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Danka Petrović<sup>1</sup>, Predrag Petrović<sup>2</sup>

## CT CRITERIA OF THE RESECTABILITY OF PANKREAS CARCINOMA

**Apstrakt:** Karcinom pankreasa relativno je čest tumor sa incidencijom od 7,6 na 100.000 stanovnika godišnje u Zapadnoj Evropi, čineći oko 5% svih karcinoma. Uprkos ograničenoj veličini tumora, većina karcinoma glave pankreasa u vreme postavljanja dijagnoze je neresektabilna (oko 80%), bilo zbog lokalnog proširenja tumora (40%) ili prisustva udaljene metastatske bolesti (40%).

Adenokarcinom pankreasa generalno ima lošu prognozu sa 5-godišnjim preživljavanjem od oko 8%, zbog čega je od najvećeg značaja preoperativna procena lokalne resektabilnosti karcinoma pankreasa zbog daljeg planiranja hirurškog lečenja, neoadjuvantne/adjuvantne terapije ili palijativnog zbrinjavanja bolesnika. U Japanu je 2016. g. načinjena poslednja revizija internacionalnog vodiča za preoperativnu CT procenu resektabilnosti karcinoma pankreasa koji se zasniva na evaluaciji tumorske ekstenzije na vaskularne i anatomske strukture, utvrđivanju udaljenih metastaza pomoću dijagnostičkog modaliteta dinamske kontrastne kompjuterizovane tomografije (CT) koji kategorizuje tumor u tri klase prema prisustvu/odsustvu vaskularne invazije: resektabilan, potencijalno resektabilan i neresektabilan. Potencijalno resektabilni karcinomi pankreasa sa invazijom vaskularnih struktura, a ukoliko klinički i ECOG (engl. Eastern Cooperative Oncology Group) perfomans status dozvoljavaju, mogu proći neoadjuvantnu terapiju radi prevođenja tumora u resektabilnu formu kada se upotrebljava agresivnija hirurška terapija. Ukoliko se tokom eksplorativne laparoskopije uoči da se radi o neresektabilnom karcinomu, pristupa se palijativnoj hirurgiji ili se načini perkutana bilijarna drenaža sa implantacijom stenta.

**Ključne reči:** karcinom pankreasa, resektabilnost, vaskularna invazija, ct evaluacija

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<sup>1</sup> Danka Petrović, Centre for imaging diagnostic, Institut of oncology of Vojvodina, 21208 Sremska Kamenica, Serbia. E-mail: [pecadana@gmail.com](mailto:pecadana@gmail.com)

<sup>2</sup> Emergency center, Clinical center of Vojvodina, University of Novi Sad, Serbia

**Abstract:** Pancreatic cancer is a relatively common tumor with an incidence of 7.6 per 100,000 in Western Europe, accounting for about 5% of all cancers. Unfortunately, the most pancreatic cancers are unresectable (about 80%) at the time of diagnosis, due to local tumor extension (40%) or presence of distant metastasis (40%). Pancreatic adenocarcinoma generally has a poor prognosis and preoperative assessment of cancer resectability is of vital importance for treatment planning. The last revision of international guidelines for preoperative computer tomography (CT) assessment of pancreatic cancer resectability was done in Japan 2016, for preoperative evaluation of tumor extensibility and resectability. It is based on the tumor extension on vascular and adjacent structures and presence of distant metastases using contrast enhanced computed tomography (CECT). It categorizes the tumor into three classes according to the presence or absence of vascular invasion: resectable, borderline resectable (BR), and unresectable (UR). Borderline resectable pancreatic cancer with invasion of vascular structures may be treated with neoadjuvant therapy for the purpose of understaging/undersizing and converting tumor into resectable stage, followed by more aggressive surgical resection. If explorative laparoscopy shows unresectable cancer some palliative procedures should be performed or percutaneous biliary drainage with stenting.

**Keywords:** pancreatic cancer, resectability, vascular invasion, CT evaluation

## *Introduction*

Pancreatic cancer is a relatively common tumor with an incidence of 7.6 per 100,000 in Western Europe, accounting for about 5% of all cancers. Despite the size of the tumor, most pancreatic cancers are unresectable at the time of diagnosis (about 80%) due to local tumor extension (40%) or the presence of distant metastatic disease (40%) [1]. Overall cancer mortality in Serbia (147.8 per 100,000) ranks among the highest in the world. In general, the 5-year survival rate in the world and in our country is less than 5%; while in patients with resectable cancer and negative resection margins this percentage is slightly higher (18%–24%) [1, 2]. Multislice computed tomography (MSCT) is the most useful imaging modality in detection, staging, and evaluation of pancreatic cancer resectability and in the monitoring of therapy. Therefore, determination of pancreatic tumor resectability is of critical importance in terms of histopathological evaluation of the resected specimen. The resected specimen is classified into three categories according to the American Joint Committee on Cancer (AJCC) and the International Union Against Cancer (UICC); negative resection margins (R0), microscopic tumor infiltration (R1), or macroscopic residual tumor

(R2). The R classification has clinical and therapeutic significance, as it is a strong prognostic predictor.

Preoperative contrast enhanced CT imaging allows the evaluation of vascular invasion and invasion of surrounding peripancreatic structures and organs by pancreatic cancer, tumor staging and the assessment of its resectability [1, 2].

Previously, almost every country in the world had its own CT criteria, which varied greatly from region to region and were based on local experiences and technical capabilities. In 2016, an international consensus on CT criteria for assessing pancreatic resectability was reached at the 20<sup>th</sup> International Symposium of the International Pancreatologists Association, held in Japan. At that symposium, a new subgroup of patients was clearly defined and named - borderline resectable cancer. To that subgroup of patients about 5-10% of patients can be added which were refers to a group of locally advanced cancers that are potentially resectable after neoadjuvant therapy [3]. Five to ten percent of patients from a group of locally advanced tumors that is potentially resectable after neoadjuvant therapy can be added to that subgroup.

### ***CT RESECTABILITY CRITERIA OF PANCREATIC CARCINOMA***

The aim of diagnostic imaging is to obtain good preoperative assessments of cancer resectability. They are of great help for performing a successful surgical procedure with negative resection margins, which means better prognostic parameters for the patient. Preoperative evaluation of pancreatic cancer resectability is based on preoperative imaging with multislice computer tomography performed in compliance with the pancreas protocol, including unenhanced and contrast-enhanced imaging in the late arterial and portal venous phases after intravenous administration of 100 mL of iodine contrast. Multiplanar reconstructed images at 1mm thickness are performed, in addition to the volume-rendered and maximal intensity projection reconstructed images.

Pancreatic cancer is classified as: A) resectable, B) borderline resectable, and C) unresectable. Unresectable tumors are divided into locally advanced and metastatic tumors. Local advances are divided into locally advanced type A and locally advanced type B [4]. A resectable tumor is any tumor that has negative resection margins (R0) during surgical treatment. A potentially resectable tumor if treated with in-front surgery will be at high risk for positive resection margins (R1) due to vascular invasion, but after neoadjuvant therapy it increases the chances of margins being R0 with more complex surgery - vascular resection and reconstruction. Locally advanced type A tumors that become potentially resectable after systemic and chemo-irradiation therapy (e.g., coeliac trunk resection and reconstruction; and locally advanced type B where surgery is not indicated (AMS circulatory infiltration) [5].

In 2016, an international consensus was adopted in Japan to standardize the classification of pancreatic cancer resectability [6, 7]. Today, pancreatic cancer is considered resectable when tumor mass does not affect the arterial blood vessels of the upper mesenteric artery (AMS), the coeliac trunk (TC) and the common hepatic artery (ACH), the blood vessels of the upper mesenteric vein (VMS), and/or vena portalis (VP) or narrows them by less than 180°[8]. Borderline pancreatic carcinomas are divided according to invasion of blood vessels into: BR-PV pancreatic tumors, where infiltration of the VP and/or VMS of 180° or more is present; with suitable vessel proximal and distal to the site of involvement allowing for safe and complete resection and vein reconstruction; the tumor does not exceed the lower edge of the duodenum; there is no infiltration of the arteries; and into BR-A where there is infiltration of the arterial vessels AMS and AC by less than 180° without signs of deformity (due to reconstruction), and AHC, without infiltration of the hepatic proper artery and celiac trunk (aortic infiltration or the presence of anatomic variations of the arteries categorize the tumor as unresectable) [8, 9, 10].

Unresectable pancreatic cancers are divided into locally advanced and metastatic pancreatic cancers [11]. Locally advanced pancreatic cancers are tumors that infiltrate VP/VMS more than 180° or occlude them; contact with most proximal draining jejunal branch into SMV; and/or the tumor crosses the lower edge of the duodenum, infiltrates the peripancreatic arteries by 180° or more; invasion of ACH with infiltration of AHP and /or TC and aorta[10, 11]. Furthermore, the difference between UR and BR tumor is also defined by VMS/VP infiltration and whether the tumor reaches the inferior edge of the duodenum (determines the possibility of vascular reconstruction with a venous graft). Tumors reaching beyond the lower edge of the duodenum are considered unresectable (Figure 1).

In the case of pancreatic tumors where there is infiltration of both the arteries and veins, pancreatic resectability is classified as BR-A [12, 13]. In our country, as in the world, structured radiological reports are used, which in addition to blood vessels, also contain information on the relationship of pancreatic tumor tissue with surrounding structures and organs such as duodenum, stomach, retroperitoneum, colon, spleen, liver, etc. Lymph nodes larger than 1 cm in the short-axis diameter and necrotic lymph nodes are regarded as metastatic lymph nodes. Regional lymph nodes include (a) lymph nodes along the common bile duct, common hepatic artery, portomesenteric vein, and pancreaticoduodenal arcades for pancreas head cancer, and (b) lymph nodes along the common hepatic artery, celiac axis, splenic artery, and splenic hilum for pancreas body or tail cancer [14]. Variant arterial anatomy, including accessory or replaced right hepatic artery and replaced common hepatic artery, and the degree of tumor contact with variant arteries have also been evaluated (Figure 1).

Figure 1.

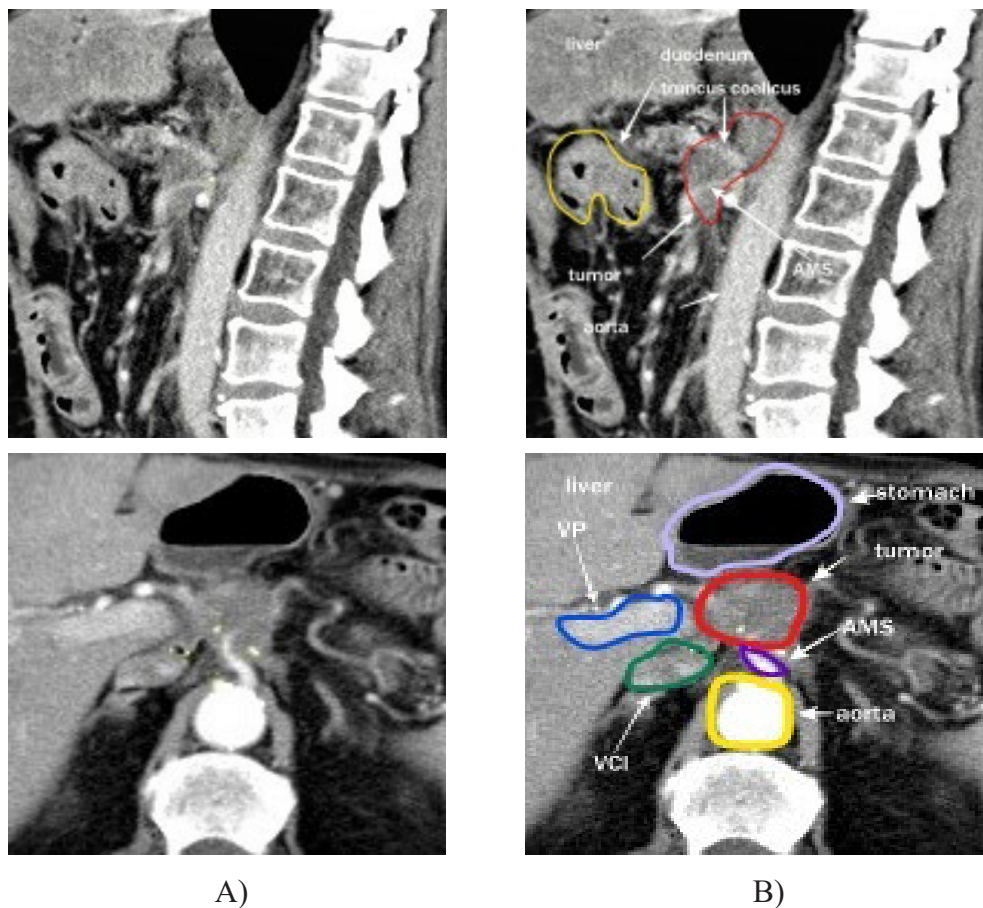


Figure 1. CT imaging of pancreatic cancer. A) Sagittal postcontrast image. B) Axial post-contrast image.

AMS: superior mesenteric artery, VCI: inferior vena cava, VP: portal vein.

## Conclusion

Borderline resectable tumors are tumors that infiltrate VMS/VP with bilateral stenosis and occlusion; but do not reach the lower edge of the duodenum, infiltrate  $<180^\circ$  AMS and TC without stenosis or deformity, the tumor is in direct contact with AHC without extension to AHP and TC [10, 11, 12]. Neoadjuvant chemotherapy with or without radiotherapy in BR tumors increases the chances of negative resection margins in delayed surgical procedures. The rate of resectability after neoadjuvant

therapy is 48% – 90% [14, 15]. The final benefit of a proper CT classification of tumor resectability is to improve treatment outcomes and to increase survival rates.

### *Literature*

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