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Pancreatic cystic lesions

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Pancreatic Cystic Lesions

Prevalence of pancreatic cystic lesions

3% CT

20% MR

45% MRCP



Significant clinical entity

Most common pancreatic cystic lesions

Most common pancreatic cystic lesions

Epithelial

Epithelial

Non-
Epithelial

Non-
Epithelial

Most common pancreatic cystic lesions

**Epithelial
Neoplastic**

**Epithelial
Non-
Neoplastic**

**Non-
Epithelial
Neoplastic**

**Non-Epithelial
Non-
Neoplastic**

Most common pancreatic cystic lesions

Epithelial Neoplastic	Epithelial Non-Neoplastic	Non-Epithelial Neoplastic	Non-Epithelial Non-Neoplastic
Serous cystadenoma (SCA)			
Mucinous cystadenoma (MCS)			
Intraductal papillary T (IPMN)			
Solid pseudopapillary T			
Cystic neuroendocrine T			
VHL ass SCA			

Most common pancreatic cystic lesions

Epithelial Neoplastic	Epithelial Non-Neoplastic	Non-Epithelial Neoplastic	Non-Epithelial Non-Neoplastic
Serous cystadenoma (SCA)	Lymphoepithelial		
Mucinous cystadenoma (MCS)	Mucinous non-N		
Intraductal papillary T (IPMN)	Retention cyst		
Solid pseudopapillary T		
Cystic neuroendocrine T			
VHL ass SCA			

Most common pancreatic cystic lesions

Epithelial Neoplastic	Epithelial Non-Neoplastic	Non-Epithelial Neoplastic	Non-Epithelial Non-Neoplastic
Serous cystadenoma (SCA)	Lymphoepithelial	<u>Benign:</u> Lymphangioma	
Mucinous cystadenoma (MCS)	Mucinous non-N	<u>Malignant:</u> Sarcoma	
Intraductal papillary T (IPMN)	Retention cyst		
Solid pseudopapillary T		
Cystic neuroendocrine T			
VHL ass SCA			

Most common pancreatic cystic lesions

Epithelial Neoplastic	Epithelial Non-Neoplastic	Non-Epithelial Neoplastic	Non-Epithelial Non-Neoplastic
Serous cystadenoma (SCA)	Lymphoepithelial	<u>Benign:</u> Lymphangioma	Pseudocyst
Mucinous cystadenoma (MCS)	Mucinous non-N	<u>Malignant:</u> Sarcoma	
Intraductal papillary T (IPMN)	Retention cyst		
Solid pseudopapillary T		
Cystic neuroendocrine T			
VHL ass SCA			

Pancreatic Cystic Lesions

- Diagnosis based on:
 - patient clinical data
 - (age, gender, previous clinical history,)
 - imaging findings (CT/MR/MRCP)
 - endoscopy (MPD communication, internal structure)
 - cyst fluid/tissue analysis
 - (amylase, CEA, mucin, cytology,)

- DD between:
 - Non-mucinous vs mucinous (pre-malignant lesions)
 - neoplastic vs non-neoplastic cyst (Pseudocyst)

Pancreatic Cystic Lesions

- **Which imaging modality**

Pancreatic Cystic Lesions

- **Which imaging modality**
 - **Detection:** CE-MR/MRCP >> CE-CT
 - **Characterization:** CE-MR/MRCP ~ CE-CT
 - Calcification CT >>> MR/MRCP
 - Aggressive imaging features CE-MR/MRCP > CE-CT
 - Communication with PD MR/MRCP >> CT

Pancreatic Cystic Lesions

- **Which imaging modality**
 - **Detection:** CE-MR/MRCP >> CE-CT
 - **Characterization:** CE-MR/MRCP ~ CE-CT
 - Calcification CT >>> MR/MRCP
 - Aggressive imaging features CE-MR/MRCP > CE-CT
 - Communication with PD MR/MRCP >> CT
 - **EUS**
 - detection
 - characterization
 - cystic fluid / tissue sampling

Imaging Findings

- Location (head/body/tail)
- Size (< or > 3 cm)
- Gross appearance (unilocular/multilocular/..)
- Capsule (thin/thick/enhancing?)
- Internal structure (homogenous/heterogenous/hematic/...)
- Septa (thin/thick/enhancing?)
- Calcifications (central/peripheral- thin/thick)
- Solid component (mural nodules, enhancing?)
- Pancreatic duct communication
- Pancreatic duct appearance (dilatation?)



Imaging Findings

- **Location (head/body/tail)**
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Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



Imaging Findings

- **Location (head/body-tail)**

Head →

- Serous Cystadenoma
- IPMN

Body-tail →

- Mucinous Cystadenoma
- Solid pseudopapillary T

Imaging Findings

- Location (head/body/tail)
- **Size**
- Gross appearance (unilocular/multilocular/..)
- Capsule (thin/thick/enhancing?)
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Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



Imaging Findings

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- Size
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- Capsule (thin/thick/enhancing?)
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- Septa (thin/thick/enhancing?)
- Calcifications (central/peripheral- thin/thick)
- Solid component (mural nodules, enhancing?)

Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



Imaging Findings

• Gross appearance (unilocular/multilocular/..)

Unilocular →

- Mucinous Cystadenoma
- Pseudocyst
- IPMN
- Serous cystadenoma

Multilocular →

- Serous Cystadenoma
- IPMN

Imaging Findings

- Location (head/body/tail)
- Size
- Gross appearance (unilocular/multilocular/..)
- **Capsule (thin/thick/enhancing?)**
- Internal structure (homogenous/heterogenous/hematic/...)
- Septa (thin/thick/enhancing?)
- Calcifications (central/peripheral- thin/thick)
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Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



Imaging Findings

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- Capsule (thin/thick/enhancing?)
- **Internal structure (homogenous/heterogenous/hematic/...)**
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Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



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Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



Imaging Findings

- Location (head/body/tail)
- Size
- Gross appearance (unilocular/multilocular/..)
- Capsule (thin/thick/enhancing?)
- Internal structure (homogenous/heterogenous/hematic/...)
- Septa (thin/thick/enhancing?)
- **Calcifications (central/peripheral- thin/thick)**
- Solid component (mural nodules, enhancing?)

Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



Imaging Findings

- **Calcifications (central/peripheral- thin/thick)**



Imaging Findings

- Location (head/body/tail)
- Size
- Gross appearance (unilocular/multilocular/..)
- Capsule (thin/thick/enhancing?)
- Internal structure (homogenous/heterogenous/hematic/...)
- Septa (thin/thick/enhancing?)
- Calcifications (central/peripheral- thin/thick)
- **Solid component (mural nodules, size, enhancing?)**

Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



Imaging Findings

- Location (head/body/tail)
- Size
- Gross appearance (unilocular/multilocular/..)
- Capsule (thin/thick/enhancing?)
- Internal structure (homogenous/heterogenous/hematic/...)
- Septa (thin/thick/enhancing?)
- Calcifications (central/peripheral- thin/thick)
- Solid component (mural nodules, enhancing?)

Pancreatic duct communication

Pancreatic duct appearance (dilatation?)



Imaging Findings

Pancreatic duct communication

Communication



- IPMN
- Pseudocyst

No Communication



- Serous cystadenoma
- Mucinous cystadenoma
- Solid pseudopapillary T

Imaging Findings

- Location (head/body/tail)
- Size
- Gross appearance (unilocular/multilocular/..)
- Capsule (thin/thick/enhancing?)
- Internal structure (homogenous/heterogenous/hematic/...)
- Septa (thin/thick/enhancing?)
- Calcifications (central/peripheral- thin/thick)
- Solid component (mural nodules, enhancing?)

Pancreatic duct communication



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Pancreatic duct appearance (dilatation?)/parenchyma



Pancreatic Cystic Lesions

56 yo woman
Gastric bypass
Abdominal pain
No history of AP/CP

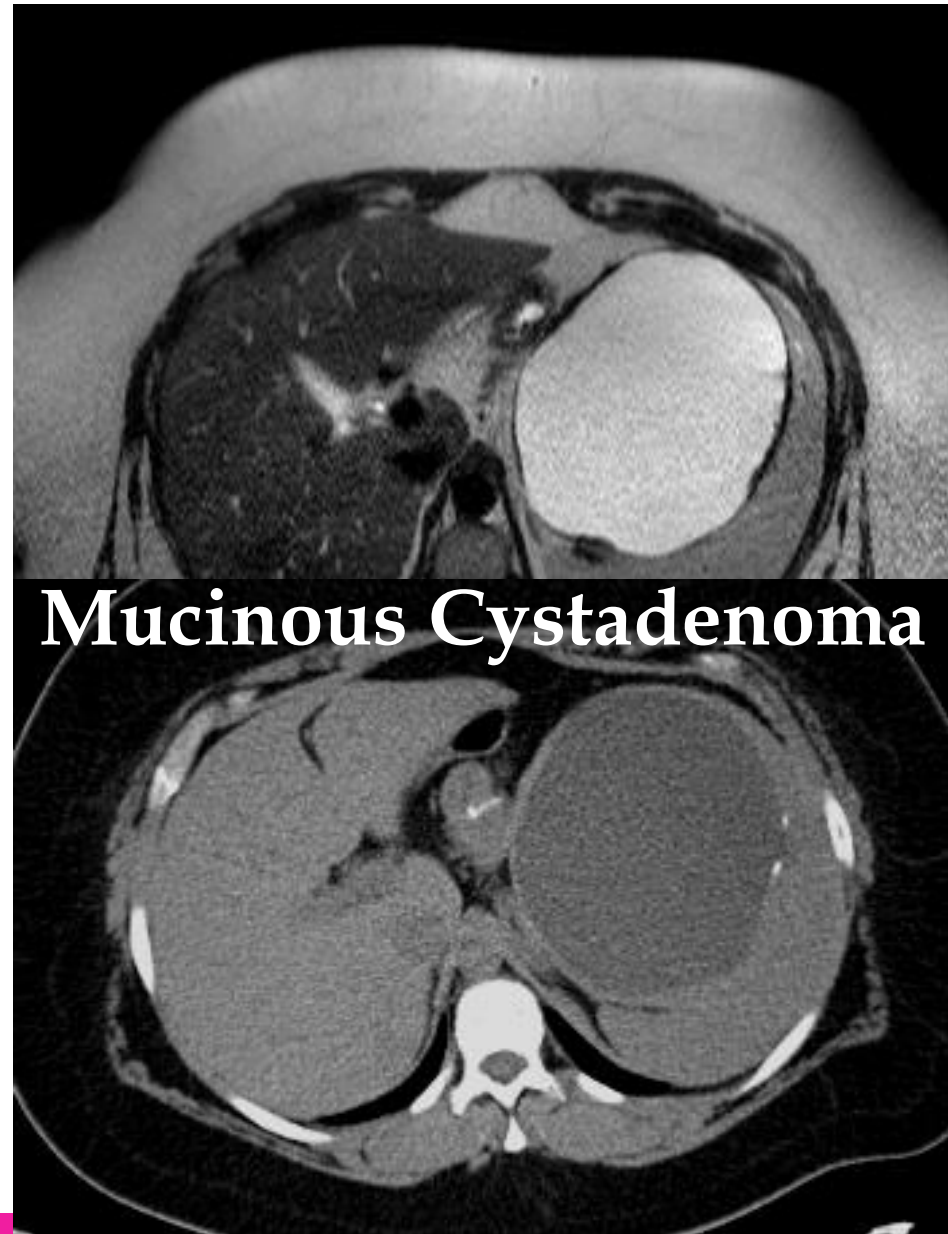
Location: body-tail
Size : > 3 cm
Pattern: unilocular
Content: homogenous
Septa: no
Wall: thin
Solid component: no
Calcifications: thin/peripheral
MPD normal



Pancreatic Cystic Lesions

56 yo woman
Gastric bypass
Abdominal pain
No history of AP/CP

Location: body-tail
Pattern: unilocular
Content: homogenous
Septa: no
Wall: thin
Solid component: no
Calcifications: *thin/peripheral*
MPD: normal



Mucinous Cystadenoma

Mucinous Cystadenoma: key points

- 50% of all cystic neoplasm: « macrocystic adenomas »

- F (40-60y) > 95% (**Mother**)

- **Body-Tail** > 95%

- Well-encapsulated uni-multilocular cyst > 2 cm (mean 8-10 cm)

- **Thin calcifications peripheral and eccentric: 15% (pathognomonic)**

- Ovarian-type stroma (**pathognomonic**)

- Malignant degeneration: 6%-27%

- MRCP: normal MPD; **no communication**

- Challenge: young woman, unilocular mass

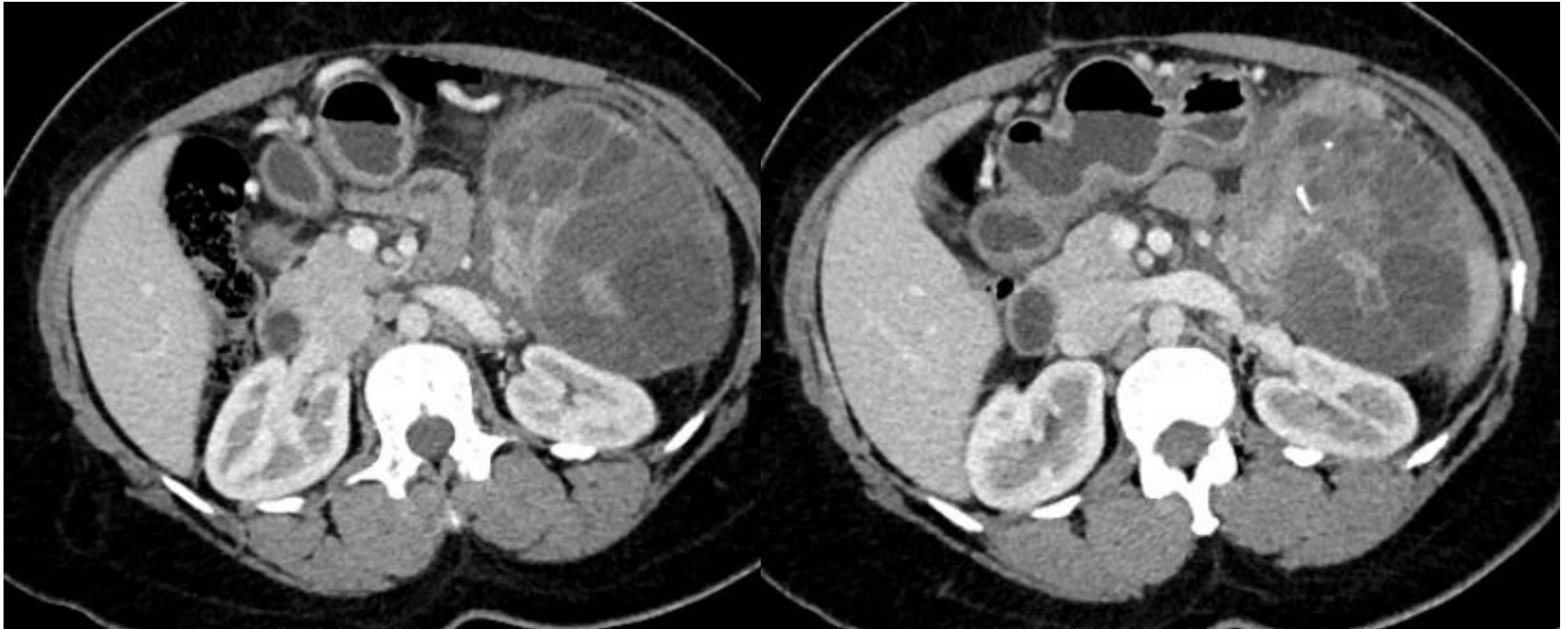
- **Treatment: oncological surgical resection (FU for lesion < 4cm and no risk factors)**

Mucinous Cystadenoma

Risk factors for malignancy

- Large tumor size: > 4 cm
- Asymmetric wall thickening, (enhancing) solid component, associated mass
- Peripheral (eggshell) calcifications

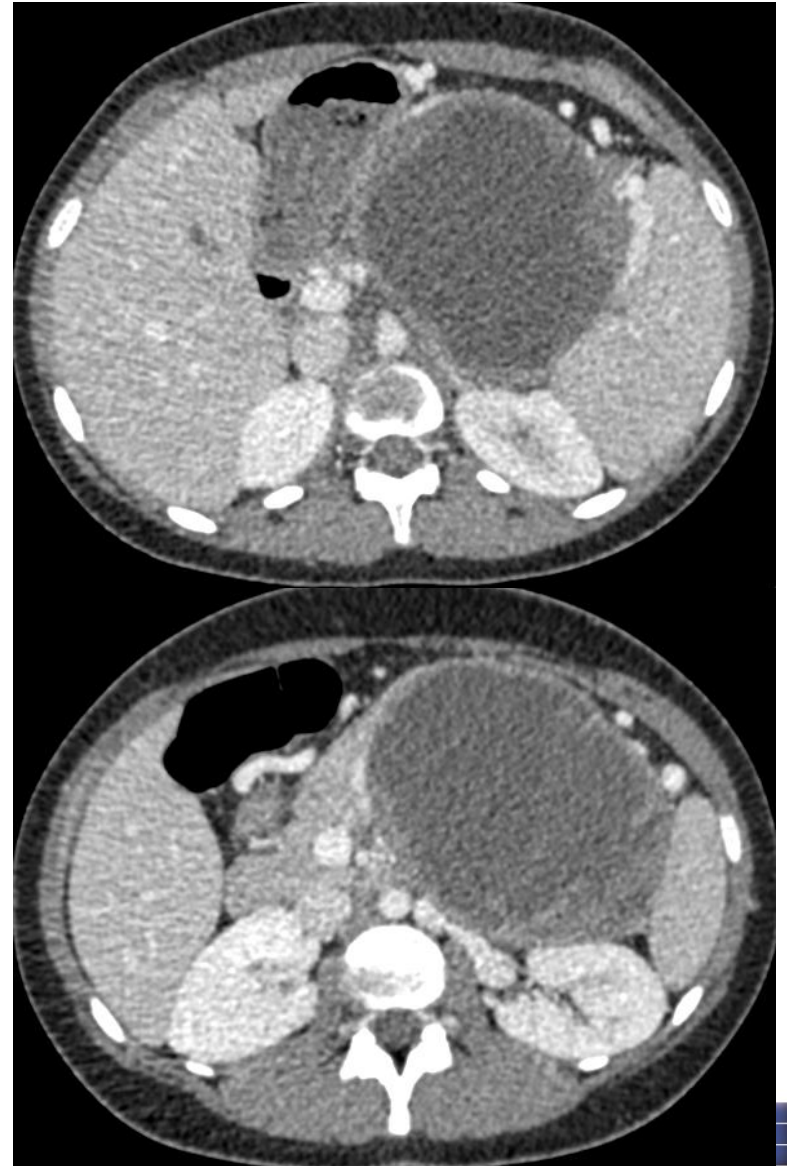
Mucinous cystadenoma/adenocarcinoma



Pancreatic Cystic Lesions

17 yo woman
epigastric pain
loss of weight
No history of AP/CP

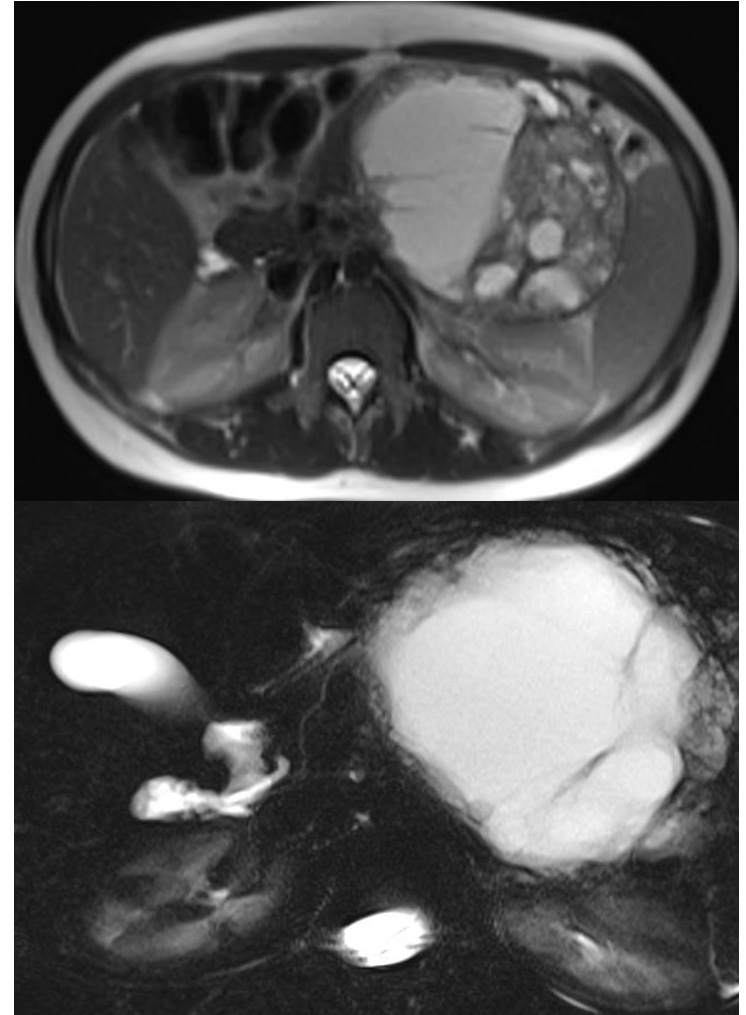
Location: body-tail
Size: >3 cm
Pattern: unilocular
Content: homogeneous
Septa: yes
Capsule: thick
Solid component: yes
Calcifications: no



Pancreatic Cystic Lesions

17 yo woman
epigastric pain
loss of weight
No history of AP/CP

Location: body-tail
Size: >3 cm
Pattern: unilocular
Content: heterogenous
Septa: yes
Capsule: thick
Solid component: yes
Calcifications: no
MPD: normal



Pancreatic Cystic Lesions

17 yo woman

epigastric pain

loss of weight

No history of AP/CP

Location: body-tail

Size: >3 cm

Pattern: unilocular

Content: heterogenous

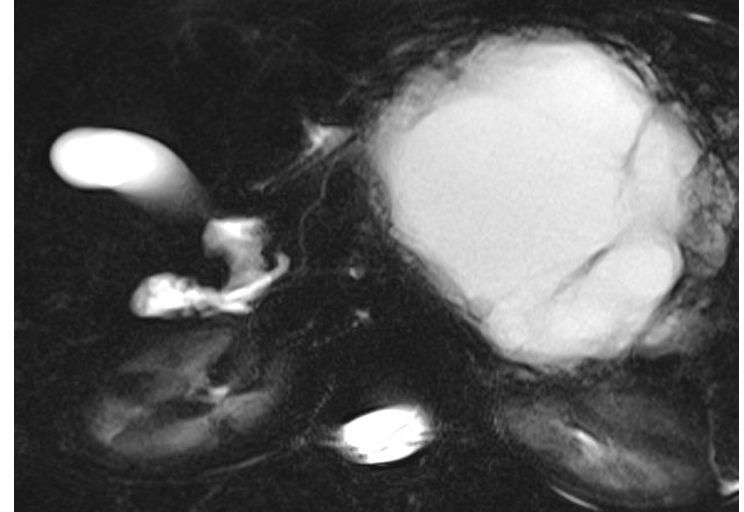
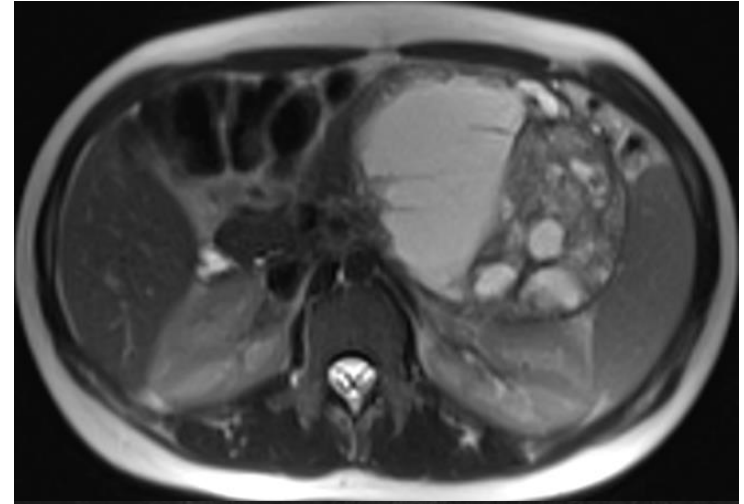
Septa: yes

Capsule: thick

Solid component: yes

Calcifications: no

MPD: normal



Solid pseudopapillary T: key findings

- 3% of all cystic neoplasm
- F (20-30y) > 90% (**Daughter**)
- **Body-Tail** > Head
- Well-encapsulated large mass with **solid and cystic** components
- Intra-T haemorrhage
- Malignant potential: 10-20%
- MRCP: normal MPD; **no communication**



Pancreatic Cystic Lesions

70 yo woman
Incidental finding
Asymptomatic
No previous history

Location: neck-body

Size: > 3 cm

Pattern: multilocular

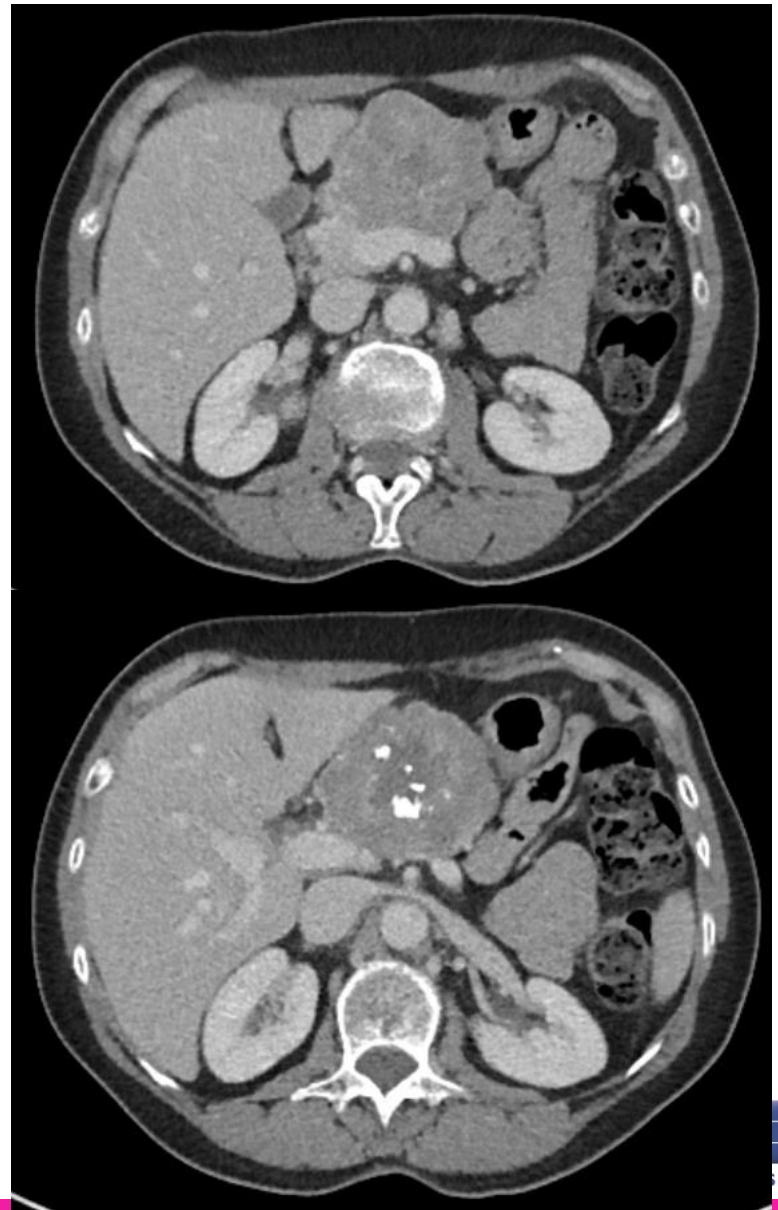
Content: heterogenous (?)

Septa: yes

Capsule: yes

Solid component: yes (?)

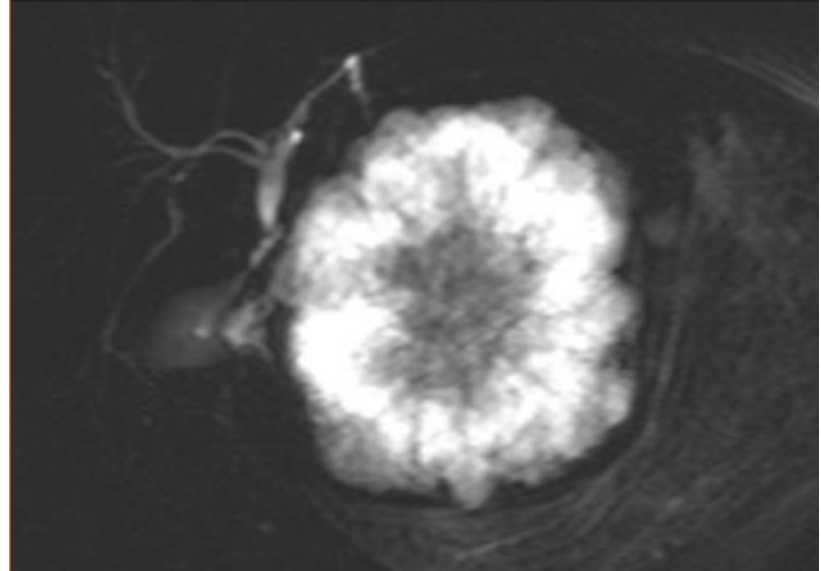
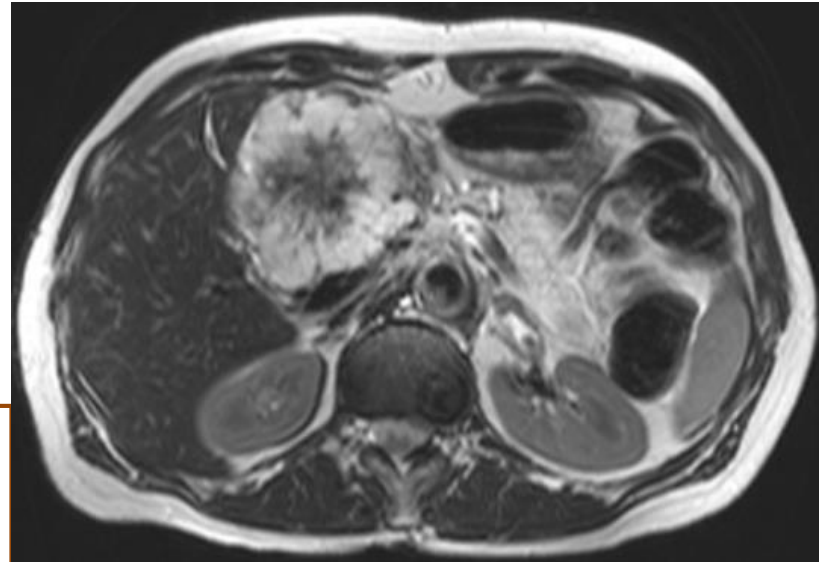
Calcifications: yes/central/thick



Pancreatic Cystic Lesions

70 yo woman
Incidental finding
Asymptomatic
No previous history

Location: neck-body
Size: > 3 cm
Pattern: honey-comb
Content: cysts with central fibrosis
Septa: yes
Capsule: yes
Solid component: no
Calcifications: yes/central/thick
MPD: normal



Pancreatic Cystic Lesions

70 yo woman

Incidental finding

Asymptomatic

No previous history

Location: neck-body

Size: > 3 cm

Pattern: **honey-comb**

Content: **cysts with central fibrosis**

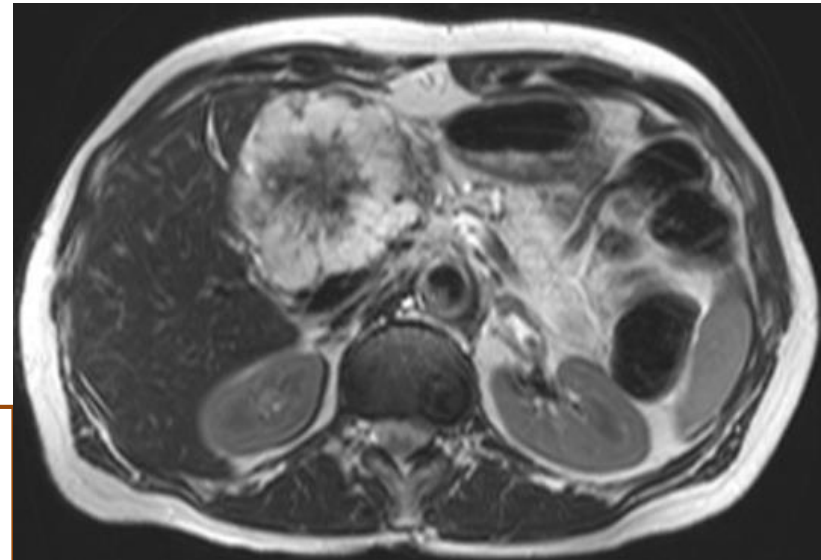
Septa: yes

Capsule: yes

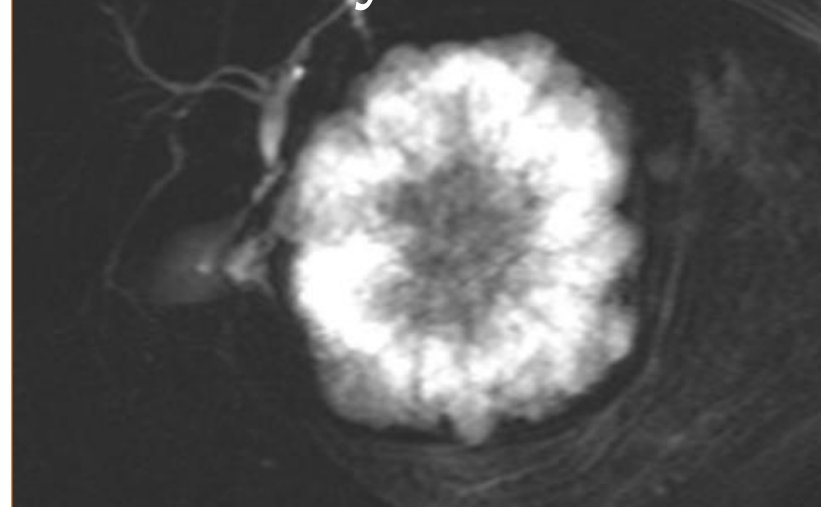
Solid component: no

Calcifications: **yes /central/thick**

MPI: normal



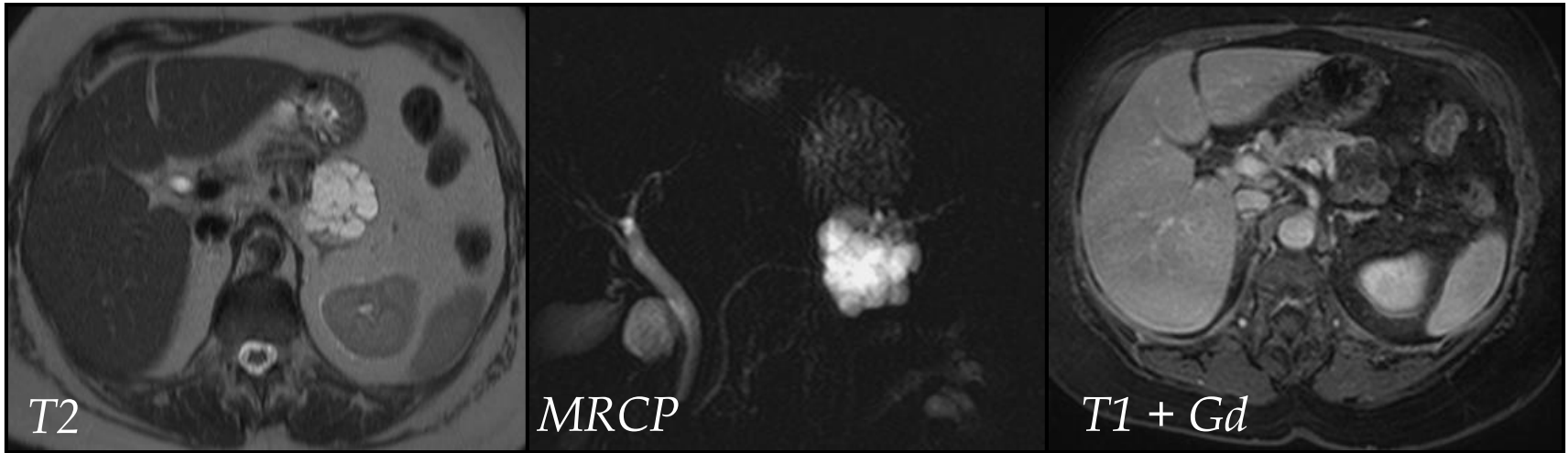
Serous Cystadenoma



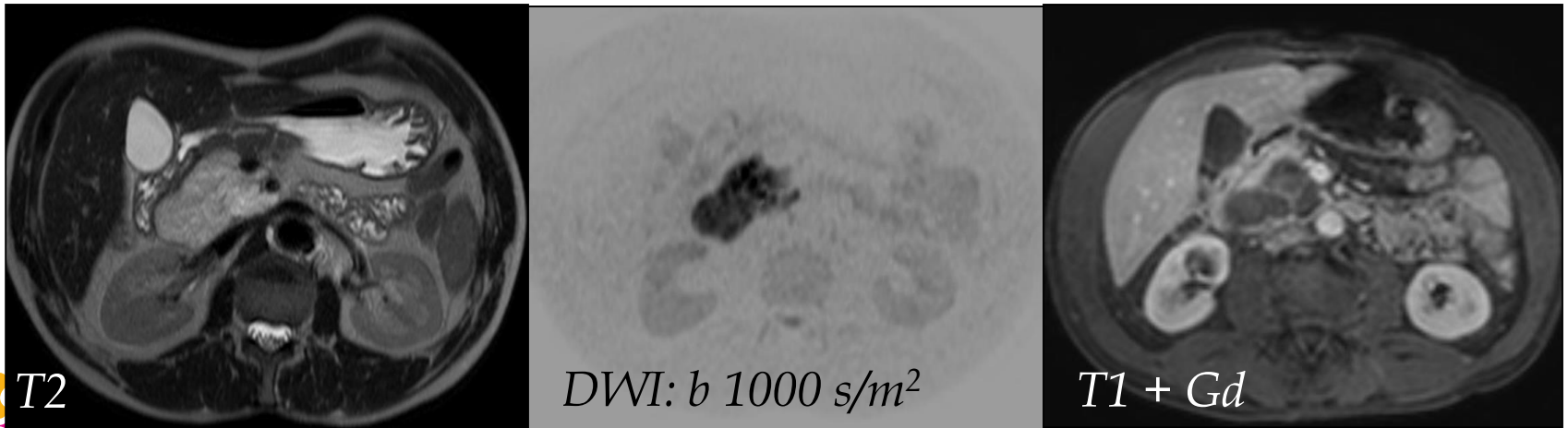
Serous Cystadenoma

- 30% of all cystic neoplasm: « microcystic adenomas »
- F >> M (**Grand-mother**)
- **Head** >> Body-Tail
- Polycystic (70%), Honeycomb (20%), Oligocystic (10%) patterns
- Cysts < 2 cm (except the olygocystic)
- **Central** fibrous scar with **calcification** (30%) = **pathognomonic**
- Size: mean 5 cm (few to > 25 cm)
- MRCP: normal pancreatic duct ; **no communication**
- Gd: enhancement of septa and walls
- Benign neoplasm: no indication for surgery unless symptomatic
- Challenges : patient, uncinate process, MPD dilatation, unilocular macrocystic pattern (DD: MCA/IPMT)

Serous Cystadenoma



Polycystic pattern 70% : small cysts < 2 cm



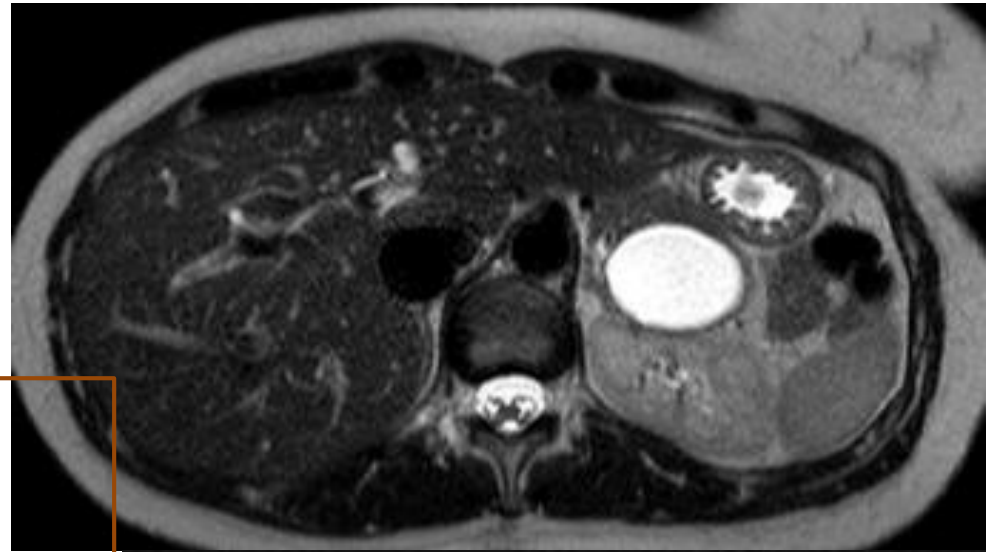
Honeycomb pattern 20%: subcentimetric cysts, pseudo-solid mass



Pancreatic Cystic Lesions

32 yo woman
Incidental cystic lesion
No history of AP/CP

Location: tail
Size: 4 cm
Pattern: unilocular
Content: homogenous
Septa: no
Wall thickness: thin
Solid component: no
Calcifications: no
MPD: normal/ no communication



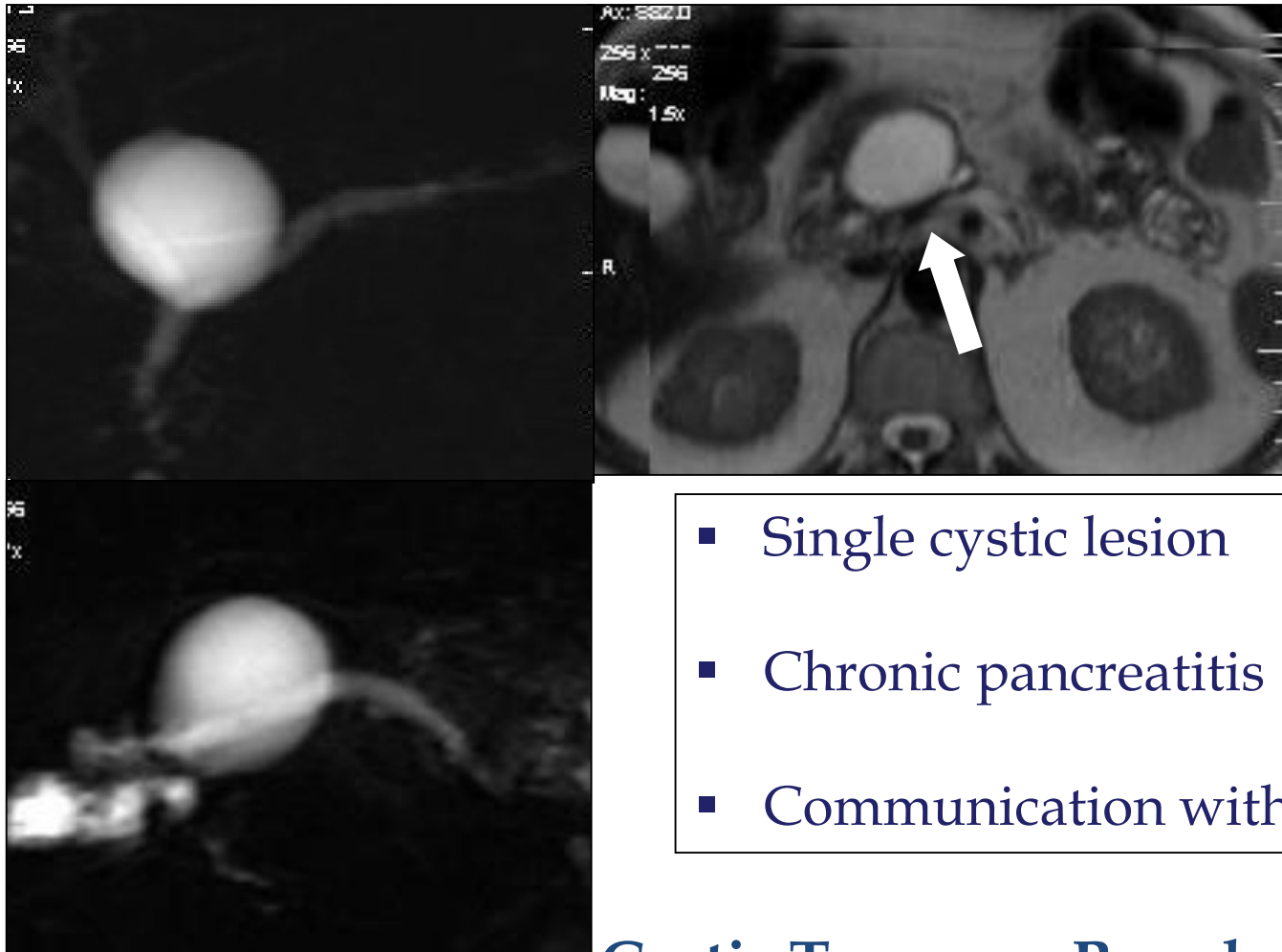
Mucinous CA?
Serous CA?
Other?

**Serous cystadenoma
oligocystic**



Challenges: SCA vs Pseudocyst

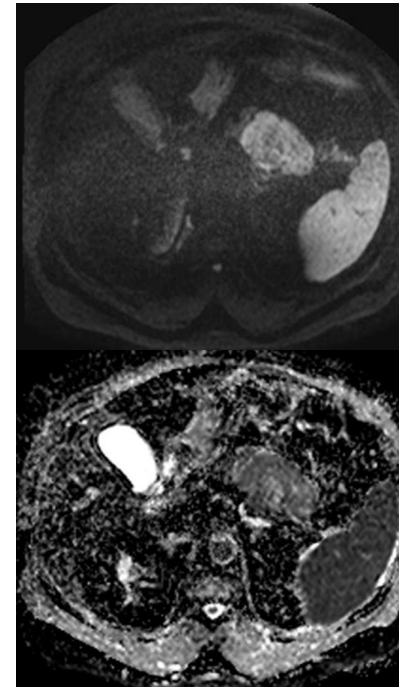
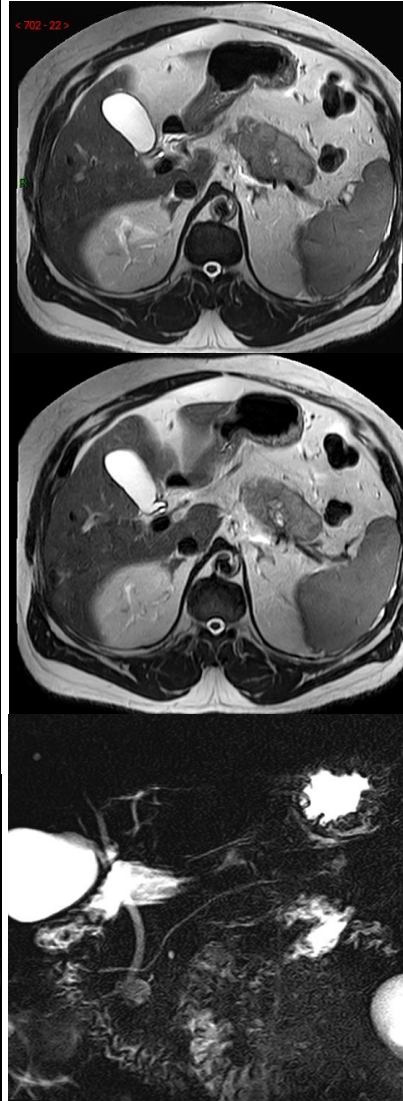
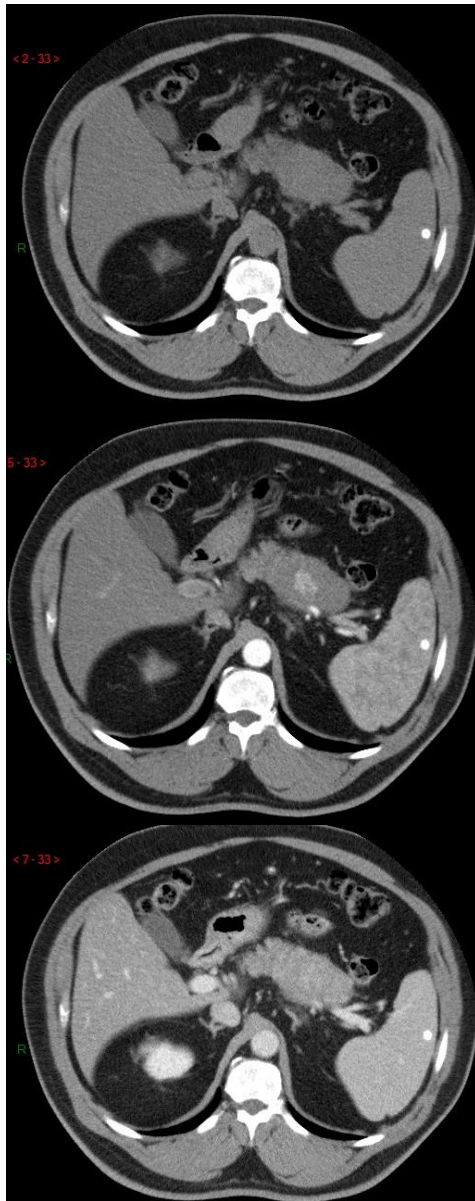
Oligocystic or macrocystic pattern



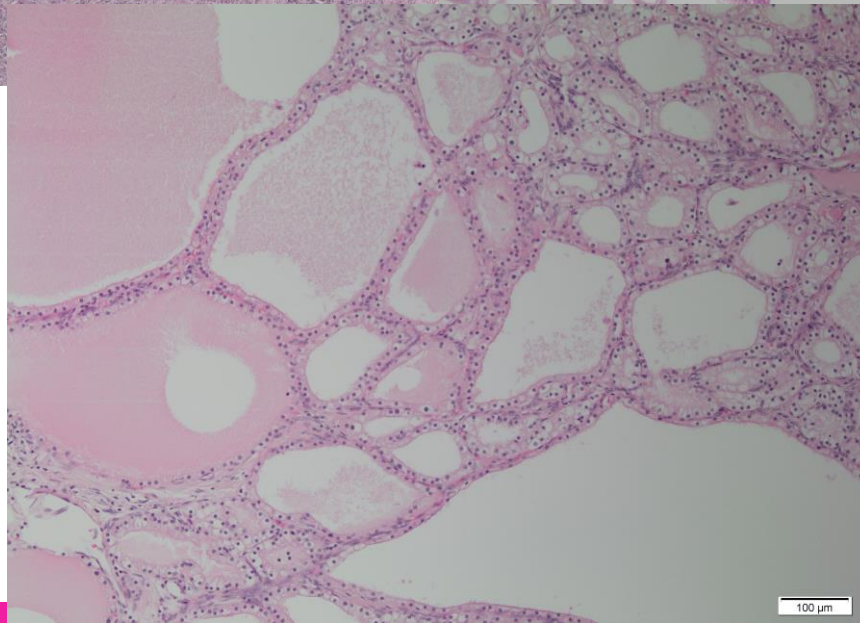
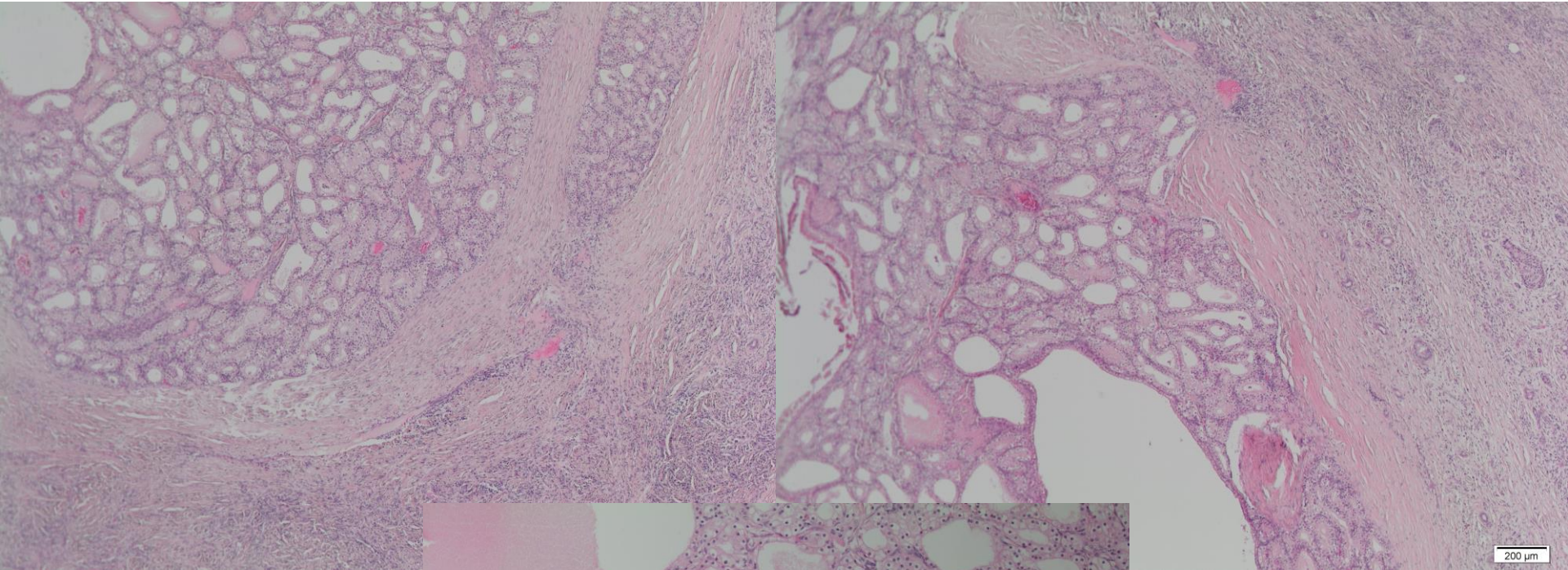
- Single cystic lesion
- Chronic pancreatitis
- Communication with MPD?

Pancreatic Cystic Lesions

67 yo man
Abdominal pain
Nausea, no vomiting
No significant clinical history
CA 19.9 N



Final diagnosis: *Serous cystadenoma*



Serous Cystadenoma

Table 1

Benign and Malignant Cystic Pancreatic Lesions Resected

Study and Year of Publication	No. of Lesions Resected*	No. of Malignant Lesions Resected after Detection [†]	No. of Benign Lesions Resected [‡]	No. of Benign Lesions Resected after Detection [§]	No. of Benign Lesions Resected during Surveillance	No. of Serous Cystadenomas Resected [#]
Chung et al (91), 2013	247 (28)	61/204 (29.9)	43/247 (17.4)	33/204 (16.2)	10/43 (23)	31/43 (72)
Correa-Gallego et al (28), 2010	159 (100)	25/136 (18.4)	47/159 (29.6)	39/136 (28.7)	8/23 (35)	26/47 (55)
Fernandez-del Castillo et al (169), 2003	212 (37)	66/212 (31.1)	62/212 (29.2)	62/212 (29.2)	NS	23/62 (37)
Ferrone et al (7), 2009	256 (71)	20/101 (19.8)	59/256 (23.0)	19/101 (18.8)	12/13 (92)	34/59 (58)
Goh et al (92), 2008	176 (40)	55/176 (31.2)	70/176 (39.8)	70/176 (39.8)	NS	47/70 (67)
Grobmyer et al (178), 2009	78 (48)	13/78 (17)	28/78 (36)	28/78 (36)	NS	15/28 (54)
Lee et al (41), 2008	166 (27)	31/166 (18.7)	38/166 (22.9)	38/166 (22.9)	NS	38/38 (100)
Lee et al (179), 2007	92(100)	11/72 (15)	33/92 (36)	24/72 (33)	9/20 (45)	25/33 (76)
Morris-Stiff et al (8), 2013	68 (100)	10/68 (15)	20/68 (29)	NA	NS	15/20 (75)
Salvia et al (29), 2012	476 (41)	23/476 (4.8)	43/476 (9)	NA	NA	13/43 (30)
Spinelli et al (5), 2004	49 (NA)	10/49 (20)	15/49 (31)	NA	NS	14/15 (93)
Total	1979	325/1738 (18.7)	458/1979 (23.1)	313/1145 (27.3)	39/99 (39.4)	281/458 (61.4)

23% of all resected lesions were benign

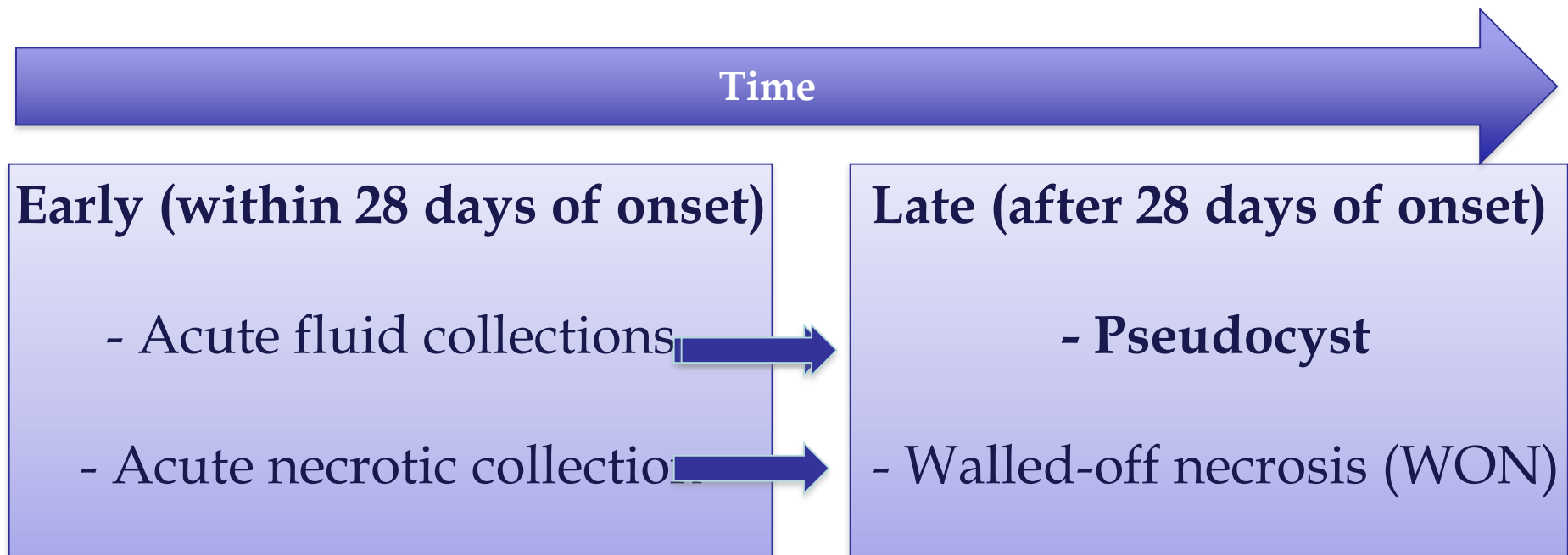
61% were SCA

Pancreatic Cystic Lesions

“Pseudocyst”

Pancreatic fluid collection AP/CP definition according to:

- delay since onset (early/late)
- content

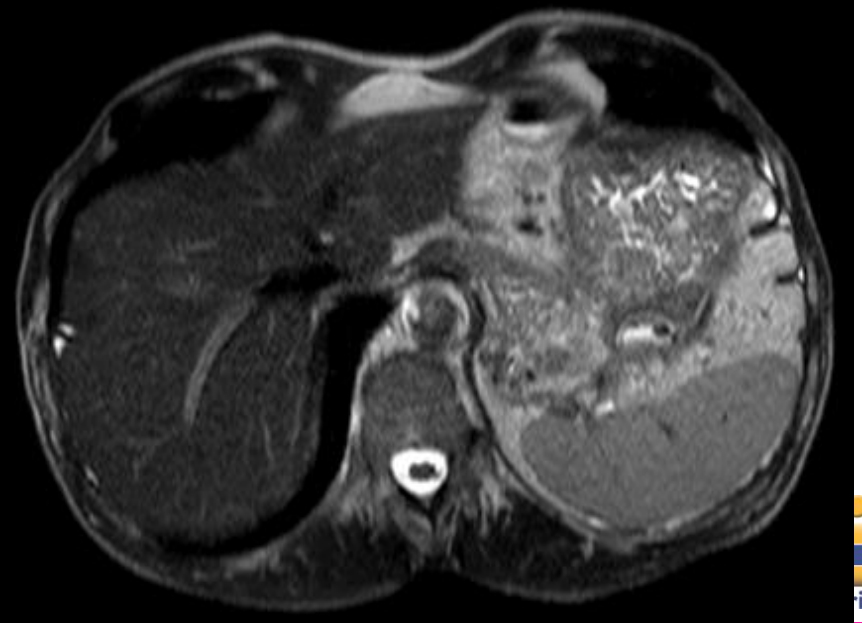
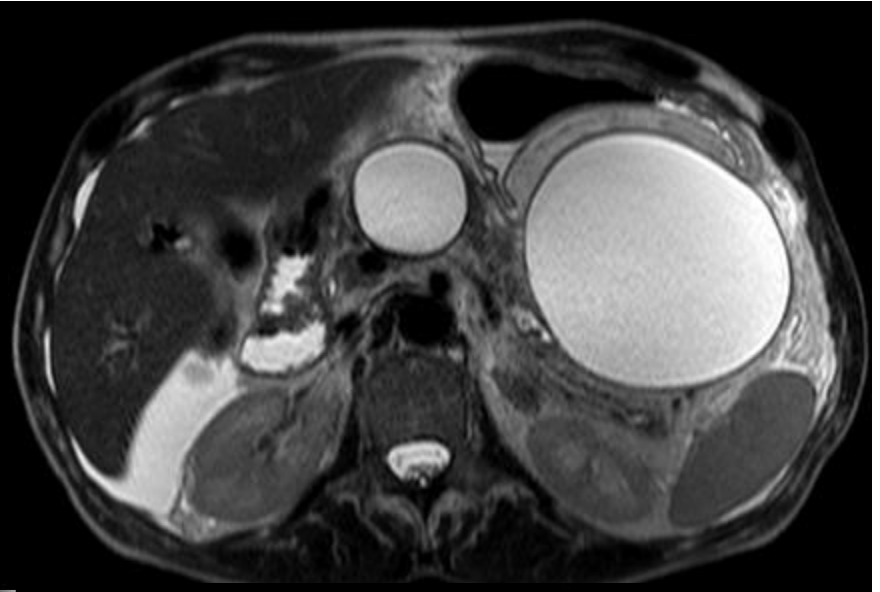
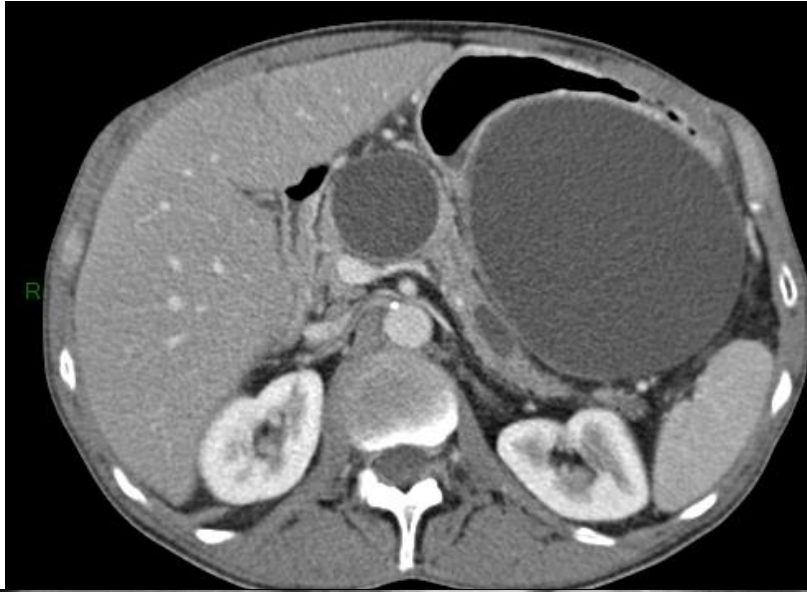


Pseudocyst

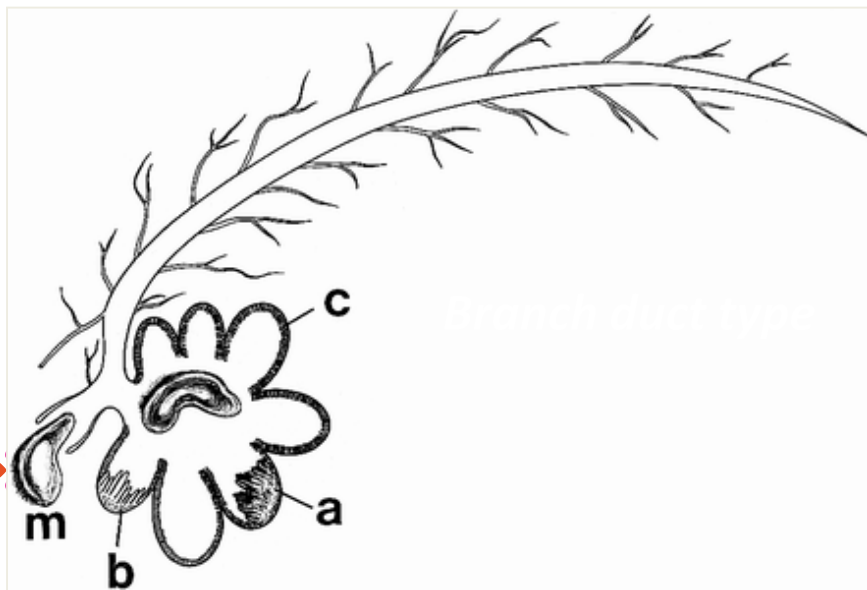
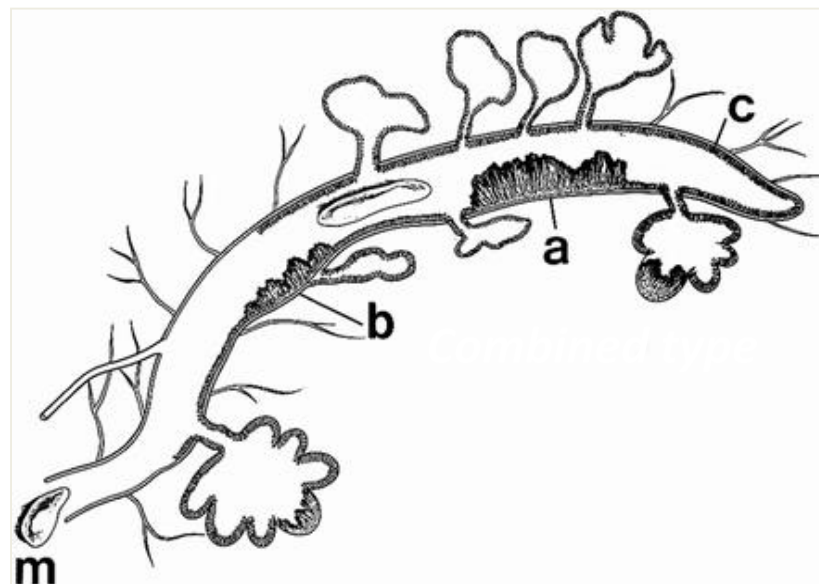
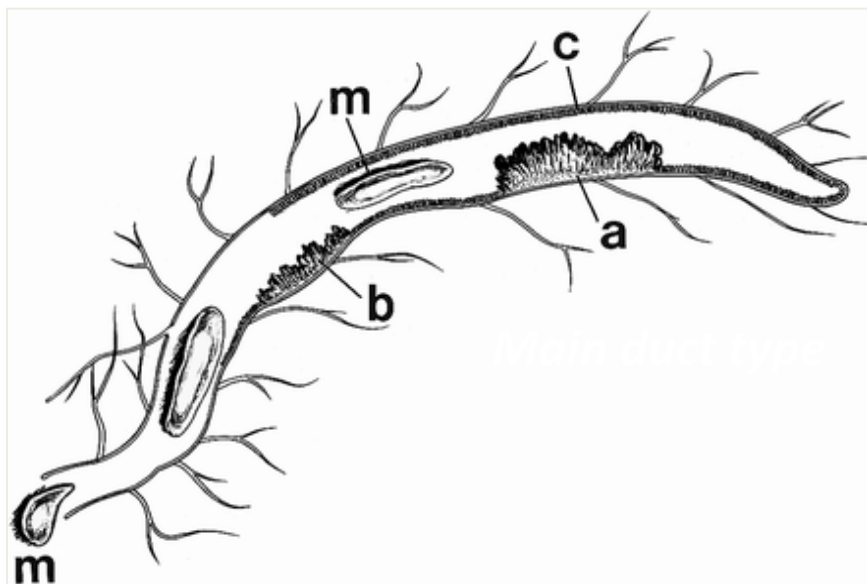
Definition according to the Revised Atlanta Classification 2012

- I. Fluid collection in the peripancreatic tissues (AP/CP)
- II. Surrounded by a well-defined wall
- III. Arises from disruption of MPD or side branches
- IV. No solid material in content (MR > CE-CT)
- V. Fluid analysis: increased amylase activity

Pseudocyst



Intraductal Papillary Mucinous Neoplasm



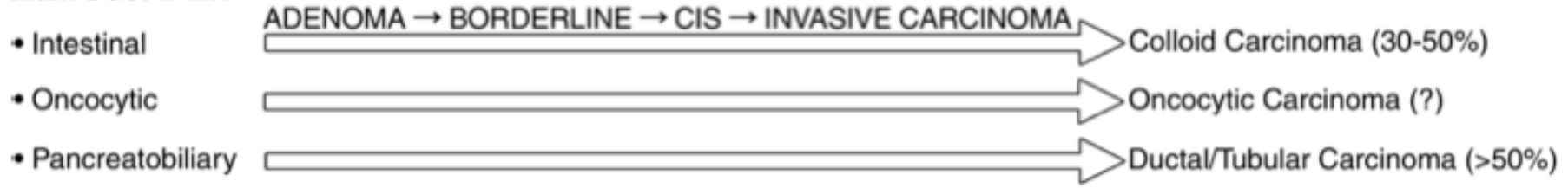
From Lim JH et al; Radiographics 2001

Intraductal Papillary Mucinous Neoplasm

Carcinogenetic progression of IPMN phenotypes

Figure 2

Main Duct-IPMN



Branch Duct-IPMN



IPMN are macroscopic markers for invasive pancreatic cancer

IPMN: MD vs BD-type

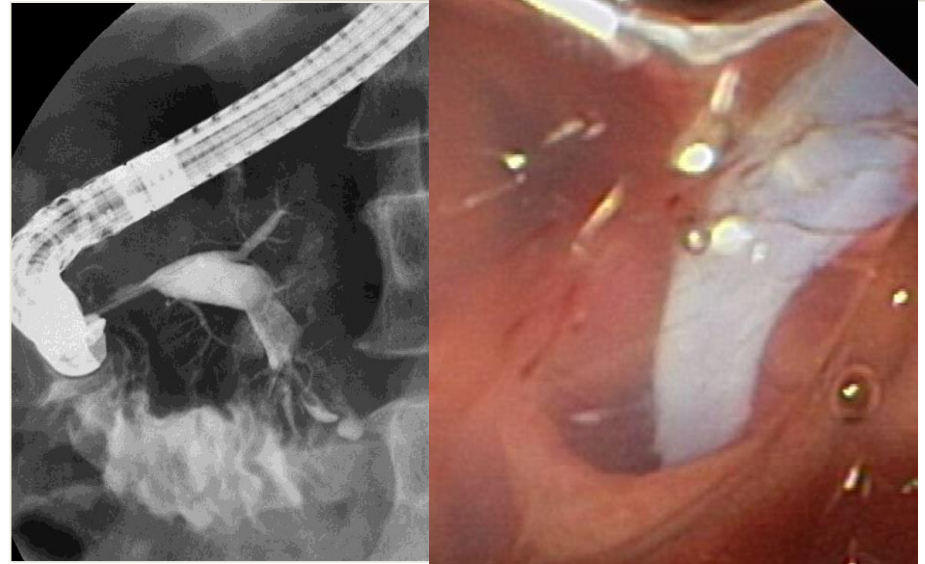
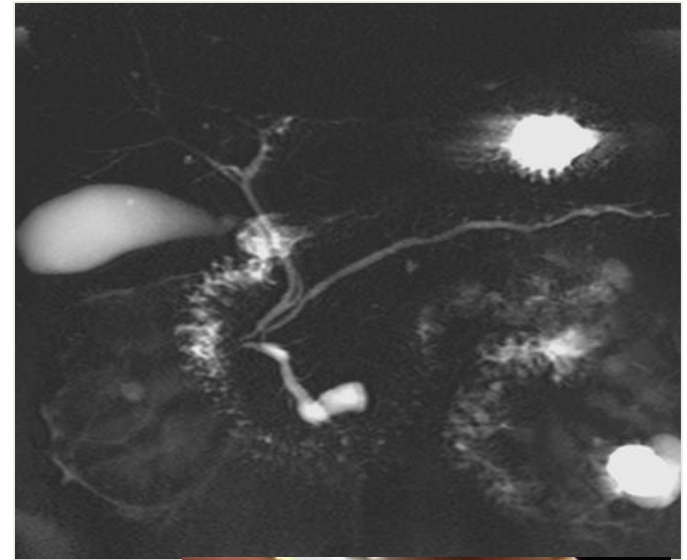
Frequency of malignancy

Main-duct type : 61.6% (36-100%)

Branch-duct type: 31% (14-48%)

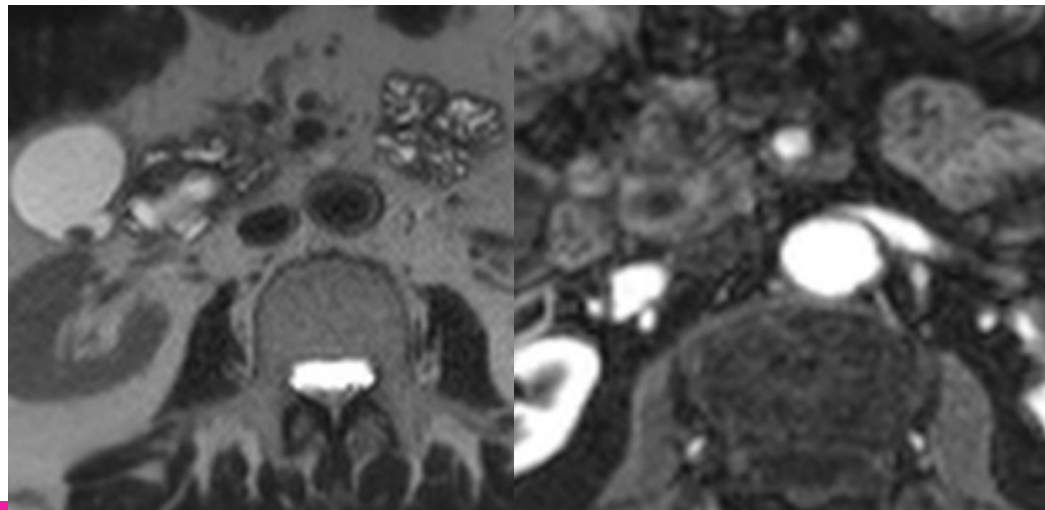
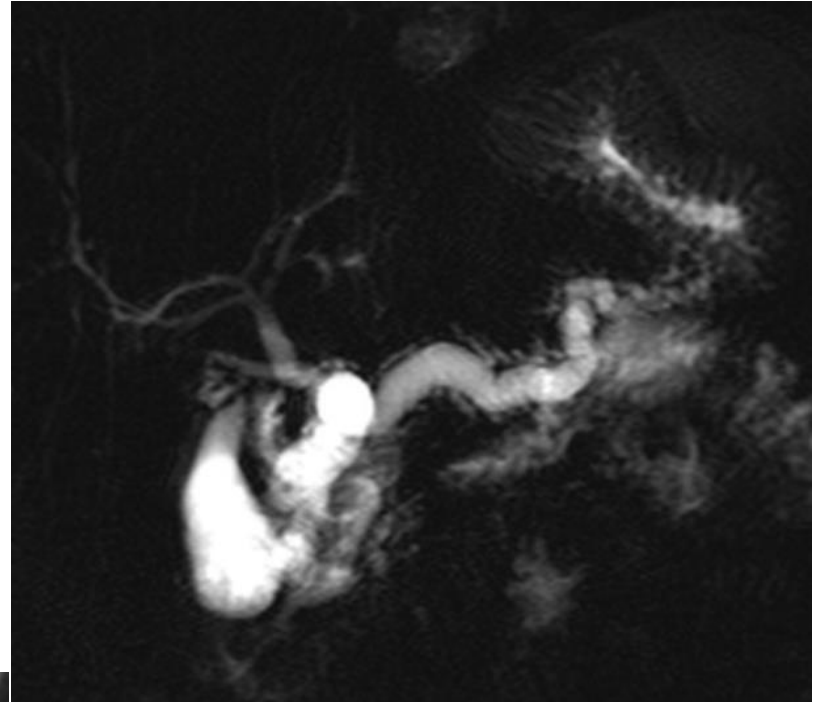
IPMN: Branch-duct type

- ◆ Uncinate process (most frequently) but it can be multifocal (30%)
- ◆ Unilocular or multicystic
- ◆ Communication with the MPD is crucial for diagnosis
- ◆ MRCP > ERCP (extent of disease)
- ◆ EUS: internal architecture



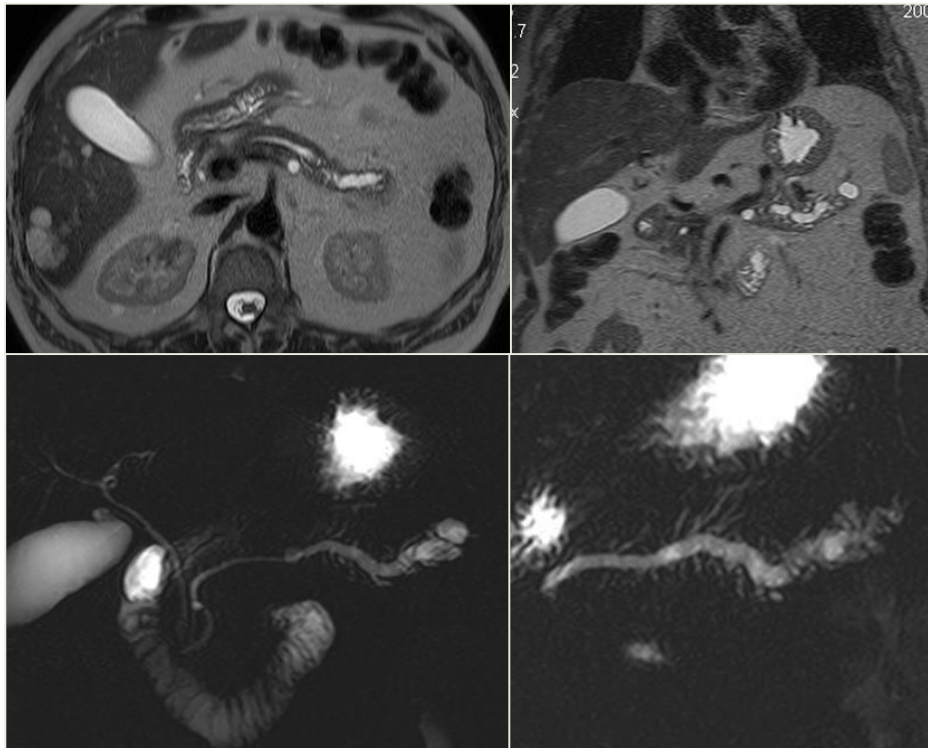
IPMN: Main-duct type

- Segmental or diffusion dilatation (absence of other causes)
- Mucin-filled MPD (mobile)
- Parenchymal atrophy
- Enhancing nodules



IPMN: Main-duct type challenges

- Differential diagnosis with chronic pancreatitis
 - Dilatation w/o stricture
 - ERCP still recommended in doubtful cases



Criteria for resection of IPMN

- **Relative Criteria**

- Growth rate 5 mm/year
- Increased CA 19.9
- MPD between 5-9 mm
- Symptoms (AP, diabetes)
- Mural nodules < 5 mm

- **Absolute Criteria**

- Jaundice
- Mural nodules > 5 mm
- MPD dilatation > 10 mm
- High grade dysplasia at cytology

Mural nodule ≥ 5 mm at EUS:

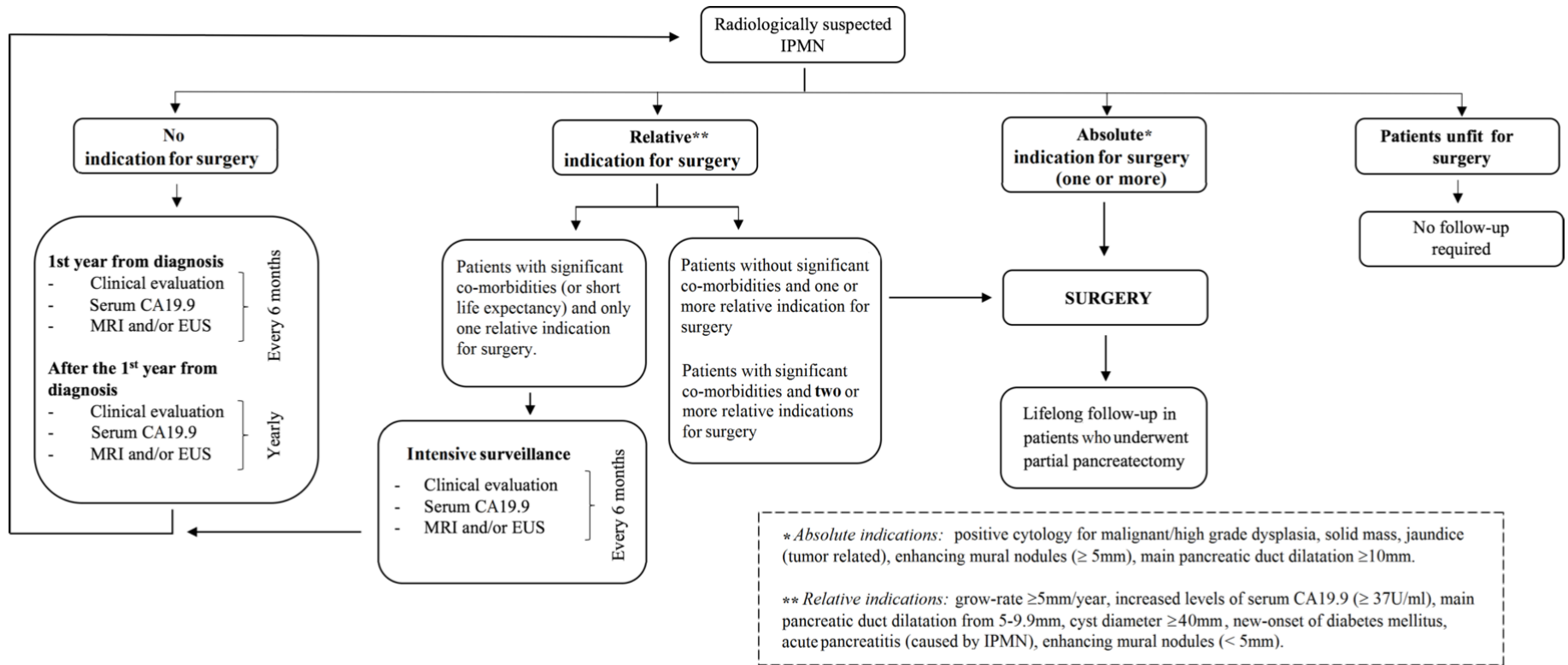
Sensitivity 73-85%

Specificity 71-100%

For high grade dysplasia/cancer

European Guidelines

Management of IPMNs



IPMN: Predictive factors for malignancy

High risk stigmata

- Lesion with obstructive jaundice
- Enhancing mural nodule >5mm
- Dilated MPD > 10 mm

Resection

Worrisome features

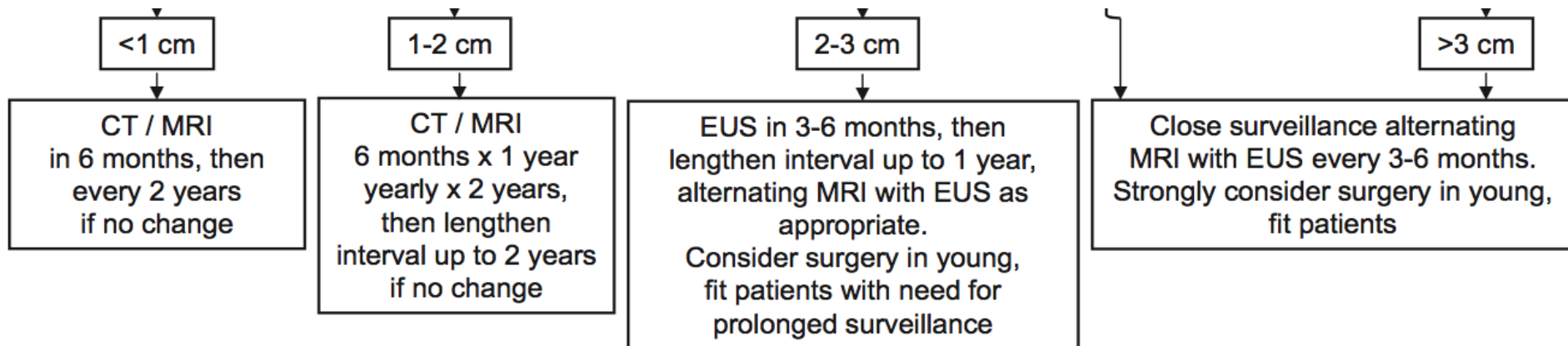
- Size > 3 cm
- Pancreatitis
- enhancing mural nodule <5 mm
- Thickened enhancing wall
- Dilated MPD (5-9mm)
- Distal pancreatic atrophy
- Lymphadenopathy
- CA 19-9 increased
- Rapid growth

*Surveillance
EUS-FNA*

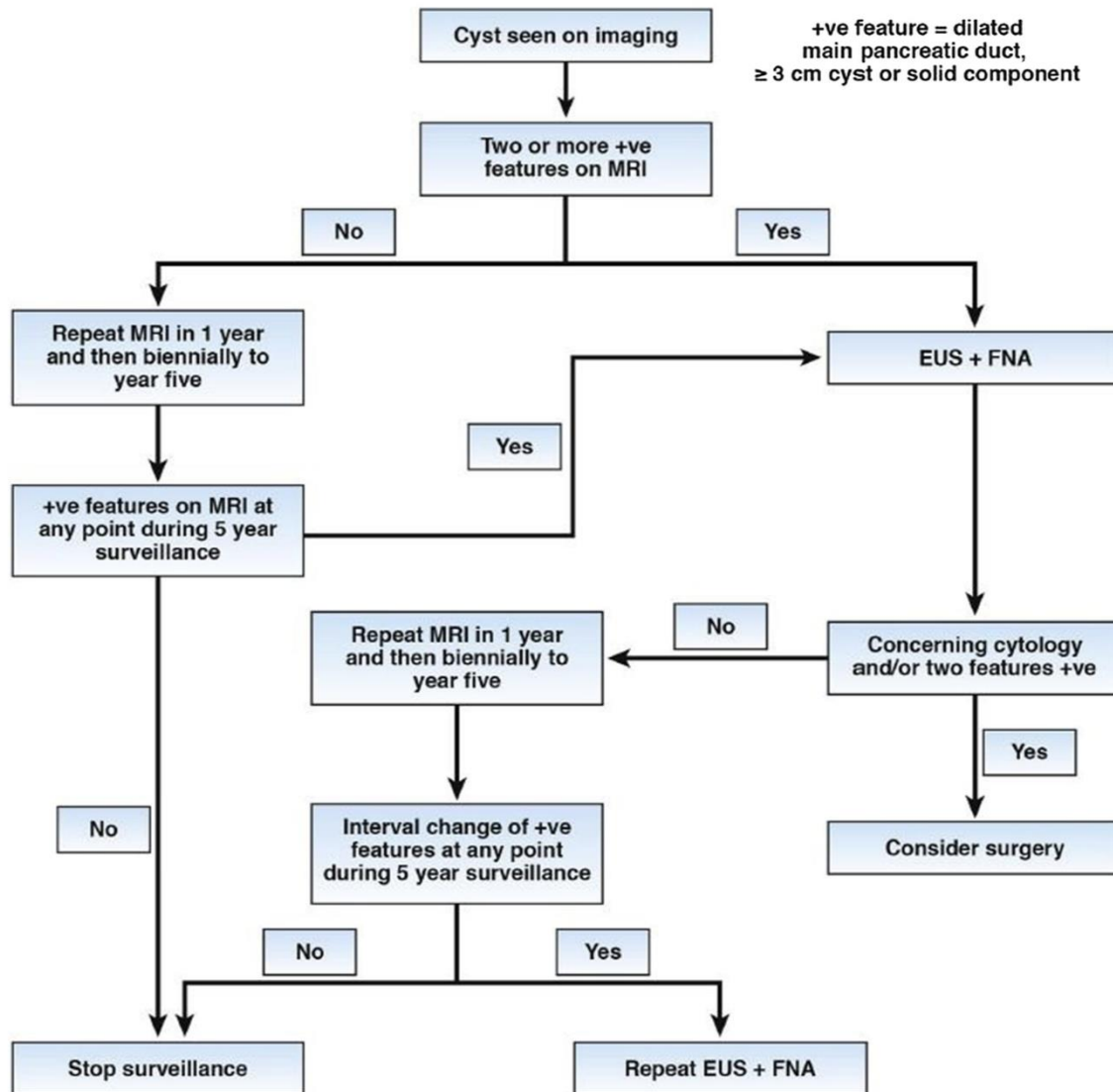
Revision of international consensus Fukuoka guidelines
for the management of IPMN of the pancreas
Tanaka M et al Pancreatology 2017

Fukuoka Guidelines

Management of IPMN



AGA Guidelines



IPMN: key points

- 18% of all cystic neoplasm

- M>F (~ 60y)

- Duct involvement: **BD-type, MD-type & mixed type**

- Communication with PD**

- MD-type challenge: DD chronic pancreatitis

- Malignant potentiality: **precursor of pancreatic cancer**

- Frequency of malignancy: **MD-type >>BD-type**

- Treatment : **Worrisome features/Relative criteria : Surveillance**

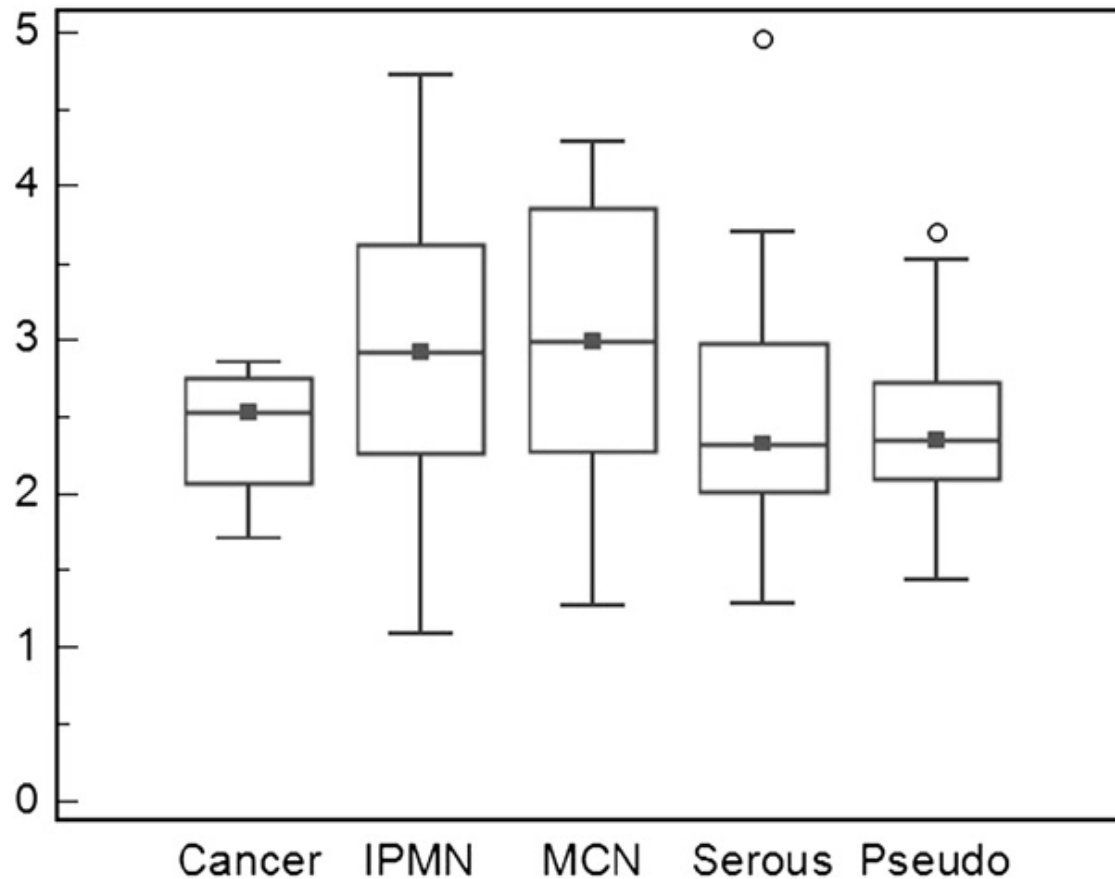
High risk stigmata/Absolute criteria : Resection

DD neoplastic vs non-neoplastic cysts

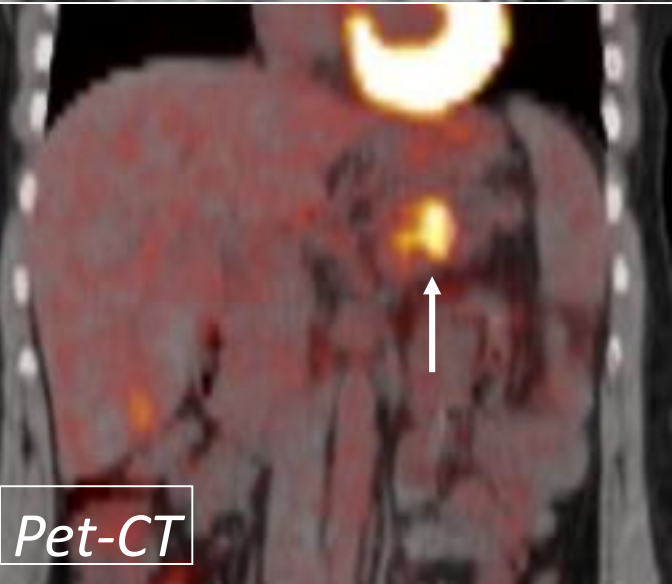
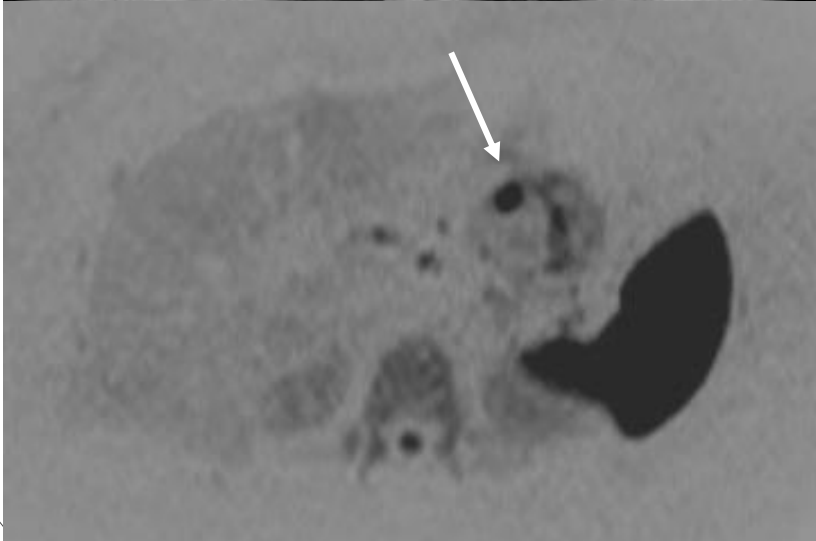
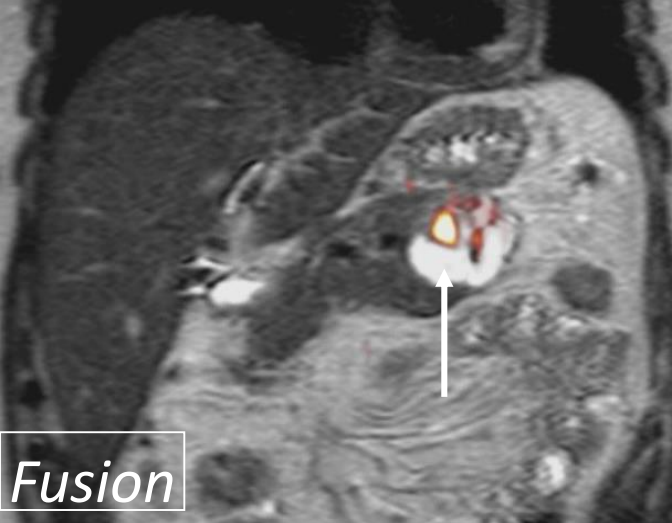
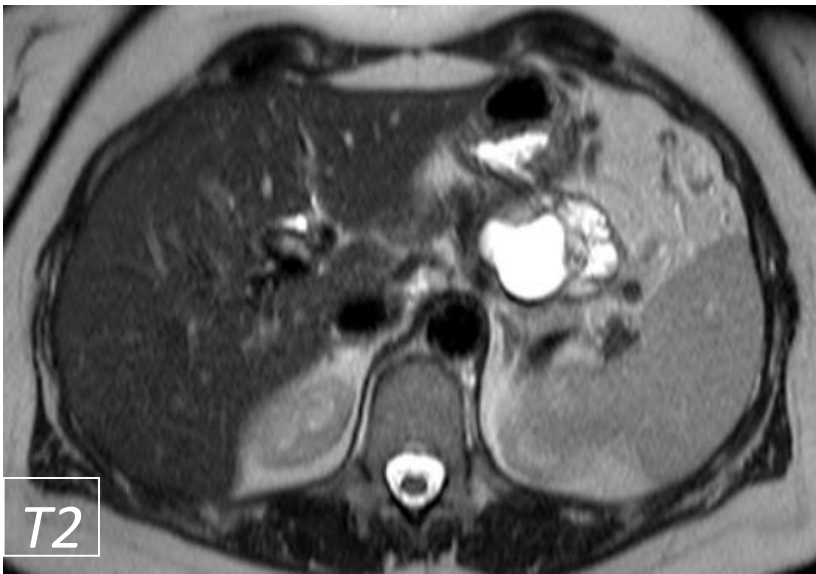
- *MR Diffusion-weighted imaging?*

Pancreatic cystic lesions and DWI

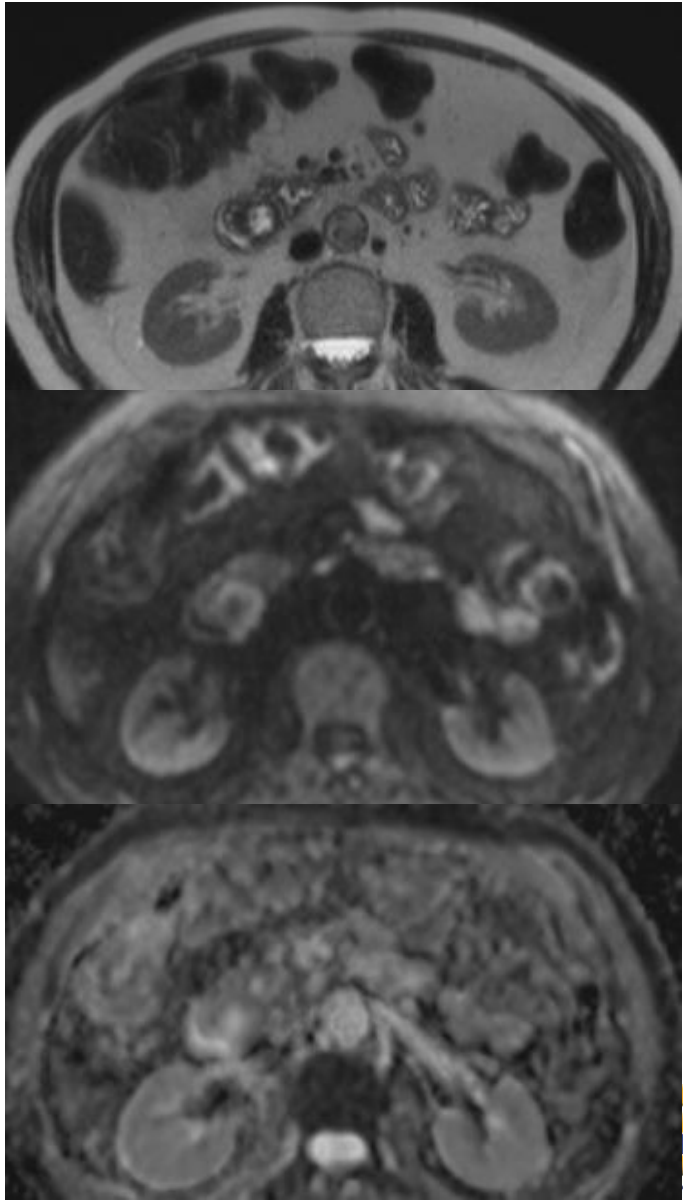
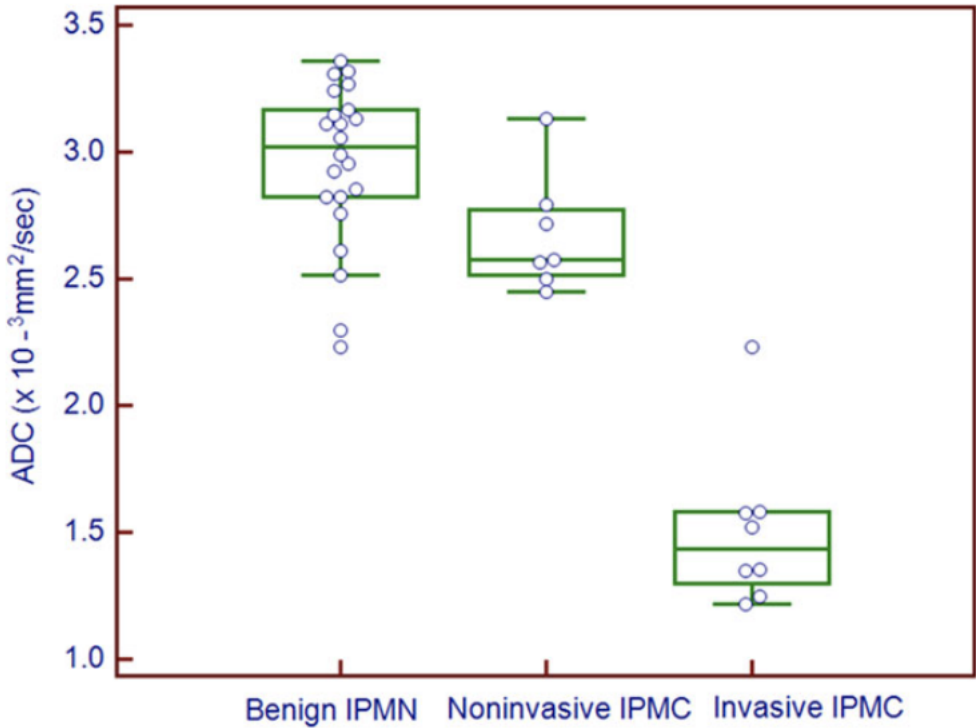
ADC of various pancreatic cystic lesions



MR Diffusion-weighted imaging



MR Diffusion-weighted imaging



EUS-cyst fluid/tissue analysis

Table III. Fluid analysis from sampling.

	Pseudocyst	SCNs	MCNs	IPMNs
Fluid analysis				
Amylase	High [25]	Low, <250 U/L [41]	Low-moderate, <250 U/L [41,108]	High [25]
CEA (ng/ml)	<5 [41]	<5 [20,41]	>800 [41]	5–800, variable Malignant IPMN: >110 ng/ml [42]
CA 19-9 (U/ml)	<37 [41]	<37 [20]	Variable	Variable
Cytology	Presence of abundant acute inflammation and histiocytes Absence of glandular epithelium [42]	Glycogenated cuboidal epithelium, abundant clear cytoplasm, non-mucinous [20,42]	Columnar mucinous epithelium [42] Ovarian-type stroma	Ductal epithelium, papillary protrusions, mucinous [36]
Mucin staining; columnar epithelium	Negative [50]	Negative [20]	Positive [45]	Positive [45]
Glycogen staining; cuboidal epithelium		Positive [20,45]		

Molecular Markers

KRAS	-	-	+	+
GNAS	-	-	-	+
VHL	-	+	-	-
CTNNB1 mut	-	-	-	-
RNF43 mut	-	-	+	+

Conclusions

- **Increasing prevalence**
high-resolution imaging tools, detection in asymptomatic pts

- **CT & MR/MRCP**
high sensitivity/specificity for lesion detection/characterization

- **Biological behaviour and therapeutic management:**
SCA ≠ MCA ≠ IPMN ≠ PC

- **For DD:**
 - clinical data (age, gender , previous history,)
 - multimodality diagnostic approach:
 - CT/MR-MRCP
 - Endoscopy (ERCP/EUS)
 - Fluid analysis (EUS)

Conclusions

Table 1
Typical clinical and imaging features of common pancreatic cysts (Cited and modified from reference#2 with permission).

Characteristic	MCN	BD-IPMN	SCN	Pseudocyst
Sex (% female)	>95%	~55%	~70%	<25%
Age (decade)	4th, 5th	6th, 7th	6th, 7th	4th, 5th
Asymptomatic	~50%	mostly when small	~50%	nearly zero
Location (% body/tail)	95%	30%	50%	65%
Common capsule	yes	no	yes	N/A
Calcification	rare, curvilinear in the cyst wall	no	30–40%, central	no
Gross appearance	orange-like	grape-like	spongy or honeycomb-like	variable
Multifocality	no	yes	no	rare
Internal structure	cysts in cyst	cyst by cyst	microcystic and/or macrocystic	unilocular
Main pancreatic duct communication	infrequent	yes (though not always demonstrable)	no	common
Main pancreatic duct	normal or deviated	normal, or dilated to >5 mm, suggesting mixed type	normal or deviated	normal or irregularly dilated, may contain stones
Cyst fluid analysis	mucin, high CEA, <i>GNAS</i> wild, <i>RNF43</i> mutated	mucin, high CEA, <i>GNAS</i> frequently mutated, <i>RNF43</i> mutated	serous, very low CEA, VHL gene mutated, <i>RNF43</i> wild	nonmucinous, high amylase

Abbreviations: MCN, mucinous cystic neoplasm; BD-IPMN, branch duct intraductal papillary mucinous neoplasm; SCN, serous cystic neoplasm; N/A, not applicable; CEA, carcinoembryonic antigen.