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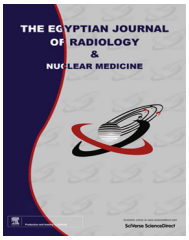

ORIGINAL ARTICLE

Assessment of vascular invasion in pancreatic carcinoma by MDCT

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KEYWORDS

Pancreatic;
Carcinoma;
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Abstract *Background:* Pancreatic cancer is one of the aggressive cancers with poor resectability and survival rates. The relationship to adjacent vessels must be assessed before deciding the choice of treatment.

Aim: Assessment of the MDCT signs of arterial and venous invasion in pancreatic carcinoma.

Subjects and methods: Total of 179 of the major peripancreatic vessels (CA; CHA; SMA; PV; SMV) in 47 patients who underwent surgery for pancreatic cancer after MDCT were assessed at surgery and compared with CT findings. Statistical analysis of the findings was done using Chi square test.

Results: 115 vessels were not invaded at surgery, while the remaining 64 vessels were invaded (22 arteries and 42 veins). There was over all statistically significant difference between arterial and venous invasion regarding stenosis, occlusion, infiltration and circumferential involvement of the vessel wall.

Conclusion: Assessment of vascular invasion is crucial in the evaluation of resectability for pancreatic cancer. MDCT is an accurate diagnostic tool for peripancreatic vascular invasion in cancer pancreas.

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1. Introduction

Pancreatic cancer is considered one of the most deadly and aggressive cancers. The resectability and 5-year survival rates for pancreatic cancer are still very poor with survival rates for cancers of the pancreatic body and tail about 10% & that for pancreatic head about 19% (1–4). The complication rates of pancreatic surgery are approximately 40%. It is therefore crucial to correctly identify patients who would most benefit from surgery i.e., those with lesions potentially responsive to curative resection, and reduce as much as possible the number of unnecessary laparotomies (5). In addition to diagnosing and

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staging a pancreatic carcinoma, the relationship of the tumor to major peripancreatic vessels, including celiac artery (CA); common hepatic artery (CHA); superior mesenteric artery (SMA); portal vein (PV); superior mesenteric vein (SMV) must be thoroughly assessed, since their involvement can preclude resection (6). CT is the established method for diagnosing and staging pancreatic carcinoma (7,8). The introduction of MDCT has allowed further refinements in detecting pancreatic adenocarcinoma and in determining unresectability (8–11). Multi-detector row CT (MDCT) scanning of the pancreas enables multiphasic thin collimation scanning, with excellent spatial resolution, especially in the z-plane (9). These volume data sets can be easily manipulated with three-dimensional imaging, potentially providing additional information to conventional axial scans (12).

2. Aim of work

The purpose of our study was to assess the MDCT signs of arterial and venous invasion in pancreatic carcinoma.

3. Patients and methods

Between October 2010 and March 2013, 112 consecutive patients with suspected pancreatic carcinoma underwent biphasic MDCT for pancreatic examination.

3.1. Examination techniques

The following multi-detector CT scanners were used to examine the patients: (TOSHIBA Aquilion 16, Toshiba Medical systems, Japan) for 82 patients, and (Siemens Emotion 16; Siemens, Erlangen, Germany) for 30 patients, 600–800 ml of water or water soluble contrast agent was given orally to patients prior to the study to distend stomach, duodenum & proximal jejunum. Each patient received 100 ml of non-ionic contrast material (iopromide 370 mg/ml; Ultravist; Schering, Berlin, Germany) via intravenous injection at the rate of 4 ml/s. Unenhanced and biphasic, late arterial phase and portal venous phase, enhanced scans were performed. We routinely use bolus tracking, positioning a region of interest on the abdominal aorta at the level of the celiac axis and using an enhancement threshold of 110 HU, late arterial phase (10-s delay from the time of peak aortic enhancement), and a portal venous phase (35-s delay).

The CT examinations were performed in the cranio-caudal direction. The following scanning parameters were used for both 16-channel multi-detector CT scanners: detector configurations of 16×0.75 mm, section thickness of 3.0 mm reconstruction intervals of 1.5 mm for both scanners, table speeds of 17.0 mm per rotation, effective amperage settings of 200 mAs; rotation times of 0.5 s; tube voltage of 120 kVp; and a matrix of 512×512.

3.2. Image analysis and surgical correlation

Pancreatic tumor relation to major peripancreatic vessels, including celiac artery (CA); common hepatic artery (CHA); superior mesenteric artery (SMA); portal vein (PV); and superior mesenteric vein (SMV), was determined preoperatively at consensus reading of axial CT source images combined with post-processed images by two radiologists using the following criteria:

1. Contiguity of tumor with the adjacent vessel was graded A, D based on that suggested by Li et al. (13) and the template provided by Gottlieb et al. (14): Grade A, fat plane or normal pancreatic tissue visible between tumor and vessel; Grade B (*Abutment*) and Grade C (*Encasement*), tumor surrounding of less than and more than 50% of the vessel circumference respectively; Grade D, arterial embedment in tumor or venous occlusion.
2. Detailed vascular anatomic deformation: vessel stenosis presented a semi-circular or concentric smaller contour of the vessel. A straight contour on one side was regarded as flattened, not as stenosis. Vessel wall infiltration presented as irregular and indented shape at the vascular margin abutting tumor.

At surgery, 179 out of 235 vessels were properly assessed, the remaining 56 vessels were inadequately assessed either due to deeply seated vessels or matting with adjacent structures. The surgical criterion of tumor ingrowth into the vessels was that the vessel could be observed, or found by palpation to be infiltrated or occluded at surgery. Easy separation of an adherent vessel from its surrounding tissue during surgery was a clinical sign of perivascular adhesion due to inflammatory or fibrotic reaction rather than tumor invasion.

An informed consent was taken from all patients before performing the MDCT and surgery after explanation of the procedures and their benefits or potential hazards. All data collected were coded to insure patient privacy.

3.3. Statistical analysis

Chi-square tests were performed on the difference between the number of affected arteries and veins, and on the MDCT signs: (a) vessels showing stenosis or occlusion; (b) vessels showing wall irregularity; (c) tumor surrounding more than 50% of the vessel circumference; to check for any significant difference between the invaded arteries and veins. A P value of < 0.05

Table 1 Grade A, C: the grade of contiguity of tumor with the adjacent (115) non-invaded vessels (SMA, superior mesenteric artery; CA, celiac artery; CHA, common hepatic artery; PV, portal vein; SMV, superior mesenteric vein).

	SMA	CA	CHA	PV	SMV	Total
Grade A	15	20	22	27	16	100
Grade B < 50% Abutment	3	1		2	3	9
Grade C > 50% Encasement	1		1		4	6
Total	19	21	23	29	23	115

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