CT and MRI of pancreatic cysts

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Oregon Health and Science University
1.2% of patients have a pancreatic cyst at CT or MRI and >50% are neoplastic.

Pancreatic cysts in ~25% of autopsies:
- Atypia in 16% of these & carcinoma-in-situ in 3%

Some pancreatic cancers are now thought to be derived from these cysts.

Learning objectives

**WHAT IS IT?**

- Recognize reliable CT and MRI features for characterization of pancreatic cysts

**WHAT SHOULD BE DONE WITH IT?**

- Suggest evidence-based guidance on appropriate management
Characterization
Why characterize?

**MUCINOUS CYSTIC TUMORS**
- Intraductal papillary mucinous neoplasm (IPMN)
- Mucinous cystic neoplasm

**NON-MUCINOUS CYSTIC TUMORS**
- Serous cystadenoma
- Cystic degeneration solid tumor
- Inflammatory fluid collection
- Simple/congenital cyst

*“M” TUMORS*
- Mucin-containing Marker elevated (high CEA)
- Malignant risk
Frequency in pooled surgical series

<table>
<thead>
<tr>
<th>Lesion</th>
<th>N = 520</th>
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<tbody>
<tr>
<td>IPMN</td>
<td>138 (27%)</td>
</tr>
<tr>
<td>Serous cystadenoma</td>
<td>132 (25%)</td>
</tr>
<tr>
<td>Mucinous cystic neoplasm</td>
<td>89 (17%)</td>
</tr>
<tr>
<td>Cystic degeneration solid tumor</td>
<td>69 (13%)</td>
</tr>
<tr>
<td>Inflammatory PFC*</td>
<td>48 (9%)</td>
</tr>
<tr>
<td>Simple/congenital cyst*</td>
<td>4 (1%)</td>
</tr>
<tr>
<td>Symptomatic</td>
<td>335 (64%)</td>
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</tbody>
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"CLASSIC" CYSTIC NEOPLASMS (~70%)

DIFFERENTIAL CONSIDERATIONS

* LIKELY UNDER-REPRESENTED

1. MGH – high resection rate (Arch Surg 2003; 138: 427-3)
3. MSKCC -“Selective” policy (Ann Surg 2006; 244: 572-82)
## Terminology

<table>
<thead>
<tr>
<th>OLD</th>
<th>NEW</th>
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<tbody>
<tr>
<td>Microcystic adenoma</td>
<td>Serous cystadenoma</td>
</tr>
<tr>
<td>Macrocystic adenoma/adenocarcinoma</td>
<td>Mucinous cystic neoplasm</td>
</tr>
<tr>
<td>Mucinous ductal ectasia</td>
<td>IPMN (intraductal papillary mucinous neoplasm)</td>
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</tbody>
</table>
Intraductal papillary mucinous neoplasm:
- Tumor = Intraductal hypersecreting nodules
- Imaging = ducts dilated by mucin (rings & tubes)
- Jellylike mucin leaking from papilla in 20-55%
- Usually > 60 yrs and men ≈ women
- Mimics acute or chronic pancreatitis

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Leaking mucus
Favors pancreatic head
49 YEAR OLD WOMAN WITH DIARRHEA

Typical intercommunicating cysts and tubes
Gaping “fish-mouth” papilla
Mucinous cystic neoplasm

- **Typical features:**
  - Women:men ≥ 8:1
  - **No communication**
  - Involves body or tail
  - Mural calcification in 15%
  - CEA > 200 ng/mL in 80%

- Mean age 45 years
- **Ovarian stroma**
- Lobulated/exophytic
- Few big locules
- Was “macrocystic”

76 YEAR OLD WOMAN WITH LUNG CANCER
Serous cystadenoma

Typical features:
- Relatively rare
- Mean age 70-80 years
- Women:men ≈ 3:1
- Central scar in 20-38%
- Old “microcystic”

“S TUMOR”
SPONGELIKE
STELLATE SCAR
SUNBURST
CALCIFICATION
MAY LOOK SERIOUS

77 YEAR OLD WOMAN WITH LUNG CANCER
Natural history

- Resect if symptomatic or > 4 cm?
  - Faster growth; 20 mm/year versus 1 mm/year

- Risk of malignancy is negligible:
  - Serous cystadenocarcinomas are reportable

  J Clin Gastroenterol 2005;39: 253-6
Cystic degeneration of solid tumor

- **SPEN:** 100% (56/56)
- **NE tumor:** 10% (17/170)
- **Adenocarcinoma:**
  Macrocysts in 8% (38/483) at pathology
- **Acinar cell cancer:** 83% (5/6)

Clin Radiol 2010; 65: 223-9
Cystic degeneration of solid tumor

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References:
- J Pancreas 2006; 7(1S):131-36
- Radiology 1996; 199: 707-11
- Mod Pathol 2005; 18: 1157-64
- Clin Radiol 2010; 65: 223-9
Cystic degeneration of solid tumor

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- NE tumor: 10% (17/170)
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Inflammatory PFC

- Collections secondary to pancreatitis:
  - Includes acute post-pancreatitis collection, pseudocyst, abscess, and walled off necrosis

- Unilocular cyst without septae or solid parts:
  - But may have **internal debris** (high PPV)
  - Amylase >5000U/mL: 61-94% sens, 58-74% spec

Kappa = 0.89 (objective)
13/20 pseudocysts versus 1/22 cystic neoplasms

**INTERNAL DEBRIS**

JCAT 2008; 32: 757-63  Radiology 2009; 251: 77-84
Gastrointestinal Endoscopy 2005; 61: 363-70
Inflammatory PFC

- History of pancreatitis fairly reliable:
  - 100% (30/30) of pseudocysts, 6/70 (9%) other cysts
  - Evolution on serial imaging may also help

64 year old with recent pancreatitis

2 months later...
Mucinous cancer on biopsy

JCAT 2008; 32: 757-63
Radiology 2009; 251: 77-84
Gastrointestinal Endoscopy 2005; 61: 363-70
Simple/congenital cysts

- Traditional radiology teaching:
  - Rare, outside of syndromes (VHL)

- Challenged by newer data:
  - 186 cysts <12 mm found in 300 autopsies; most benign but atypia in 6.4% and CIS in 3.4%
  - Cysts on SSFSE in 19.6% of unselected patients (283/1444); 84% ≤10 mm

*Int J Pancreatol 1995; 18:197-206*
*Radiology 2002; 223: 547-553*
## Characterization - summary

<table>
<thead>
<tr>
<th>Pathology</th>
<th>Clinical and imaging findings</th>
<th>Sample</th>
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<tbody>
<tr>
<td>IPMN</td>
<td>Older men or women Intercommunicating cysts and tubes</td>
<td></td>
</tr>
<tr>
<td>MCN</td>
<td>Middle-aged women Exophytic “bunch of grapes”</td>
<td></td>
</tr>
<tr>
<td>Serous cystadenoma</td>
<td>Elderly women or sometimes men Spongelike/Stellate (&quot;S&quot; tumor)</td>
<td></td>
</tr>
<tr>
<td>SPEN</td>
<td>Young woman or girl Solid with cystic/hemorrhagic parts</td>
<td></td>
</tr>
<tr>
<td>Cystic NE tumor</td>
<td>Any age or gender Hypervascular solid/cystic mass</td>
<td></td>
</tr>
<tr>
<td>Simple cyst</td>
<td>Any age Small incidental unilocalular cyst</td>
<td></td>
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</table>
Management
## Cancer risk in mucinous tumors

<table>
<thead>
<tr>
<th></th>
<th>Main (+ mixed) duct IPMN</th>
<th>Side branch IPMN</th>
<th>MCN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive cancer and CIS</td>
<td>70%</td>
<td>25%</td>
<td>17%</td>
</tr>
<tr>
<td>Invasive cancer</td>
<td>43%</td>
<td>15%</td>
<td>12%</td>
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</tbody>
</table>

**Surgical** data suggests resection of:
- All main duct IPMNs
- Branch duct IPMNs if > 3 cm or mural nodules
- MCNs > 4 cm or mural nodules

*Tanaka et al, Pancreatology 2006; 6: 17–32*
Malignant transformation

71 YEAR OLD WOMAN WITH PAIN

Cancer arising in IPMN proven at surgery
Malignant transformation

72 YEAR OLD WOMAN – 3 YEARS INTERMITTENT PAIN AND DILATED Pancreatic Duct

“Mucinous adenocarcinoma” at pathology
Malignant transformation
EUS is not perfect...

61 YEAR OLD WOMAN WITH INTERMITTENT STABBING PAIN IN THE UPPER ABDOMEN

Whipples: IPMN with dysplasia - no invasive cancer
Does pathology matter?

**Outcome studies after surgery:**
- CIS pooled with “non-invasive”
- Invasive cancer in IPMN has worse prognosis

Rodriguez et al, Gastroenterology 2007; 133: 72–79
Yamao et al, Pancreas 2011; 40: 67-71

72 IPMNs  145 BD-IPMNs  72 MD-IPMNs  156 “true” MCNs
Other important studies

<table>
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<th>Population</th>
<th>Findings</th>
</tr>
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<tbody>
<tr>
<td>Multicenter surgical study (n = 166; ≤3 cm)</td>
<td>Cancer risk if asymptomatic &amp; benign-appearing = 3.3% (similar to operative mortality, observation justified?)</td>
</tr>
<tr>
<td>Incidental cysts on US or CT (n = 79; ≤2 cm)</td>
<td>No pancreatic deaths in 67 with 5+ years of follow-up</td>
</tr>
<tr>
<td>Incidental cysts seen on EUS (n = 97)</td>
<td>No pancreatic deaths in 93 with mean 4 yr follow-up No surgery in 71/93 (76%) &lt;3 cm and benign on EUS, surgery in other 22 - 13 premalignant and 2 malignant</td>
</tr>
</tbody>
</table>

PANCREATIC CYST

Distinctive
(Serous cystadenoma, pseudocyst)

- MANAGE AS PER DIAGNOSIS

Indeterminate

Low risk or low yield

- IGNORE?

High risk (size, IPMN,nodules)

- EUS/SURGERY?

Intermediate risk

- SURVEILLANCE/EUS?
### Sendai guidelines

**Consensus on mucinous pancreatic cysts**

<table>
<thead>
<tr>
<th>Features</th>
<th>Recommendation</th>
</tr>
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<tr>
<td>&lt; 1 cm</td>
<td>Annual follow-up</td>
</tr>
<tr>
<td>1-3 cm and simple on EUS or MRI</td>
<td>Follow-up every 6 months for 2 years then every year</td>
</tr>
<tr>
<td>&gt; 1 cm and complex</td>
<td>Resect</td>
</tr>
</tbody>
</table>

*Tanaka et al, Pancreatology 2006; 6: 17-32*
# ACR guidelines

*If detected incidentally in asymptomatic patient*

<table>
<thead>
<tr>
<th>Size</th>
<th>Recommendation</th>
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</table>
| < 2 cm  | Single follow-up in one year  
- No more work-up if stable  
- Go to next level if bigger |
| 2-3 cm  | Do MRI/MRCP for characterization  
- Repeat every 6 months for 2 years if side branch IPMN  
- Repeat annually if uncharacterized  
- Repeat every 2 years if serous cystadenoma |
| > 3 cm  | Serous cystadenoma: Consider resection if 4+ cm  
Uncharacterized: Cyst aspiration/resection as appropriate |

*Berland et al, J Am Coll Radiol 2010;7:754-773*
Other “expert” publications

- ASGE: Review questioning utility of imaging, EUS, FNA, and fluid analysis
- ACG “guidelines”: Really just a review paper plus selected scenarios/FAQs
- SSAT/AGA/ASGE: Review paper with no clear recommendations

ASGE Standards of Practice Committee. Gastrointestinal Endoscopy 2005; 61: 363-70
Reasons for uncertainty

General:
- Surgical series ≠ “All comers”
- Pathology ≠ outcome (does CIS progress?)
- Cost & risk analyses needed (≤2% mortality)
- Variable pathology (e.g. ovarian stroma for MCN?)

66 YEAR MAN WITH CRF – “MCN” DIAGNOSED AT PATHOLOGY AFTER DISTAL PANCREATECTOMY, BUT CLASSIC IPMN!!
Reasons for uncertainty

- Imaging:
  - Limited imaging accuracy
  - Limited EUS availability/capacity
  - MCN versus side branch IPMN

35 YEAR OLD WOMAN WITH CYSTIC PANCREATIC LESION FOUND DURING STAGING OF BREAST CANCER
Imagine if this was you...

64 year old man with 3 weeks of nocturnal epigastric pain relieved by sitting up – pain now resolved
Case example

64 year old man with 3 weeks of nocturnal epigastric pain relieved by sitting up – pain now resolved
74 year old woman with cyst found at CT for pelvic pain – grew from 2.8 to 3.9 cm over 6/12 – MCN with high grade dysplasia at Whipple’s
81 year asymptomatic retired dentist with family history of pancreatic cancer – presumed multifocal IPMN
Case example

43 year old woman with cyst found after one episode LUQ pain – IPMN with moderate dysplasia at surgery
Case example

49 year old man with single episode of acute abdominal pain that resolved spontaneously...
Three years later…

Biopsy demonstrated mucinous adenocarcinoma
Clinical and MRI findings often allow accurate characterization, but some cysts are indeterminate.

Evidence (in my opinion!) supports relatively conservative approach to many incidental pancreatic cysts:
- < 5-20 mm: Ignore or single follow-up?
- Bigger: Surveillance or EUS, resect if complex and/or > 3-4 cm?
Thank you

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