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Pancreatic Carcinoma: Role of Multislice Tripahsic CT in Assessement of Tumor Resectability, Prospective Study

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Abstract

Purpose: To evaluate the role of MSCT in assessment of pancreatic tumors, its local and distant spread to determine line of treatment that should be used accordingly.

Patients and Methods: Prospective study of twenty patients (16 males and 4 females) with pancreatic masses or symptoms suggestive of pancreatic disease, their ages range from 40-66 years with mean age was 53. Multislice CT 64 detectors used, Triphasic CT liver study was performed (pre-contrast, arterial phase, porto-venous phase and delayed phase). Findings are matched with histopathological results, clinical and surgical data for operable cases.

Results: Pathology revealed pancreatic adenocarcinoma in 19 out of 20 patients. Only one case fine needle aspiration revealed inflammatory process and managed conservatively. Multislice CT was excellent in detecting unresectable tumors either because of vascular encasement seen in 17 out of 20 cases or metastatic disease.

Conclusion: MSCT is a usefull tool in detection and staging of pancreatic tumors, determination of tumor resectability. Further progress in preoperative staging of pancreatic ductal adenocarcinoma using multislice CT tripahsic technique should be directed toward improving early detection of small pancreatic tumors and assessment of early metastatic disease.

Key Words: *Multislice CT — Cancer pancreas — Staging Resectability.*

Introduction

ADENOCARCINOMA is the second most common cause of death from cancer. In clinical practice, pancreatic cancer is synonymous with pancreatic ductal adenocarcinoma, which constitutes 90% of all primary malignant tumors arising from the pancreatic gland. Tumors may arise from pancreatic ducts (99%) or from acinar cells (1%). More than 90% of pancreatic cancers appear in the late stage of disease; this observation emphasizes the role of radiology in early detection and determination of resectability of the tumor by assessment of its local and distant spread and its relationship to surrounding vasculature, and the results determine the possibility of curative resection.

The diagnosis of pancreatic cancer is rarely made at an early stage. This is one of the main reasons for failing to achieve a cure in most patients [1].

There is much debate concerning the sensitivity and specificity of imaging investigations in the diagnosis and staging of pancreatic carcinoma.

Multislice computed tomography (CT) scanning is generally accepted to be the first line of investigation in a patient with suspected pancreatic cancer. The reasons for this preference include its wide availability, speed, thin sections, optimal enhancement, high spatial resolution, and consistently good images [1].

The introduction of multidetector-row scanners has facilitated the acquisition of images during multiple phases of intravenous contrast administration. Utilization of a pancreatic parenchymal phase, using a scan delay of 40s has resulted in superior pancreatic parenchymal enhancement. In some studies, this has led to superior tumor-to-parenchymal contrast differences, facilitating superior tumor detection, when compared to portal venous or delayed phases of imaging [2]. The

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List of Abbreviations:
3-D : Three-dimensional.
FOV : Field of view.
HQ : High quality.
HS : High speed.
MDCT : Multidetector computed tomography.
MIP : Maximum intensity projection.
SDCT : Single detector computed tomography.

information obtained from these multiphase exams was used to generate 3D images of the arterial, venous and pancreatico-biliary anatomy **[3-5].** These in selected cases are useful for surgical planning also help to determine presence or absence of hepatic focal lesions **[6].**

Material and Methods

Twenty patients (16 males and 4 females) referred to the radiology department NCI from June 2012 to Feb. 2013 with pancreatic masses or symptoms suggestive of pancreatic disease, their ages range from 40-66 years with mean age was 53. Multislice CT 64GE detectors used, Triphasic study was performed (pre-contrast, arterial pancreatic phase, porto-venous phase and delayed phase). Findings are matched with histopathological results, clinical and surgical data for operable cases. All of our patients underwent clinical history, physical examination, laboratory work-up (cell blood count, serum creatinine, urea, liver function tests). Oral water 750-1000m1 was given as negative intraluminal contrast in some cases diluted gastrographin was given, 120-150mL of iodinated contrast material intravenously administered at a rate of 3-4mL/s, and scanning with thin (2- to 3-mm) collimation during pancreatic parenchymal phase (at 25-35s) with the liver phase obtained at 60-70s FOV 20-25, 1.25 HS table speed of lcm/sec (7.5mm/0 8sec), cover from 1 cm above celiac axis to 3rd part of duodenum 3-D reformations using volume rendering and/or MIP, with curved planar reconstruction along major vessels.

*Pancreatic parenchymal phase (PPP):*25-35-sec delay, 2 5mm w/5mm recon interval HQ, table speed 1 cm/sec (7.5mm/0 8), same coverage area, both AP and PPP acquired during single breath hold. 3-D reformations using volume rendering and or curved planar reconstruction along ducts.

Portal venous phase (PVP): 60-sec delay, larger FOV, diaphragm to iliac crest, 5-mm collimation w/5mm recon in HQ table speed of lcm/sec (7 5mm /0.8 sec).

Optimal technique for mass detection now include thin section scanning in the pancreatic parenchymal phase, followed by scanning through the entire abdomen and pelvis in the portal venous phase **[7].**

Results

Pathology revealed pancreatic adenocarcinoma in 19 out of 20 patients. Only one case fine needle aspiration revealed inflammatory process and managed conservatively. The following tables showed variable findings observed in these cases regarding site of the primary lesion within the pancreas, extra-pancreatic extension and vascular involvement (Tables 1-3 respectively).

Table (1)

Item of study	Site of lesion					
	Head	Body	Neck	Tail	Body & Head	Body & Neck	Body & Tail
No. of cases	10	4	1	1	4		

Table (2)

Item of study	Extra-pancreatic extension							
	Direct invasion							Distant
	Fat stranding mesenteric invasion	Splenic invasion	Bowel invasion	Stomach invasion	Left kidney	Liver	Lymph nodes	Hepatic focal lesions
No. of cases	9	4	3	3	1	1	4	8

Table (3)

Item of study	Vascular involvement							
	Arterial					Venous		
	Celiac artery	Splenic artery	Hepatic artery	Superior mesenteric artery	Left renal artery	Portal vein	Splenic vein	Superior mesenteric vein
No. of cases	4	12	4	5	1	2	8	12

Fig. (1): 50 years old male presented with obstructive jaundice. Multislice CT axial image showed pancreatic head lesion, encasing the celiac trunk and significantly dilated pancreatic duct as well as intrahepatic biliary radicles dilatation. The lesion confirmed by fine needle aspiration biopsy as adenocarcinoma.

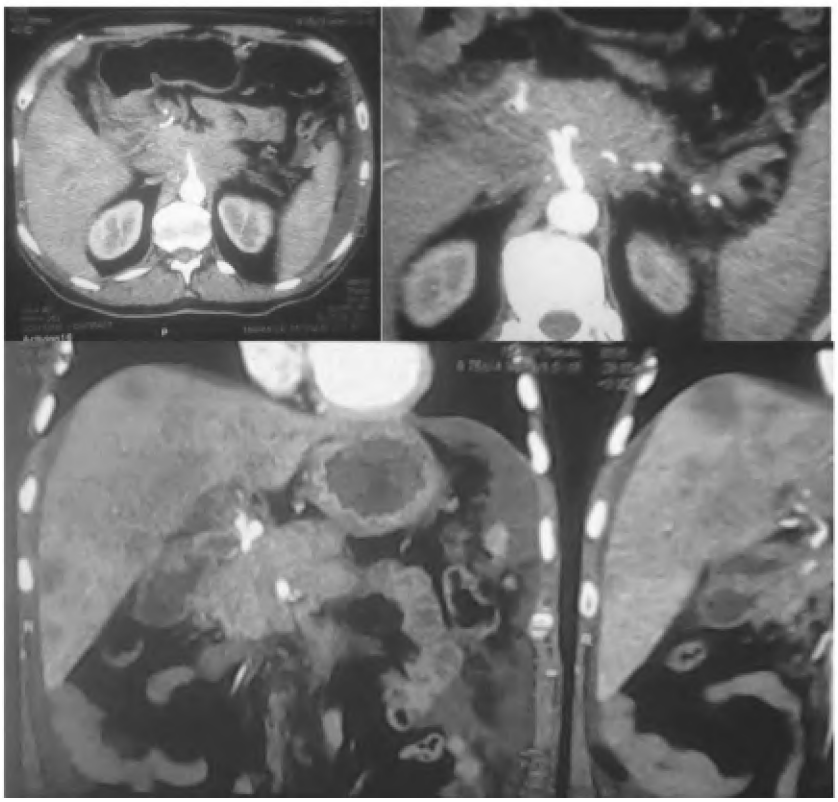

Fig. (2): 60 years old male presented with vague abdominal pain. Multislice CT showed heterogeneously enhancing pancreatic body lesion, encasing the celiac trunk and superior mesenteric artery infiltrating the posterior gastric wall as well as the duodenal wall with multiple hepatic focal lesion confirmed by fine needle aspiration biopsy as adenocarcinoma.

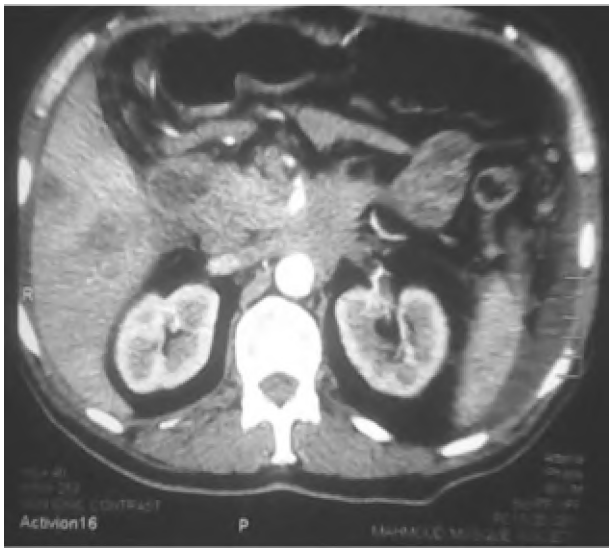

Fig. (3): Multislice CT axial image arterial phase showed superior mesenteric artery encasement and hepatic focal lesions are detected as well as perihepatic and perisplenic fluid collection.

Fig. (4): Multislice CT axial image venous phase showed pancreatic mass with superior mesenteric vein more than 50% contact. Note superior mesenteric artery separated from the mass by fat plane.

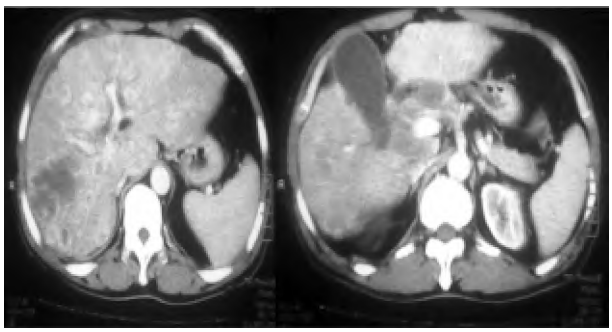

Fig. (5): Multislice CT axial image showed hypodense soft tissue mass at the head of pancreas extending into the uncinated process as well as neck of pancreas associated with multiple bilobar variable sized and density hepatic focal lesions some showed "target sign" metastatic deposits.

Discussion

Multislice CT is excellent in evaluating pancreatic tumors and assessing its local and distant spread so detecting unresectable tumors.

Most of our cases (16 cases) (80%) were inoperable at time of diagnosis, vascular encasement seen in 16 out of 20 cases, superior mesenteric vein and splenic artery are seen involved in 12 out of 20 patients, superior mesenteric artery 5 cases, Celiac trunk involved in 4 cases and portal vein 2 cases. Only 3 out of 19 are operated because of early disease. With the use of newer multislice helical CT scanners, previous studies showed the tumor detection rates have improved to around 90-95%, the positive predictive values for resectability are slightly above 80% [21. However in our study the probability of tumor resection is reduced as most of cases are advanced at time of presentation. In all cases presented with pancreatic tail affection (4 cases presented with pancreatic tail lesion & 4 cases presented with pancreatic body & tail lesions) liver metastasis is seen and the patients not operated upon, in contrast the cases presented with pancreatic head lesions only one presented with hepatic metastasis and obstructive jaundice making detection more earlier, however, they presented with vascular encasement in 8 of 10 cases also hindering their resectability.

Adenocarcinoma of the pancreas is the tumor most likely to spread beyond the organ of origin at diagnosis [81.

In our study we detected different types of tumor spread to different intraperitoneal and retroperitoneal structures as kidney seen in one case, spleen in 4 cases. Stomach and bowel affection of tumor seen in 3 cases as well as regional lymph nodes affection seen in 4 cases.

Encasement of 100% of an adjacent vessel has long been known to indicate nonresectable tumor as seen in 16 of our cases. Using SDCT, Lu et al. 191 set out to determine the criteria for non resectability of major splanchnic vessels, grading the celiac axis, hepatic artery, superior mesenteric artery (SMA), portal vein and SMV on a scale of 1 to 4 for vessel involvement by tumor. Grade 1 equals tumor contiguous to less than 25% vessel circumference, grade 2 equals tumor contiguous to 25% to 50% vessel circumference, grade 3 equals tumor contiguous to 50% to 75% vessel circumference, and grade 4 equals more than 75% tumor contiguous to vessel circumference or any vasoconstriction. Cut off between grade 2, representing a resectable lesion, and grade 3, representing an

unresectable lesion, yielded the lowest number of false negatives and acceptable false positives, with sensitivity and specificity for unresectability reaching 84% and 98%, and positive predictive value and negative predictive value reaching 95%.

As a general rule, involvement of any vessel by tumor exceeding 50%, or 180 degrees of the circumference is highly specific for unresectable tumor **[7]**. This is especially true of the arteries (Figs. 3,4). Parameters for unresectable venous involvement are more variable. In some studies, alteration of vein lumen shape, obliteration of the vein, and thrombosis, rather than contiguity of more than 50% circumference, are required before the tumor is deemed unresectable **[10].**

There is more room for false positives in predicting significant venous involvement because some surgeons more aggressively resect and graft the superior mesenteric vein and portal confluence in an attempt to cure the patient **[6].**

The most common sites of metastases are liver seen in 9 out of 19 patients (in one case by direct tumoral extension and as metastatic disease in 8 cases).

The only chance for cure in the small number of patients without obvious spread is surgical resection, most commonly a Whipple procedure or Whipple variant. These procedures carry up to a 25% mortality rate, decreasing to 5% in experienced hands **[8].**

With respect to the evaluation of a known or suspected pancreatic mass, the goals of CT are to confirm the diagnosis by detecting and localizing the mass and to evaluate the extent of disease in anticipation of potential resection. In the case of pancreatic adenocarcinoma, exclusion of hepatic and peritoneal metastases and evaluation of local extension of tumor into the peripancreatic tissues, lymph nodes, and most importantly the critical arterial (superior mesenteric artery, celiac axis, hepatic artery) and venous (superior mesenteric vein, portal confluence, main portal vein) structures to predict resectability of the lesion are desired. With CT angiography (CTA), the goal of preoperative vascular mapping in patients who are potential candidates to undergo Whipple procedure is to clearly define the angiographic map with an accuracy equal to classic angiography and to depict the relationship of the mass to potentially invaded vessels, attempting to differentiate between abutment and invasion of vessels along their course. With axial images alone, narrowing or constriction of vessels may be difficult to judge **1111.** In addition to CTA, optimal techniques for mass detection now include thin section scanning in the pancreatic parenchymal phase, followed by scanning through the entire abdomen and pelvis in the portal venous phase. Generally, a precontrast study through the pancreas to localize the area to be studied after IV contrast enhancement is performed with thicker section images.

In the case of functional neuroendocrine tumors of the pancreas, the arterial phase helps to identify hyperenhancing lesions, which may be multiple or located in a peripancreatic location **[7]**.

Conclusion:

MSCT is useful to confirm and stage pancreatic tumors. Further progress in preoperative staging of pancreatic ductal adenocarcinoma using multislice CT tripahsic technique should be directed toward early detection of small pancreatic tumors improving its probable resectability.

References

1- NANCY J. McNULTY, ISAAC R. FRANCIS, JOEL F. PLATT, RICHARD H. COHAN, MELVYN KOROBKIN and ACHAMYELEH G.: Multi-Detector Row Helical CT of the Pancreas: Effect of Contrast-enhanced Multiphasic Imaging on Enhancement of the Pancreas, Peripancreatic Vasculature and Pancreatic Adenocarcinoma. Radiology, 220: 97-102, 2001.

2- ISAAC R. FRANCIS: Role of CT in detection and staging of pancreatic carcinoma, Cancer Imaging, 4 (1): 10-14, 2004.

3- MAHESH KUMAR: Chief Editor: John Karani, Colm Boylan, Narainder Gupta, pancreatic adenocarcinoma imaging, Medscape reference, Update Sep., 2011.

4- CATALANO C., LAGHI A., FRAIOLI F., et al.: Pancreatic carcinoma: The role of high resolution multislice spiral CT in the diagnosis and assessment of resectability. Eur. Radiol., 13: 149-156, 2003.

5- HORTON K.M. and FISHMAN E.K.: Multidetector CT angiography of pancreatic carcinoma: Part I: evaluation of arterial involvement. Am. J. Roentgenol., 178: 827-832, 2002.

6- KALBHEN C.L., YETTER E.M., OLSON M.C., et al.: Assessing the resectability of pancreatic carcinoma: The value of reinterpreting abdominal CT performed at other institutions. AJR Am. J. Roentgenol., 198 (3): 628-634, 2012.

7- LEE, JOSEPH K.T., SAGEL, STUART S., STANLEY, et al.: Title: Computed Body Tomography with MRI Correlation 4th edition. Lippincott Williams & Wilkins of all the GI malignancies, Pancreatic, 1 (15): 1034-1039, 2006.

8- JOHNSON P.T., HEATH D.G., HOFMANN L.V., et al.: Multidetector-row computed tomography with three-

dimensional volume rendering of pancreatic cancer: A complete preoperative staging toll using computed tomography angiography and volume-rendered cholangiopancreatography. J. Comput Assist Tomogr., 27: 347-53, 2003.

9- LU D.S.K., REBER H.A., KRASNY R.M., et al.: Local staging of pancreatic cancer: Criteria for unresectability of major vessels as revealed by pancreatic-phase thin-section helical CT. AJR Am. J. Roentgenol., 168: 1439-1443, 1997.

10- VALLS C., ANDIA E., SANCHEZ A., et al.: Dual phase helical CT of pancreatic adenocarcinoma: Assessment of resectability before surgery. AJR Am. J. Roentgenol., 178: 821-826, 2002.

11- DARREN D. BRENNAN, GIULIA ZAMBONI, JACOB SOSNA, MARK P. CALLERY, CHARLES M.V. VOLLMER, et al.: Virtual Whipple: Preoperative Surgical Planning with Volume-Rendered MDCT Images to Identify Arterial Variants Relevant to the Whipple Procedure. AJR, 188: W451-W455, 2007.