PANCREATIC ADENOCARCINOMA: Criteria for surgical resectability in the era of neoadjuvant therapy

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Disclosure Statement

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Teaching points

• Review updated criteria for surgical resectability of pancreatic ductal adenocarcinoma (PDAC): resectable, borderline resectable and unresectable

• Review use of a PDAC radiology CT reporting template

• Discuss peripancreatic arterial and venous resection and reconstruction in the setting of PDAC

• Review CT findings of PDAC pre- and post-neoadjuvant therapy with regards to resectability
Background

- Pancreatic ductal adenocarcinoma (PDAC) has poor prognosis and surgical resection is only potentially curative treatment.

- Surgical resection traditionally reserved for patients with locally limited tumors without vascular invasion or metastases.

- In patients with locally advanced PDAC involving peripancreatic arteries or veins, downstaging can be achieved with neoadjuvant combined chemotherapy and radiation therapy in up to one-third of patients.

- In selected patients, surgical resection may be performed including arterial and venous resection and reconstruction.
Advancing surgical techniques

- Standard surgical procedure for pancreatic head and uncinate process cancer is pancreateoduodenectomy. Distal pancreatectomy performed for cancers left of the superior mesenteric vein

- As surgical resection remains the only hope for cure, more aggressive surgical approaches have been advocated to increase resection rates

- Vascular resection is one attempt to increase complete resection rates and cure/survival

- **Venous resection** to achieve tumor clearance and improve survival published more the 30 years ago. Today, venous resection regarded as standard of care in hands of an experienced surgeon¹

- **Arterial resection** remains controversial. Concerns over high peri-operative mortality and poor short- and long-term outcomes². Aggressive surgery considered in carefully selected patients
Use of neoadjuvant therapy

- Neoadjuvant treatment (NAT) becoming valid treatment option for borderline and locally advanced pancreatic cancer (LAPC)
- Chemotherapy and chemoradiotherapy (CRT) used as treatment modalities
- In up to 30 - 40% of patients, NAT can downstage to resectability
- However, NAT does not generally induce radiological tumor regression of LAPC with major vessel involvement
- Also, usual criteria for tumor response are not applicable to PDAC:
  - Tumor size
  - Change in tumor attenuation
The arrow shows main portal vein (MPV) narrowing on coronal CT due to PDAC, pre-NAT. Arrowhead shows improvement in MPV caliber post-NAT.
Pre-NAT, the red arrow shows PDAC involving the pancreatic body with extension to the celiac axis bifurcation. The distal aspect of the common hepatic artery (CHA) has no tumor involvement (red arrowhead). Post-NAT, subtle tumor progression is seen along the distal CHA (gold arrowhead).
Surgical Resectability Classification according to National Comprehensive Cancer Network Guidelines (NCCN)\(^5\)

- **Resectable**
  - No evidence of SMV or PV distortion
  - Clear fat planes around celiac axis, hepatic artery and SMA

- **Borderline resectable**
  - SMV or PV distortion, narrowing or occlusion with suitable vessel to allow safe resection and reconstruction
  - GDA encasement up to HA with either HA abutment or short segment encasement without extension to CA
  - SMA abutment <180°

- **Locally advanced / unresectable**
  - **Head**
    - SMA encasement >180°
    - Celiac abutment
    - Unreconstructable SMV-PV occlusion
  - **Body**
    - SMA encasement >180°
    - Celiac encasement >180°
    - Unreconstructable SMV-PV occlusion
    - Aortic invasion
  - **Tail**
    - SMA encasement >180°
    - Celiac encasement >180°
1 - PDAC in the head of the pancreas with no portal venous distortion or arterial involvement is a potentially resectable tumor

2 - Borderline tumor with SMV distortion and less than 180° abutment of SMA

3 - Locally advanced unresectable tumor with complete SMA encasement

Arrow, SMV
Arrowhead, SMA
Standardized reporting

- Accurate disease staging critical to guide management
- Ensures documentation of all important information, especially vascular involvement
- Provides uniform, clear, and complete reporting
- Assists with databases and research

**Key points**
- Lesion size and location
- Presence and detailed extent of vascular involvement
- Presence of arterial variants with or without tumor contact
- Presence of nodal and metastatic disease
### Pancreatic Ductal Adenocarcinoma Radiology Reporting Template

**Appendix E1**

**Pancreatic Cancer Staging Template**

**Morphologic Evaluation**
- Appearance (in the pancreatic parenchymal phase): hype-, iso-, or hypodense mass
- Size (maximal axial dimension in centimeters): measurable or nonmeasurable (sootyattenuating tumors)
- Location (head right of SMV, body left of SMV): head/infracentral or body/tail
- Pancreatic duct narrowing: abrupt cutoff with or without upstream dilatation: present or absent
- Biliary tree abrupt cutoff with or without upstream dilatation: present or absent

**Arterial evaluation**

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Degree of increased hazy attenuation</th>
<th>Degree of increased hazy attenuation/striation contact</th>
<th>Focal vessel narrowing or contour irregularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA</td>
<td>Present or absent</td>
<td>≤180° or &gt;180°</td>
<td>Present or absent</td>
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<tr>
<td></td>
<td>Degree of increased hazy attenuation</td>
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<td>Focal vessel narrowing or contour</td>
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<td>Celiac</td>
<td>Present or absent</td>
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</table>

**Venous evaluation**

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<th>Degree of increased hazy attenuation/striation contact</th>
<th>Focal vessel narrowing or contour irregularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPV</td>
<td>Present, absent, or complete occlusion</td>
<td>≤180° or &gt;180°</td>
<td>Present or absent</td>
</tr>
<tr>
<td>SMV</td>
<td>Present, absent, or complete occlusion</td>
<td>≤180° or &gt;180°</td>
<td>Present or absent</td>
</tr>
</tbody>
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**Extrapancreatic evaluation**

- Liver lesions: present or absent; suspicious/inconclusive or likely benign
- Peritoneal or omental nodules: present or absent
- Ascites: present or absent
- Suspicious lymph nodes: present or absent (portal, celiac, splenic hilum, paraaortic, retrocaval)
- Other extrapancreatic disease (invasion of adjacent structures): present or absent

**Impression:** Tumor, size and location
- Vascular contact: absent or present (vessel involved and extent)
- Metastasis: absent or present (location)

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Vascular variants

- Description of anomalous anatomy and vessel contact is necessary
- May affect surgical planning
- Replaced right hepatic artery (RRHA) of particular importance
- Proximal SMA narrowing by atherosclerosis or medial arcuate ligament should also be described$^6$
Example of replaced right hepatic artery arising off the SMA

PDAC in the head (asterix) with associated pancreatitis. Pre-operative concern for RRHA (arrow) soft tissue contact was present. No arterial involvement was present at surgery.
Hazy attenuation/stranding contact

- Given ill-defined nature of PDAC, this is a challenging aspect of reporting

- Stranding could represent:
  - Tumor infiltration
  - Pancreatitis
  - Post treatment inflammation or fibrosis
  - Post biopsy change
Example of hazy attenuation/contact

PDAC in the head (asterix) with associated pancreatitis. The SMA (arrow) has circumferential surrounding hazy attenuation/contact. No SMA tumor contact was seen at surgery.
Example of mesenteric infiltration

The arrow shows mesenteric tumor infiltration extending cranially from an uncinate PDAC.
Portal venous (PV) resection

- Mortality rate of PV resection 30 years ago was >20%; now decreased to <5%.

- Requires suitable vein proximal and distal to tumor involvement for resection and reconstruction.

- Intra-operatively, difficult to determine whether PV adherence is due to direct tumor invasion or inflammatory reaction - majority of cases have tumor invasion, justifying PV resection.

- Planned venous resections have better complete (RO) resection rates than unplanned resections.
CLASSIFICATION OF TYPES OF PV RESECTION

Modified from the initial classification by Tseng and colleagues.

SMV, superior mesenteric vein
LRV, left renal vein

Coronal CT images show narrowing of SMV (red arrow) by PDAC pre-operatively. Distal SMV (black arrow) is of good caliber and suitable for anastomosis. Post-operative coronal CT shows venous resection and reconstruction with a left renal vein graft (red arrowhead).
Arterial resection and reconstruction

- Arterial resection (AR) for PDAC is controversial

- Mainly small studies

- High post operative morbidity
  (Poster presentation, ASCO Gastrointestinal Cancers Symposium 2015, Presenting Author: Amélie Tremblay St-Germain)

- AR after NAT must be performed in carefully selected patients who would otherwise undergo no surgical intervention

Institutional criteria for AR

- Histological diagnosis of PDAC
- Metastatic work-up negative (CT chest, abdomen and pelvis)
- Age 18 – 70 years
- Fit for pancreatic surgery
- Reconstructible vein if involved
- Arterial involvement at presentation (Borderline or locally advanced)
- Single artery (either CH/HA or SMA)
Patient post total pancreatectomy with arterial and venous reconstruction.

Resected celiac axis with common hepatic artery anastomosed to the aorta with a saphenous vein graft (bracket shows graft). The red arrow shows the distal anastomosis to the CHA and the gold arrow shows the aortic anastomosis.
Conclusion

- PDAC presents challenges to both the radiologist and surgeon regarding image interpretation and potential for surgical resectability

- Standardized CT radiology reporting aids in determining resectability and subsequent treatment

- Neoadjuvant therapy may downstage some patients with locally advanced PDAC allowing surgical resection

- Radiologists should be aware that venous and arterial resection may be used in carefully selected patients to achieve complete tumor clearance

- A multidisciplinary approach to PDAC is essential to optimize treatment options and selection of patients for surgery
References


