct r otate clockwise posterior to the duodenum and join the d orsal pancreas in the retroperitoneum. The ventral pancr eatic duct and thecommon bile duct (CBD) are linked by t heir embryonic origins, which results in the adult configu ration of their common entrance into the duodenum at th e major papilla **(Mortele´ et al., 2006).**

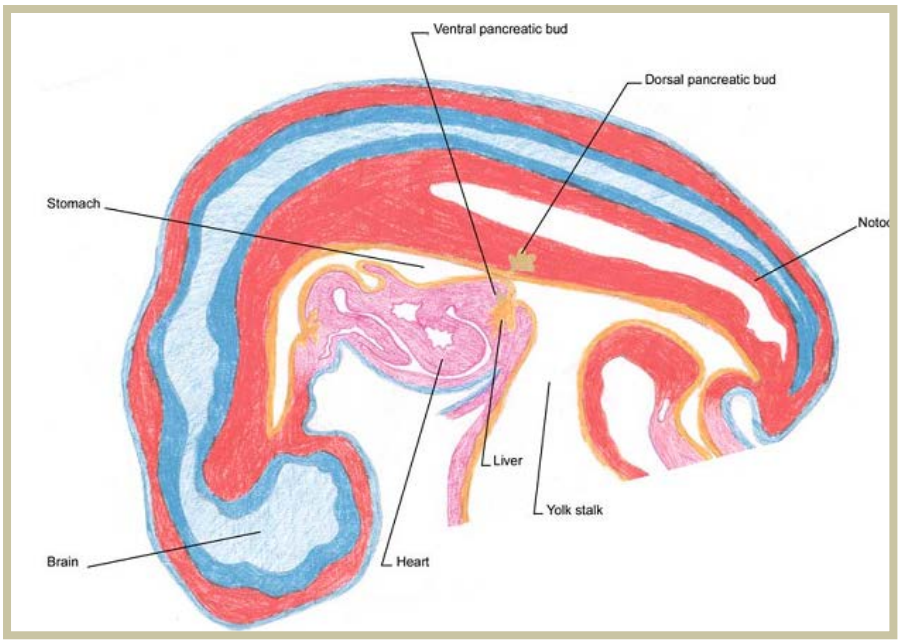

Fig.1.1. Drawings illustrate Development of dorsal and ventral pancr eatic buds at 4th week **(Moo et al., 2009).**

At approximately the 7th gestational week, the dorsal a nd ventral pancreatic ducts fuse in the region of the neck (**Figure 1.2**).The territory drained by each system can va ry, but in general the dorsal pancreatic ductal system dra

ins the tail, body, and anterior portion of the pancreatic h ead, whereas the ventral component drains the posterior aspect of the pancreatic head. Both dorsal and ventral du cts variably drain the uncinate process of the pancreatic head **(Mortele´ et al., 2006).**

The portion of the dorsal duct proximal to the dor sal-ventral fusion point is called the main pancreatic duct (MPD); if a segment of the dorsal duct persists distal to t he dorsal-ventral fusion point, it is termed the duct of Sa ntorini, or accessory duct. In 30% of individuals, howeve r, the duct of Santorini loses its communication with the minor duodenal papilla and persists only as a branch of t he MPD **(Mortele´ et al., 2006).**

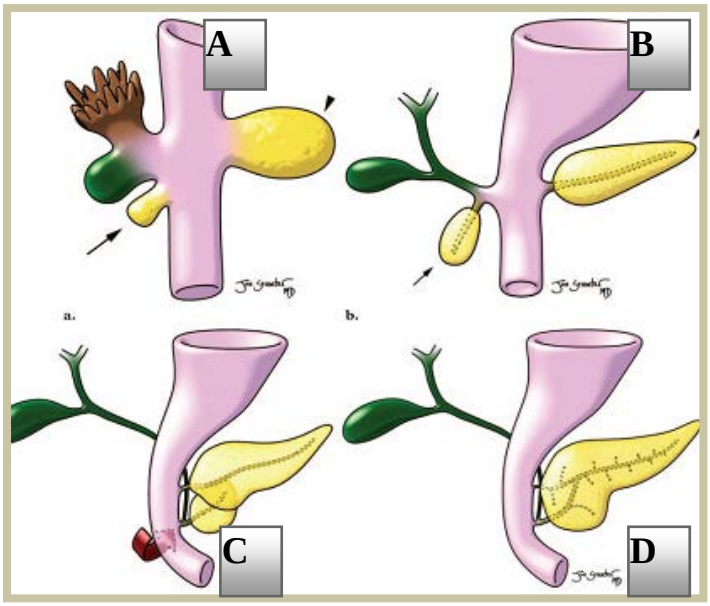

Fig.1.2. **Graphic illustrate** the normal embryologic development of the pancreas and biliary tree. The ventral pancreatic bud (arrow in **a** and **b**) and biliary system arise from the hepatic diverticulum, and the dorsal pancreatic bud (arrowhead in **a** and **b**) arises from the dorsal mesogastrium. After clockwise rotation of the ventral bud around the caudal part of the foregut, there is fusion of the dorsal pancreas (located anterior) and ventral pancreas (located posterior). Finally, the ventral and dorsal pancreatic ducts fuse, and the pancreas is predominantly drained through the ventral duct, which joins the common bile duct (CBD) at the level of the major papilla. The dorsal duct empties at the level of the minor papilla **(Mortele´ et al., 2006).**

Site:

It lies within the anterior pararenal compartment o f retroperitoneum (**Figure 1.3**)centrally it lies on the fro nt side of the first two lumbar vertebrae and may also th e last dorsal vertebra, with the interposition of abdomina l aorta on the left and inferior vena cava on the right, on t he right it is surrounded by the duodenal C –loop, on the l