

EDITORIAL

Using Multidetector Row Computed Tomography to Diagnose and Stage Pancreatic Carcinoma: the Problems and the Possibilities

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Summary

The sensitivity of computed tomography (CT) in the diagnosis of pancreatic neoplasms and accurate tumor staging has significantly been improved by the use of thin-section multi-detector row CT techniques. Greater table speed, improved tube cooling, high resolution imaging and the possibility of isotropic voxels have led to optimal multiplanar reconstruction in any arbitrary plane and particularly along the pancreatic duct and peripancreatic vessels, significantly improving the detection of small pancreatic tumors and surgical resectability where imaging modalities have so far yielded disappointing results. Nonetheless, while multi-detector row CT has greatly enhanced the imaging capabilities of CT, early diagnosis is practically impossible to achieve, since the tumor remains asymptomatic until the surrounding structures are involved. Furthermore, even when treated with radical surgery, the incidence of recurrence is high and the prognosis of pancreatic carcinoma still remains extremely poor and has not changed over the past years. In this article, the recent technical developments of multi-detector row CT in diagnosing pancreatic neoplasms and staging are considered, with special emphasis on multi-detector row CT angiography techniques and curved planar reformations. Some remaining challenging

problems such as the pre-operative identification and characterization of small hepatic lesions and detection of omental and peritoneal metastasis, the diagnosis of small isoattenuating pancreatic adenocarcinomas and promising strategies to differentiate between pancreatic adenocarcinoma and chronic inflammatory changes are also presented.

Pancreatic ductal adenocarcinoma is one of the most aggressive human malignancies. It represents the fourth most frequent cause of cancer-related death and the second most frequent cause, after colorectal cancer, when considering digestive tract cancers alone [1]. The incidence of pancreatic adenocarcinoma is still increasing; because of its silent course, late clinical symptoms and rapid growth patterns, it has been named the “silent killer” [2, 3].

Ductal adenocarcinoma accounts for about 80-90% of all of the exocrine pancreatic tumors and is mainly located in the pancreatic head (80-90% in the surgical series) [1]; at the level of the pancreatic head, the average size is 2-3 cm. With the exception of tumors arising in the uncinate process, small tumors and tumors arising from the anterior region of the head [4], pancreatic head adenocarcinoma almost always infiltrates the common bile

duct and the duct of Wirsung, causing jaundice and obstructive chronic pancreatitis respectively. From a clinical point of view, the earliest clinical sign is jaundice which precedes tumor encasement of the peripancreatic vessels. Nonetheless, the same jaundice is typically associated with an advanced tumor stage.

The only effective treatment for pancreatic adenocarcinoma is surgical resection. Criteria for surgical unresectability includes liver metastasis, contiguous invasion of the adjacent organs such as the stomach and colon, major vascular invasion, lymph node metastasis and peritoneal carcinomatosis. Therefore, the main role of preoperative staging is to distinguish between potentially resectable and clearly unresectable patients [5]. Today, because of recent improvements in radiological techniques, a wide range of imaging modalities are now available, such as multi-detector row computed tomography (MDCT), magnetic resonance imaging (MRI), endoscopic sonography, retrograde cholangiopancreatography, and angiography. Traditionally, contrast-enhanced single-slice helical CT has been considered a reliable tool in diagnosing and staging pancreatic adenocarcinoma with a reported sensitivity of as high as 97% in the detection of pancreatic cancer, an accuracy of staging as high as 93%, and positive predictive values for surgical unresectability between 89 and 100% [6, 7, 8, 9, 10]. Today, no consensus exists as to the best staging algorithm; however, the increasing availability and performance of MDCT scanners is now having a major impact on the imaging of pancreatic cancer. Unlike the old single-slice helical CT scanners, the MDCT technology allows the acquisition of entire, large volumes which can be easily and quickly managed with three-dimensional imaging in order to provide “new, advanced CT imaging” consisting of angiographic maps (“MDCT-angiography”) of the key vascular structures potentially involved with tumor extension and optimal curved planar reformations of the pancreatic gland and the bile duct system [11, 12, 13, 14]. These emerging technical developments

have constituted one of the greatest breakthroughs in diagnostic radiology and, particularly, in CT technology [15]. The most important clinical utility of CT-angiography techniques and curved planar reformations consists in their ability to provide a unique, optimal and rapid overview of the anatomy of the patient and pertinent strictures providing radiologists and referring clinicians additional perspectives. MDCT-angiography has become an excellent non-invasive technique, particularly helpful in evaluating the vessels surrounding the pancreas such as the hepatic, splenic and superior mesenteric arteries. These vessels are best evaluated with curved planar images, and the relationship between the tumor and the vessels determines surgical resectability [16, 17, 18, 19].

The same thing does not apply when we compare axial image and curved planar MDCT reformations for tumor detection and local staging of pancreatic carcinoma. In their preliminary experience Prokesch *et al.* found no significant difference between axial images and curved planar MDCT reformations in pancreatic tumor detection and staging [14].

Even using MDCT, the challenging problems which still remain in the diagnosis and staging of pancreatic carcinomas should be pointed out: 1) pre-operative identification and characterization of small hepatic lesions and detection of omental, nodal and peritoneal metastasis, 2) the diagnosis of isoattenuating pancreatic adenocarcinomas and, 3) the differential diagnosis between pancreatic adenocarcinoma and chronic inflammatory changes.

The main limitation of dual-phase single slice computed tomography (SSCT) is that it may not reveal small hepatic metastases (average size 8 mm) [6]; thus, approximately 25-30% of patients who are considered to have resectable disease at SSCT have unresectable lesions at surgery. Because liver and peritoneal metastatic implants may measure only 1 or 2 mm in size, some institutions usually perform a pre-operative laparoscopy before the patient is subjected to surgery if SSCT is negative. By acquiring thinner and

thinner slices, MDCT is able to detect smaller and smaller peritoneal and liver metastases; nonetheless, at present, no articles have yet been published with results and millimeter metastases may still pass undetected, even with MDCT [17].

For the most part, at CT, pancreatic adenocarcinomas appear as hypodense masses distorting the pancreatic contour and have associated findings such as a dilated pancreatic duct and common bile duct, atrophy of the remaining gland, vascular invasion and metastases to the lymph nodes, liver, and peritoneal cavity [16]. However, even with a tailored study protocol, some pancreatic adenocarcinomas may be undetected at MDCT because of being isoattenuating to normal pancreatic parenchyma. In these cases, indirect, secondary signs such as mass effect, an atrophic distal parenchyma and signs of an interrupted duct may all be important clues of the presence of a tumor [20]. Such adenocarcinomas account for a substantial number of pancreatic tumors in the general population and represent a challenge for early detection, despite the use of optimal scanning parameters [20]. Finally, one remaining diagnostic challenge is the differentiation between early pancreatic adenocarcinoma and a focal chronic inflammatory mass (“pseudotumor pancreatitis”). A differential diagnosis is difficult because masses resulting from both chronic pancreatitis and pancreatic carcinoma have a greater degree of histologic fibrosis content and may thus show a similar enhancement pattern on CT or dynamic gadolinium MR imaging [21, 22, 23, 24]. Therefore, three new promising diagnostic strategies are now being developed in an attempt to reach a differential diagnosis [25]. The first approach is based on the analysis of the morphology of the main pancreatic duct, whose visualization and characterization is improved by the increased temporal and spatial resolution of MDCT and the use of curved multiplanar reformations and minimum intensity projections to generate cholangiopancreatography (CTCP) images. Initial studies by Raptopoulos *et al.* have

demonstrated no significant statistic difference between CTCP and endoscopic retrograde cholangiopancreatography (ERCP) [26]. The second approach focuses on a detailed multiphasic perfusion analysis of the pancreatic parenchyma, which is optimized by the use of MDCT in each phase of the pancreatic study. Finally, the third strategy is secretin-assisted CT which may lead to both a better depiction of the pancreatic ductal system and greater enhancement of the pancreatic gland [27].

Despite developments in MRI and US, CT remains the modality most frequently used for the detection and staging of pancreatic carcinoma. Newer capabilities and clinical applications have led to an increasing use of MDCT, which increased the amount of radiation exposure received by patients [28]. However, although the technological revolution in MDCT has led to a more precise depiction of the macroscopic features of pancreatic carcinomas as well as the surrounding structures potentially involved, early diagnosis is practically impossible to achieve and the prognosis still remains poor. This depends mainly on the biological characteristics of the tumor, its pattern of growth, its strong neurotropism, and its rich peripancreatic vascular, lymphatic and neurologic network. We hope that, in the future, new developments in the field of genetics, biochemistry and biology, will invert the natural history of this highly aggressive human cancer.

Keywords Carcinoma; Pancreas; Tomography, X-Ray Computed

Abbreviations CTCP: CT-cholangiopancreatography; MDCT: multi-detector row computed tomography; SSCT: single slice computed tomography

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