Pancreas – anatomy, histology and dissection

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Embryology
- Pancreas develops during 4th to 7th weeks of gestation
- Larger dorsal bud appears first, followed by smaller ventral anlage, which develops from the base of the hepatic diverticulum
- By 5th week, both buds have a duct system that opens into the developing gut
- In 7th week ventral bud rotates clockwise & the two buds fuse to form a single organ

Head, body and tail of pancreas

Uncinate process
- 'uncus' = hook
- Ventral anlage
- Extension of the head that projects from its left-lateral aspect and hooks behind the superior mesenteric vessels
- Varying degrees of extension up to and/or behind the superior mesenteric vessels

Pancreatic duct system
- Hierarchical system of collecting ducts of gradually increasing calibre, which drain into the main pancreatic duct (MPD)
- MPD runs centrally but in the head makes a sharp turn towards the caudal aspect and courses obliquely towards the duodenum and ampulla of Vater
- The accessory (Santorini's) duct drains superior part of the head through the minor ampulla and minor papilla
- Only main duct (1.5-3mm diameter) and occasionally Santorini's duct (<1mm wide) are visible with naked eye

Ampulla & papilla of Vater
Cut-surface
- Lobulated architecture
- Separated by thin layer of loose paucicellular stroma containing vessels & nerves

Histology
- Acinar cells (85% of pancreas)
- Arranged in acini with central lumen that is usually not visible
- Pyramidal shape
- Basal nucleus with single nucleolus
- Basal cytoplasm is basophilic (RER)
- Apical cytoplasm eosinophilic & granular (zymogen granules)

Pancreatic ducts
- Centroacinar (clear) cells partially cover the apical surface of the acinar cells
- Interacinar ducts (low cuboidal epithelium) outside the acini
- Intraacinar ducts (low columnar epithelium) of varying sizes
- Interlobular ducts (columnar epithelium)
- Main pancreatic duct

Islets
- Compact islets (90%) – round and smooth
  - Cells arranged in loose complex of anastomosing loops with capillary-type blood vessels
  - Cells are ovoid in shape with pale eosinophilic cytoplasm and ovoid nucleus
  - Variation in nucleus size is normal

Islets
- Compact islets
  - alpha-cells (glucagon) = 15-20% of islet population
  - beta-cells (insulin) = 60-80%
  - delta-cells (somatostatin) = 5-10%
  - PP-cells (pancreatic polypeptide) = <2%
  - (ghrelin-secreting epsilon-cells)

Diffuse islets
- Diffuse islets (10%) – irregular in shape, less well demarcated
  - Found in uncinate process/inferior head
  - Larger size (up to 450 microns) than compact islets (150-300 microns)
  - Cells arranged in trabeculae
  - Rich in PP cells (70-80%) and few insulin cells (<2%)
**Extrainsular endocrine cells**
- <10% of endocrine cells are found outside the islets
- Located within or close to ducts
- PP cells
- Rarely alpha-, beta-, or delta-cells
- In large ducts may produce serotonin

**Interstitium**
- Within the lobules, it consists of delicate network of capillaries
- Interlobular septa have small amount of loose fibrous stroma, which supports interlobular ducts, peripheral nerves, lymphatics and blood vessels

**Specimen dissection**

**Specimen types**
- Pancreatoduodenectomy
- Distal pancreatectomy
- Total pancreatectomy
- Duodenum-preserving pancreatic resection
- Complex multi-visceral en-bloc resection
- Central pancreatectomy
- Enucleation
- Specimens following Frey, Beger or Puestow procedures (chronic pancreatitis)

**Pancreatoduodenectomy**

**Pylorus-preserving PD**
Open duodenum and stomach

Dissection techniques
- Bivalving technique
- Bread loaf slicing technique

Axial slicing technique

Axial slicing technique

Axial slicing & photography

Inking of margins
Axial slicing

Axial specimen slicing

Main pancreatic duct vs common bile duct

Inspect tissue slices on both sides

Ampulla of Vater

Venous resections
Stents and coils

- CBD is stented to relieve obstructive jaundice
- Record presence and nature (plastic for short-term use, or metal for longer period of time)
- Plastic can be left in situ, since they can be sliced easily
- Metal stents require removal before slicing

Peripancreatic LN stations (JPS)

UICC TNM lymph node classification

<table>
<thead>
<tr>
<th>Stage</th>
<th>Anatomical classification</th>
<th>Tumour of</th>
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<tbody>
<tr>
<td>A</td>
<td>Anterior/medial/anterior</td>
<td>Head and body tail of pancreas</td>
</tr>
<tr>
<td>B</td>
<td>Anterior/posterior/anterior</td>
<td>Head and body tail of pancreas</td>
</tr>
<tr>
<td>C</td>
<td>Anterior/posterior/posterior</td>
<td>Head of pancreas</td>
</tr>
<tr>
<td>D</td>
<td>Distant anterior/posterior</td>
<td>Head and body tail of pancreas</td>
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<tr>
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Tissue sampling

- Transection margins (neck & BD & duodenum/stomach) sampled en face
- Follow the sequential order of the specimen slices
- Tumour/lesion with adjacent anatomical structures, lymph nodes or margins/surfaces allowing nature of tumour/lesion and its extension to be assessed
- Whole-mount of specimen slice or entire slice embedded as 4-5 parts
- All lymph nodes should be sampled (12-15 for pancreatoduodenectomy)
- Background (pancreas, ampulla, bile duct)

Distal pancreatectomy

- Serial slicing at 3-4mm intervals in the sagittal plane (perpendicular to the long axis of the pancreas)
- Orientation – splenic artery/vein runs along cranial (superior) aspect of body and tail
- Margins: transection margin & the anterior and posterior surfaces of the body and tail
### What is a PD resection margin?
- **Transsection margin** (where tissue has been surgically divided): bile duct, pancreatic neck, duodenum or stomach, and superior mesenteric artery-facing (SMA, uncinate, mesopancreatic, medial) margins.
- **Dissection/mobilization planes/margins** (where surgeon bluntly dissects tissue along an anatomical plane): posterior margin, superior mesenteric vein (SMV) margin and around extrapancreatic bile duct.
- **Anterior surface**: is a true anatomical surface and not a surgical resection.
- 28 different names for margins of the Whipples resection specimens. (Gill et al. Pathology 2005; 41:161-7)

### Standardisation
- **Standardisation: dissection protocols and reporting protocols/synoptic reporting**
  - Gill A et al. Pathology 2005; 41: 161-7
  - 2nd edition RCPPath database, 2010
- **Major efforts should be made to reach an internationally accepted and standardised, but technically and financially feasible pathologic reporting.** (Rai B et al. Surgery 2012; 152: S102-11)

### Guidelines