PANCREATIC CANCER CT IMAGING: COMPARISON WITH SURGERY

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PANCREATIC CANCER CT IMAGING: COMPARISON WITH SURGERY (Abstract): Aim: To establish the best protocol for pancreatic computer tomography and criteria for staging (mainly for vascular invasion). Material and methods: Our research included 49 consecutive patients with pancreatic cancer examined at the Iasi “Sf. Spiridon” Hospital between January and December 2014 with a Siemens 16 Emotion CT unit. CT protocol included no enhanced CT and pancreatic phase of the superior abdomen, portal venous phase of the abdomen and pelvis. Results and discussion: The study patients were stratified into 5 age groups and the most frequently affected by pancreatic cancer were the patients aged 60 to 79 years. For T staging the extension in the per pancreatic fat tissue, into surrounding organs (5 patients had extension in other organs) and vessels was evaluated. We determined the degree of contact between the tumor and the artery, thrombosis and deformity of the veins and we have found 8 resectable lesions, 28 tumors in stage T3 and 13 pancreatic cancers in stage T4. Thirty-three patients had lymphadenopathies and 31 of them had distant metastases. Conclusions: Our study proved that computed tomography is a good method of examination for pancreatic cancer when the right imaging protocol is used; during the pancreatic phase the arteries and the tumor are well depicted, liver metastases are best evaluated during the portal venous phase. The best criterion for arterial invasion is tumor contiguity with more than half of vessel circumference, and for vein invasion deformity or thrombosis. Comparison with surgical staging was a good backup for the radiologist and depicted several differences with imaging staging, more often understating than over staging. Keywords: PANCREATIC CANCER, VASCULAR INVASION, COMPUTED TOMOGRAPHY

The incidence rates for exocrine pancreatic cancer worldwide equal its mortality rates (5%) and the main risk factors are diabetes mellitus, chronic pancreatitis, biliary stones, and smoking (1,2). The most frequent pancreatic malignancy is ductal adenocarcinoma which has nonspecific symptoms and blood tests, so imaging methods are very important for the diagnosis.Computed tomography (CT) is the method of choice for pretherapeutic evaluation of pancreatic malignant tumors (evaluates with maximum accuracy the tumoral extension into surrounding organs, vessels, lymph node involvement, distant metastasis) and follow-up after treatment (3,4). CT is widely available and is a validated tool for the diagnosis of pancreatic malignan-
cies because it depicts the tumor mass (with maximum lesion-to pancreatic parenchyma attenuation difference during the pancreatic phase), evaluates very well the arterial and venous invasion and detects hepatic metastases (5, 6). CT is widely available and is a validated tool for the diagnosis of pancreatic malignancies because depicts the tumor, evaluates very well the invasion in arteries and veins and detects hepatic metastases (5, 6). Computed tomography depicts in case of pancreatic cancer a poorly defined, isodense mass on non-enhanced CT which becomes hypo attenuating after contrast medium injection; the maximal contrast between the tumor and pancreatic parenchyma appears in fact in the pancreatic phase (between the arterial and portal venous phase) when the pancreas fully enhances and the tumor remains hypodense (7).

MATERIAL AND METHODS
Our research included 49 consecutive patients with pancreatic cancer examined at the Iasi “Sf. Spiridon” Hospital between January and December 2014 with a Siemens 16 Emotion CT unit; 36 (73.46 %) patients were surgically treated. The patients were examined in the morning, after digestive preparation (ingestion of 500 ml of 2% dilution of iodinated contrast medium). The imaging protocol included:

- non-enhanced CT of the superior abdomen,
- injection of 1-1.5 ml/kg, 370 – 400 mg I/ml nonionic hypoosmolar iodinated contrast medium, 3-3.5 ml per second;
- pancreatic phase of the superior abdomen – 20-30 seconds after the beginning of contrast medium injection;
- portal venous phase of the abdomen
and pelvic regions – 70 - 80 seconds after the beginning of contrast medium injection;
- equilibrium phase of the hepatic region – when we have to characterize liver lesions.

We have studied the per pancreatic (including the vascular extension) and distant extension of the tumor, vascular extension of each tumor and compared it with the surgical protocol. The results were processed and interpreted by statistical methods (tables, figures, p, trend).

RESULTS AND DISCUSSION
Age-group distribution. The patients were stratified into 5 age groups: 30-39 years (1 patient, 2.04 %), 50-59 (7; 14.28%), 60-69 (22; 44.89%), 70-79 (15; 30.61%) and over 80 (4; 8.16%).

Gender distribution. The gender differences in prevalence were significant (p<0.05), 31 (63.26 %) of patients being males and 18 (36.73 %) females.

Computed tomography depicts in case of pancreatic cancer a poorly defined, isodense mass on non-enhanced CT which becomes hypo attenuating after contrast medium injection; the maximum tumor-to pancreatic parenchyma contrast occurs in fact during the pancreatic phase (between the arterial and portal venous phase) when the pancreas fully enhances and the tumor remains hypodense (7).

Criteria for resectability of pancreatic cancer are: lack of distant metastasis, no invasion of superior mesenteric and celiac arteries, and limited invasion of superior mesenteric vein to allow vein reconstruction (8, 9). In all cases of pancreatic cancer, according to the data in the literature, computed tomography depicted a poorly defined, isodense mass on non-enhanced CT, which became hypo attenuating after con-
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Contrast medium injection (with the maximum contrast between the tumor and pancreatic parenchyma in the pancreatic phase) (7). For T staging we evaluated the extension into the per pancreatic fat tissue (present in 10 cases – 20.40%), surrounding organs (5–10.20% patients had extension into other organs, such as duodenum, jejunum, stomach) and vessels, but in fact vascular invasion of the superior mesenteric artery and vein and of the celiac artery is essential. We have found 8 (16.32%) resectable lesions (T1 and T2 tumors), 28 (57.14%) tumors in stage T3 (locally advanced but potentially resectable) and 13 (26.53%) pancreatic cancers in stage T4 (unresectable tumors).

All vessels around the pancreas were examined in 3 planes (axial sections, sagittal and coronal reconstructions) and the degree of contact between the tumor and the vessel, stenosis, thrombosis and deformity was determined. The criteria used for assessing the vascular extension were the degree of contact between the tumor and the artery and for veins we added deformity and thrombosis. Tumoral invasion was found in 74 vessels: 40 (49.38%) arteries (5–6.17% celiac artery, 8–9.87% hepatic artery, 8–9.87% superior mesenteric artery, 19–23.45 splenic artery) and in 34 (41.97%) veins (22–27.16% in the splenic vein and 12–14.81% in superior mesenteric vein). Of the tumors with vascular extension only 13 (26.53%) were not resectable (the ones with invasion of the celiac artery and superior mesenteric artery) and 28 were locally advanced (venous extension to one or more than one vein) (fig. 1).

In vascular invasion cases we found: contiguity of tumor to vessel on 75-100% of the circumference in 20 cases (24.69%), 50-75% in 9 (11.11%) cases, and 25-50% in 16 (19.75%) cases, venous thrombosis in 18 (22.22%) and venous deformity in 11 (13.58%) cases. Tumor-to-vessel contiguity of less than 25% was found in 7 (8.64%) cases and was not considered predictive for vascular invasion. Comparing with surgery we had only 3 (3.70%) cases of under staged vascular invasion and the best correlation between CT imaging and surgical reports for vascular invasion was contiguity of tumor to vessel on more than 50% of the circumference.

![Abdominal CT, pancreatic phase](image1)

Fig. 1. Abdominal CT, pancreatic phase a – axial sections, b - sagittal reformates: celiac artery invasion
Regional lymphadenopathies were considered present when lymph nodes measured more than 10 mm in axial diameter, but if the lymph nodes were round or had an important contrast medium uptake, an axial diameter of 5-6 mm was considered pathological (fig. 2). We found 33 (67.34%) patients with lymph node enlargement; when comparing CT with surgical findings, 3 (6.12%) patients were under staged and 2 (4.08%) patients over staged.

Liver metastases are usually hypodense nodular lesions on non-enhanced and contrast enhanced CT and in our study we found 25 (51.02%) patients with typical pattern of liver metastasis. Comparing the CT diagnosis with pathological findings we found 3 more cases with secondary hepatic lesions, under staging being due to the fact that CT missed the isodense or small lesions (less than 10 mm in diameter). Peritoneal carcinomatosis was found in 6 cases (ascites, soft tissue infiltration of the omentum and nodular peritoneal thickening of the), compared with 10 cases at surgery (small lesions were not visible at CT) (fig. 3).

![Fig. 2. Abdominal CT, portal venous phase a, b - lymphadenopathies](image1)

![Fig. 3. Abdominal CT, portal venous phase – a - peritoneal carcinomatosis, b – hepatic metastases](image2)
Comparing CT imaging of pancreatic cancer extension with surgical evaluation, more cases of under staging than over staging were found (tab. I).

**TABLE I**

Pancreatic cancer extension - comparison between computed tomography and surgery

<table>
<thead>
<tr>
<th>CT versus surgery</th>
<th>No.</th>
<th>%</th>
</tr>
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<tr>
<td>Vascular invasion over staged</td>
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<td>0 %</td>
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<tr>
<td>Vascular invasion under staged</td>
<td>3</td>
<td>3.70</td>
</tr>
<tr>
<td>Lymph nodes over staged</td>
<td>2</td>
<td>4.08</td>
</tr>
<tr>
<td>Lymph nodes under staged</td>
<td>3</td>
<td>6.12</td>
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<tr>
<td>Hepatic metastases over staged</td>
<td>0</td>
<td>0 %</td>
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<tr>
<td>Hepatic metastases under staged</td>
<td>3</td>
<td>6.12</td>
</tr>
<tr>
<td>Peritoneal carcinomatosis over staged</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td>Peritoneal carcinomatosis under staged</td>
<td>4</td>
<td>8.16</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

Our study demonstrates that computed tomography is a good method for examination of pancreatic cancer when the right imaging protocol is used; the arteries and the tumor are well depicted during the pancreatic phase and liver metastases are best evaluated during the in portal venous phase. The best criterion for arterial invasion is tumor contiguity to more than half of vessel perimeter, and for vein invasion deformity or thrombosis. Comparison with surgical staging was a good backup for the radiologist and depicted several differences with imaging staging, more often under staging than over staging.

**REFERENCES**