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CT ANGIOGRAPHY AND SURGICAL ASSESSMENT OF VESSELS' INFILTRATION BY PANCREATIC CARCINOMA

Pancreatic cancer is the second most common malignancy of the gastrointestinal tract. The only potentially curative treatment is complete surgical resection but it can be performed only in patients without metastatic disease and entire resection with negative surgically and microscopically margins (R0 resection). Complete resection of the tumour with vessels' involvement is still controversial. However, many authors proved that venous as well as arterial resection and reconstruction did not influence on final outcome. Proper preoperative staging helps in relevant treatment (surgery, radiochemotherapy or combination of these methods). The most common diagnostic step is MDCT with CTA which improves high sensitivity and specificity. The purpose of the study was to assess vessels' infiltration by pancreatic carcinoma on the basis of CTA and surgery. CTA showed 88,9% sensitivity in diagnosing vessel's involvement, however in some cases surgery is the method of choice in assessing tumours as resectable or unresectable.

1. BACKGROUND

Pancreatic cancer is the fourth leading cause of death among both men and women, the overall incidence of this cancer is approximately 8-10 cases per 100,000 in the world [5]. Polish data show similar percentage of incidences. At the time of diagnosis more than 50% of all patients have distant disease whereas 1-year survival rate is 24% and overall 5-year survival rate for this cancer is less than 5%. Such outcomes result from lack of early symptoms or very nonspecific ones, i.e. jaundice (can be early sign when the tumour is located in the head of pancreas), nonspecific epigastric pain with radiation to the back and weight loss (which usually appear in late stage carcinoma). Pancreatic carcinoma is often detected secondly to its metastases (liver, lungs or peritoneum) which can firstly demonstrate clinical symptoms. The use of proper imaging gives the chance of faster diagnosis however the recognition of small lesions is often missed. The most sensitive is endoscopic ultrasonography but it is still uncommon examination and CT remains the modality of choice.

A study by Ariyama et al [3] reported a 5-year survival rate of 100% for patients with limited tumours <1 cm in size and without parenchymal, vascular or lymphatic invasion. But the detection of such small cancers in that early stage is extremely rare. Recent studies report a sensitivity of 77% for the tumours that are <2 cm in size, with a specificity of 100% using multidetector-row CT (MDCT) [4]. Additionally performed examination, that is CTA, improves vascular infiltration recognition and helps to plan proper treatment of pancreatic cancer.

The aim of the study was a comparison of CTA and surgical assessment of the vessels' infiltration by pancreatic tumour.

2. MATERIALS AND METHODS

The study was performed on patients hospitalized at the Department of Gastrointestinal Surgery in Katowice from January 2006 to December 2006. The entry criteria included: clinical suspicion of pancreatic tumour diagnosed then by MDCT followed by CTA which showed vasculature of the tumour and the degree of vessels' involvement, finally the surgery with pathologically proven adenocarcinoma was performed. 18 patients were recruited (11 women, 7 men; mean age 61 years (41-80)). The CTA was performed in the Helimed CT Lab at Central Clinical Hospital in Katowice. The scans were taken by 16-slices GE LightSpeed scanner using dual phase pancreatic protocol (Fig.1) with 1,25 mm collimation. Contrast material (1,0 ml/kg) was injected intravenously at 3,0-3,5 ml/sec. with programmable power injector. Scan delay was controlled by SmartPrep (semi-automated software) in arterial phase (about 25 seconds after contrast administration) and portal phase (about 30 seconds after arterial phase). Each examination was assessed on transverse, sagittal, coronal and postprocessed reconstructed (multiplanar reconstruction and maximum intensity projection) scans.

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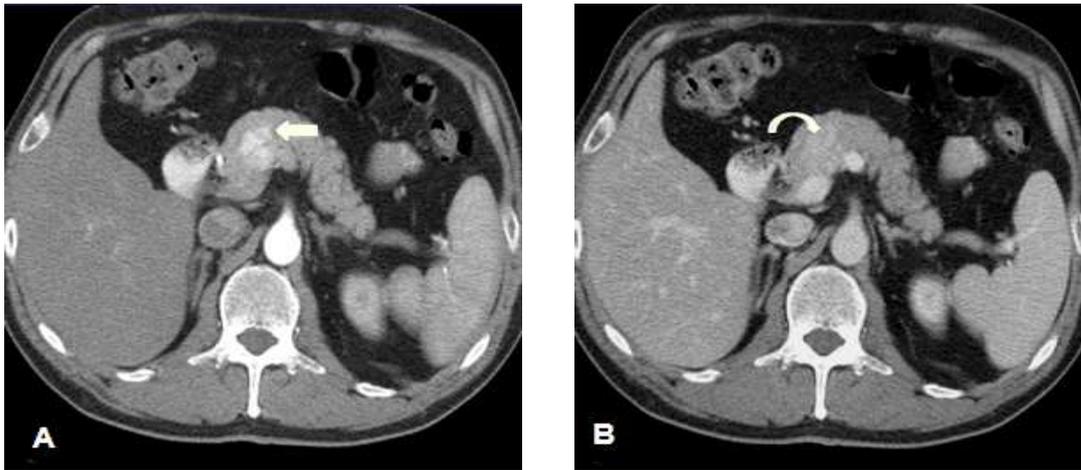


Fig. 1. Tumour localized in the head of pancreas:

A- arterial phase, tumor enhancement- straight arrow; B- portal venous phase, tumour almost not visible- curved arrow

On the basis of MDCT and then CTA examinations the size, location, attenuation of the tumour, the degree of vascular involvement by tumour and presence or absence of distant metastases were assessed. Pancreatic carcinoma was considered to be unresectable if distant metastases (ex. liver, peritoneum) and/or invasion of at least one vessel - the celiac trunk, superior mesenteric artery/vein, splenic artery/vein or portal vein were confirmed.

After performed radiological examination each patient from the study group was operated. A mean time between CTA examination and surgery was 11 days (1-40). During operation surgeon finally classified each tumour as resectable or unresectable on the basis of above criteria. After surgery pathological examination was performed.

3. RESULTS

Pancreatic carcinoma was mostly located in the head of pancreas - in 15 patients (83%) and in 3 patients (17%) the cancer was found in the body of pancreas.

Totally 108 vessels were assessed in 18 patients. CTA showed no vessels' involvement by pancreatic cancer in 8 patients (proved surgically). The number of infiltrated vessels assessed by CTA and surgery (CTA vs. surgery) were respectively 19 vs. 23 and in detail as follows: celiac trunk (CT) – 0 vs. 1, splenic artery (SA) – 1 vs. 0, superior mesenteric artery (SMA) – 3 vs. 6, splenic vein (SV) – 1 vs. 0, superior mesenteric vein (SMV) – 8 vs. 9, portal vein (PV) – 6 vs. 7. Fig. 1 presents the degree of conformity for each vessel between CTA and surgery.

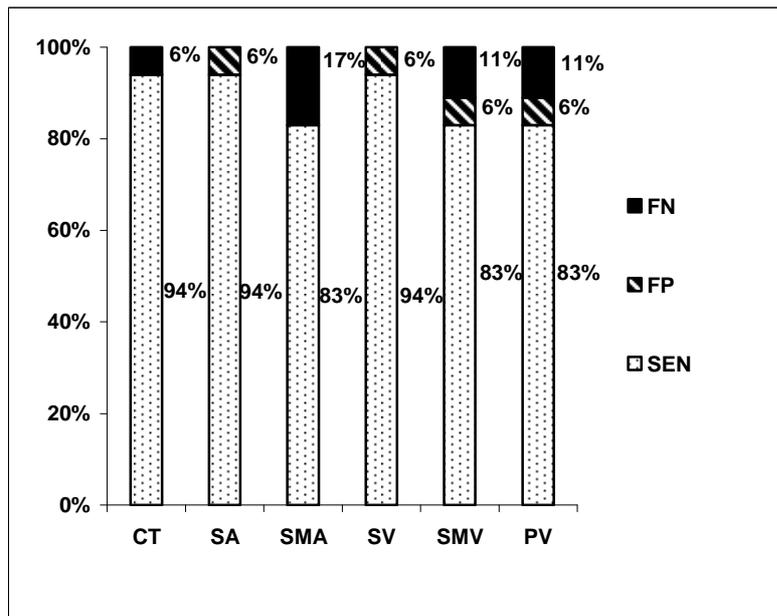


Fig. 2. The degree of conformity for each vessel between CTA and surgery; CT- celiac trunk, SA- splenic artery, SMA- superior mesenteric artery, SV- splenic vein, SMV- superior mesenteric vein, PV- portal vein, FN- false negative, FP- false positive, SEN- sensitivity

MEDICAL INVESTIGATIONS

According to CTA in 18 patients celiac trunk was free from tumour infiltration, whereas during surgery this vessel was involved by cancer in 1 case (sensitivity of CTA for this vessel was 94%). The same sensitivity was revealed to splenic artery (SA) and splenic vein (SV) but in contrary to the celiac trunk CTA in 1 patient diagnosed vascular infiltration which was not confirmed on surgery. Analyzing SMA, CTA in 15 patients properly showed vessel invasion (3 arteries with and 12 without involvement by cancer) however during surgery in 3 more persons infiltration on SMA was diagnosed (sensitivity of CTA for this vessel was 83%). CTA assessed correctly SMV in 15 patients, false negative (FN) result was observed in 2 vessels and false positive (FP) result was noted in 1 case. The same results and sensitivity were observed in relation to PV.

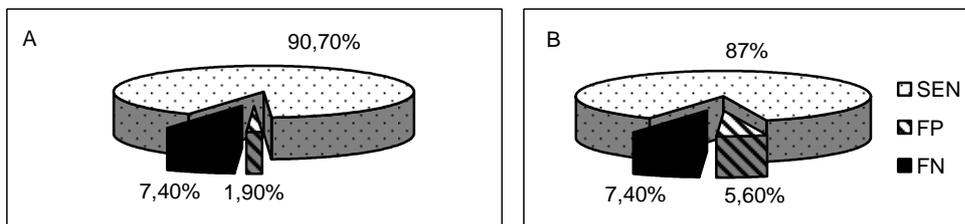


Fig. 3. CTA sensitivity in assessing: A- arteries, B- veins; SEN- sensitivity, FP- false positive, FN- false negative

The CTA sensitivity in assessing arteries was 90,7%, whereas false positive and false negative results were respectively: 1,9% and 7,4% (Fig.3 A). In relation to veins' invasion CTA showed 87% sensitivity whereas false positive and false negative results were 5,6% and 7,4% respectively (Fig.3 B). The overall CTA sensitivity in assessing vessels' involvement was 88,9%, whereas false positive and false negative results were as follow: 3,7% and 7,4% (Fig.4).

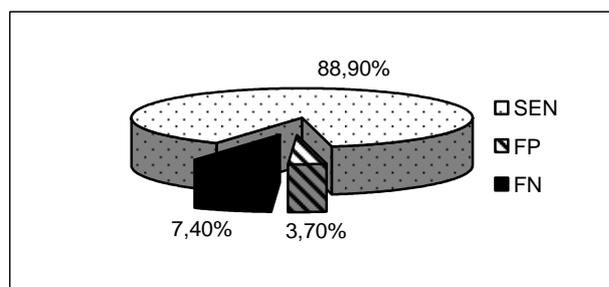


Fig. 4. Overall CTA sensitivity in assessing vessels' infiltration; SEN- sensitivity, FP- false positive, FN- false negative

Of the 18 patients, 6 with no vessels' invasion and with no distant metastases underwent definitive resection (pancreaticoduodenectomy) and the remaining 12 underwent palliative procedure. In 8 patients palliative operation was performed due to vessel's infiltration. 2 patients, despite of lack of vessel's involvement, underwent palliative surgery because of peritoneal metastases revealed during operation. In the last 2 cases palliative procedures were performed due to distant metastases known before surgery (1 patient with liver metastasis and the second one with peritoneal metastases).

4. DISCUSSION

Pancreatic cancer mostly concerns people over 60 years old. Although it can be symptomless patients typically report a nonspecific onset of pain (mid-epigastric, back pain) and a significant weight loss (over 10%). Clinical presentation of pancreatic carcinoma can be related with its anatomical location (head, body or tail of the pancreas). If the tumor is located in the head (75% of all cases) the most common sign is painless obstructive jaundice sometimes with enlarged, palpable gallbladder (Courvoisier sign) and weight loss. Much worse if the cancer is situated in the body (15-20%) or in the tail of pancreas (5-10%), then there are no early symptoms or they are nonspecific like diabetes mellitus. Diabetes appears in over 60% of patients with pancreatic carcinoma but only 1% of new onset diabetic cases in adults are related with the tumor [7]. Any other signs like acute pancreatitis, migratory thrombophlebitis (Trousseau sign) and depression are quite rare and should be taken into consideration if other causes were excluded.

Incorporated diagnostic steps are very important in staging the tumour correctly as the clinical consequences of this can be enormous. Overstaging can lead to undertreatment if a laparotomy is not performed in a patient with a potentially resectable tumour. On the other hand, understaging will lead to an unnecessary surgery with all the associated risks. It is then crucial to assess the possibility of resection by diagnosing preoperatively the size of the tumour, local tumours spread, vascular involvement and distant metastases. The "gold standard" diagnostic method used for assessing above criteria is Multidetector CT Angiography [6, 11, 20].

The criteria of resection have been changing all the time. There are many certain symptoms and situations that are considered contraindications to resective therapy. Typically, distant metastases (i.e. liver, lung, peritoneum) preclude curative resection but extrapancreatic disease involving stomach, right colon, duodenum or regional lymph nodes is not the contraindication because these organs can be resected en bloc with the tumour [1, 9, 14]. Also the patient's will and overall

health should be taken into consideration as the mortality rate associated with the operation (pancreaticoduodenectomy-Whipple procedure) is 6,6% [18]. Furthermore, historically, vascular infiltration has been considered a contraindication to resective cure. However nowadays, the invasion of superior mesenteric, splenic or portal vein is no longer an absolute contraindication [2, 14]. It is due to technical abilities which allow reconstructing vessels and sometimes replacing resected veins by native vessels, i.e. internal jugular, grater saphenous, inferior mesenteric veins or synthetic graft [2]. Lall et al [14] established criteria for venous resection. According to these criteria it is possible to resect and reconstruct the superior mesenteric, splenic and portal vein as long as flow remains in the vessel and adequate distal (portal vein) and proximal (superior mesenteric vein) tumour-free margins can be obtained. In addition, resected segment of vessel should be downstream (toward the liver) from the entry of the jejunal vein tributaries draining the small bowel (due to possible bowel infarct causing). Authors added that long-segment (typically at least 2 cm) circumferential tumour involvement of the superior mesenteric or portal vein is a relative contraindication to vascular reconstruction. A study by Howard et al [12] showed no significant impact on perioperative morbidity, mortality and overall survival of patients after pancreaticoduodenectomy without vascular reconstruction with patients who underwent venous resection. The same results were noticed by other authors [15, 16].

Nonetheless, the invasion of arteries like superior mesenteric, hepatic or celiac trunk still presents a barrier to resection. However, there are few studies reporting that arterial and combined arterial-venous resection may prolong overall survival in selected patients [17, 19, 21]. Vascular reconstructions can be technically difficult, therefore the surgeon's experience plays the major role in resectability.

In our study each patient with vessel infiltration (Fig. 5A) was considered as unresectable but when the tumour was adjacent to the vessel with present perivascular fat the patient was potentially curable (Fig. 5B).

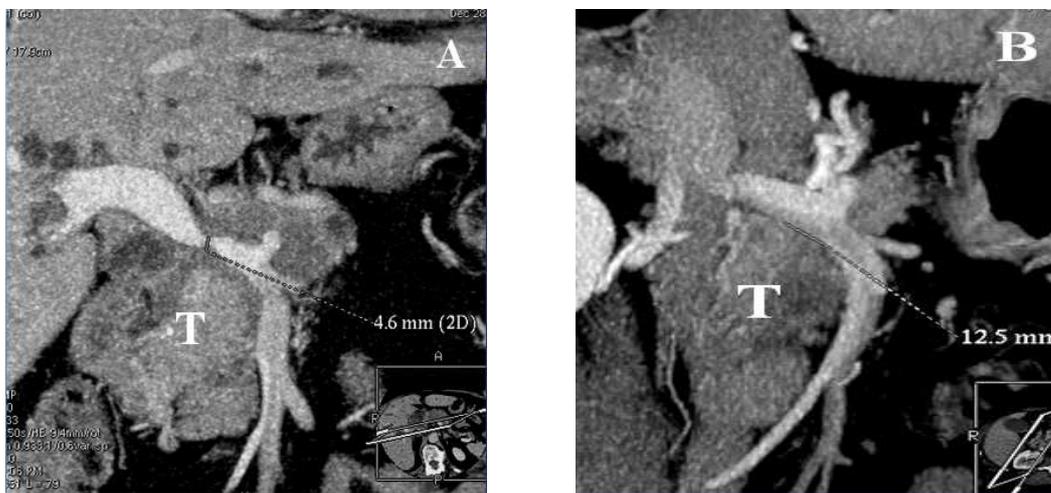


Fig. 5. Location of the tumour (T) in relation to the portal vein:
A- infiltration and significant narrowing of the vessel; B- tumour adjacent to the vessel with no vein involvement

The CTA sensitivity in assessing each vessel infiltration in our study differed from the results achieved by Klaus et al [13]. These authors assessed following vessels: superior mesenteric vein, splenic vein, portal vein, celiac trunk, superior mesenteric artery and achieved sensitivity results for these vessels were respectively: 100%, 66,7%, 100%, 100%, 100%. The results in our study were respectively as follow: 83%, 94%, 83%, 94%, 83%. The overall sensitivity for evaluating the individual vessels was 88,9% (in our study) and 90,9% (in the study by Klaus et al). These differences probably result from different patient prequalification (number of patients, the size of the tumour, distinct tumour stage), different scanning technique (time of delay, amount of administered contrast) and lack of splenic artery assessing in overall sensitivity. However, despite of these differences, other authors' studies achieved similar overall sensitivities estimated at 90% [8, 10].

Our study results showed high sensitivity in diagnosing vasculature involvement by pancreatic tumour however no statistical method was used to confirm these observations. According to particular vessels high sensitivities probably result from small number of patients in each subgroup. To verify these observations a study of more numerous group would be needed.

5. CONCLUSIONS

CT imaging plays a crucial role in the management of patients with pancreatic cancer and is currently the modality of choice. Not only the diagnosis of this cancer is important but assessed potential resectability is the key to success, especially in the tumour with such a poor outcome. In comparison to surgical assessment CTA properly diagnosed invasion of vessels and their anatomy what helped in proper therapy planning. That is why CTA with its high sensitivity in assessing vessels' infiltration is a necessary examination before surgery. But in some cases only surgery gives adequate information about patient's condition (even with clear radiological image) therefore the surgical assessment is the only way to verify pathology.

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