



MASSACHUSETTS
GENERAL HOSPITAL

PATHOLOGY



*Advancing Diagnosis
and Discovery*



EUS-FNAB of GI Tract: Specimen Handling and Triage

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Massachusetts General Hospital

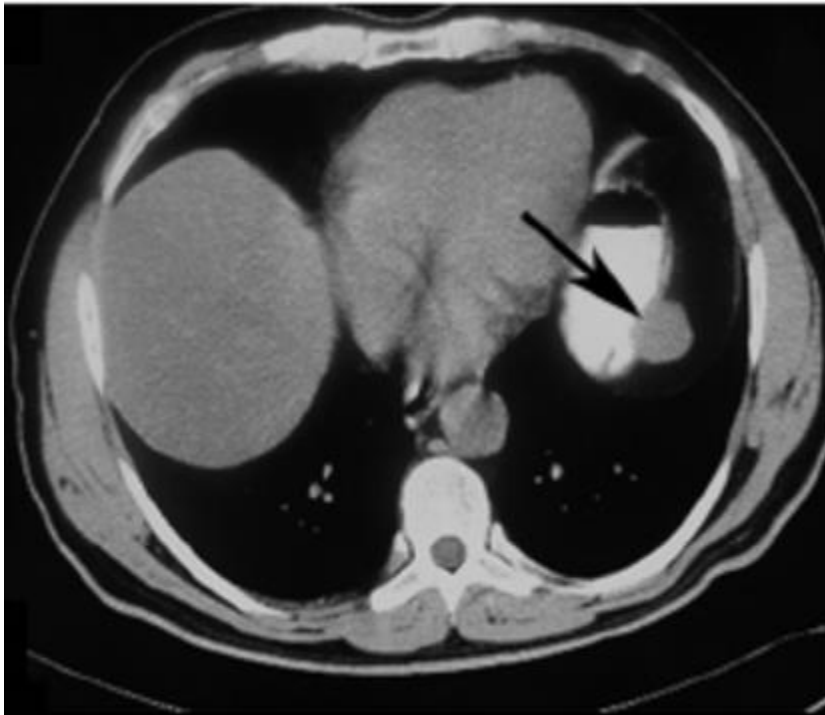
Assistant Professor of Pathology

Harvard Medical School

Boston, MA



Goal of EUS-FNA is Diagnosis



Gastrointestinal Stromal Tumor
(GIST) in gastric fundus

If definitive diagnosis not rendered, aim to provide some pathology information to triage patient for management.



High Quality FNAB



High Quality Specimen

High cellularity

Cells representative of the lesion

Quality preparations

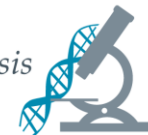


High Quality Interpretation

Training of interpreter

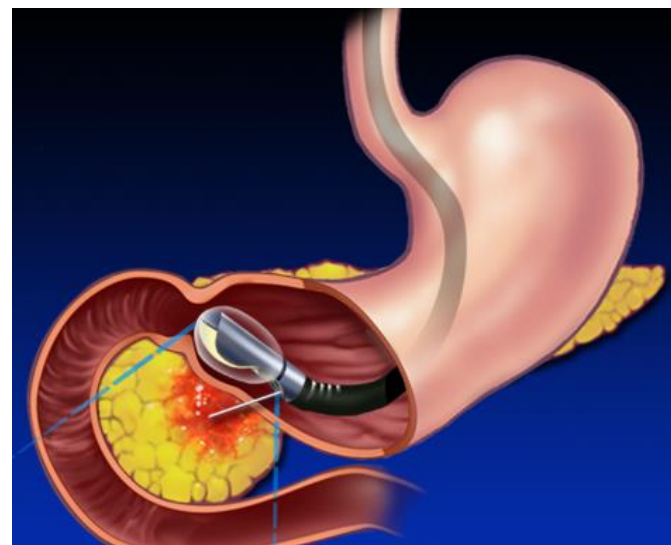
Experience of interpreter

Team approach to diagnosis



FNAB procedure

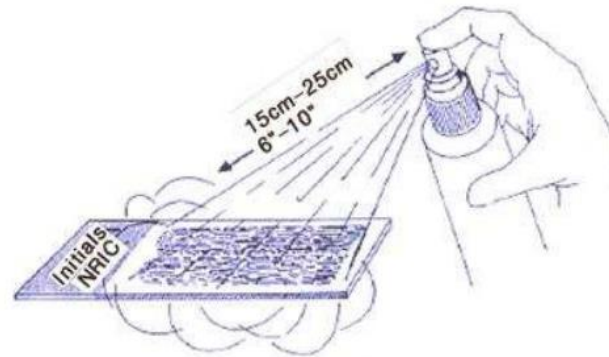
- 22-25 gauge needle & 10 cc syringe to apply vacuum
- Insert needle into target under US guidance
- Apply suction with the plunger (to generate vacuum)
- Move the needle back and forth within the nodule to obtain the sample
- Release vacuum in syringe





FNAB procedure cont'd

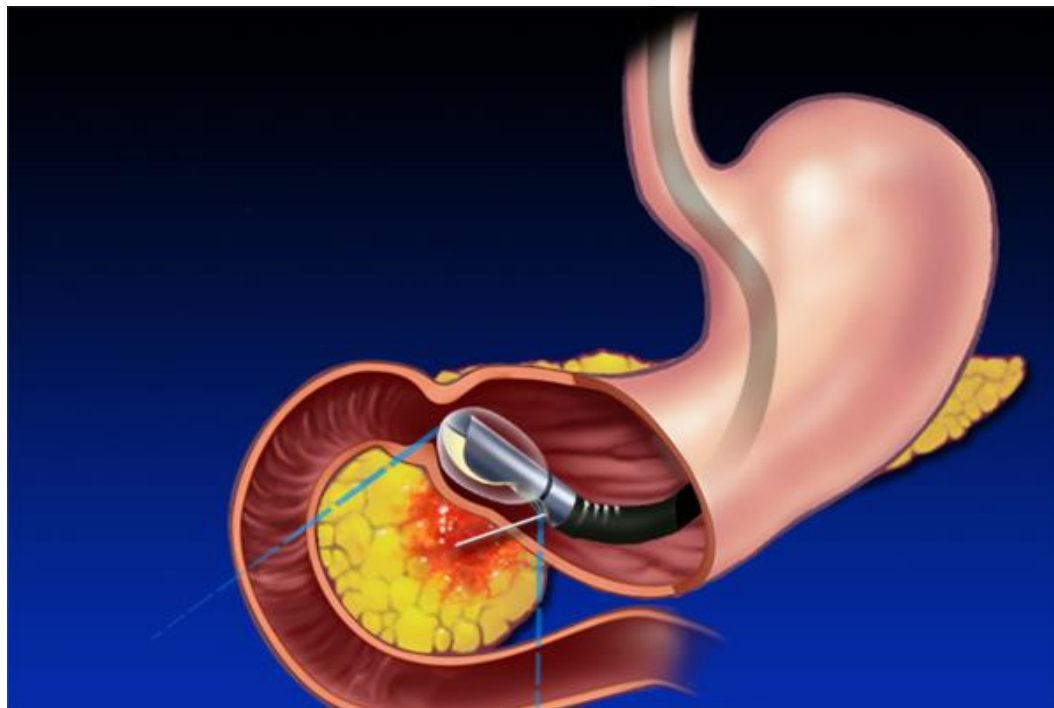
- Expel material onto glass slides
- Smear and **immediately** fix with alcohol



- Fix blood clots and tissue fragments in formalin for cell block preparation
- Rinse needle in Cytolyt or CytoRich Red for LBC;
Rinse in saline or RPMI for flow cytometry



EUS-guided FNAB



- U/S Transducer
- Color Doppler
- Aspiration needle
- Transmural aspiration
- Cytology specimen

Transesophageal: esophageal wall, lymph nodes

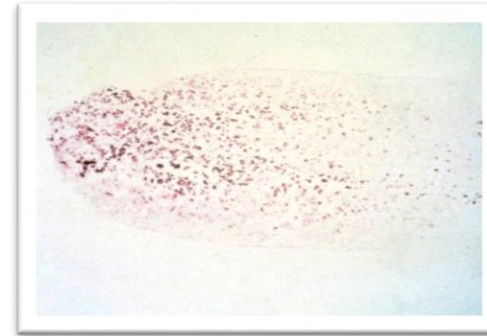
Transgastric: gastric wall, pancreatic body and tail, lymph nodes

Transduodenal: duodenal wall, pancreatic head, lymph nodes

Cytology Specimen Preparation

1. Direct Smears (ROSE)

- Alcohol fixed
- Air dried



2. Cytospin

- Fresh fluid

3. Liquid Based Prep

- Alcohol-Fixed cells
 - ThinPrep
 - SurePath



Cytology Specimen Preparation

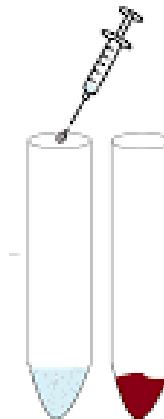
4. Cell block

- Formalin-fixed paraffin-embedded
- Rinsings and dedicated pass into RPMI or formalin
- Enrich with larger bore needle
- If cellularity is scant, process fluid as cytospin, ThinPrep, or SurePath



5. Flow cytometry

- Rinse in media if lymphoma is suspected



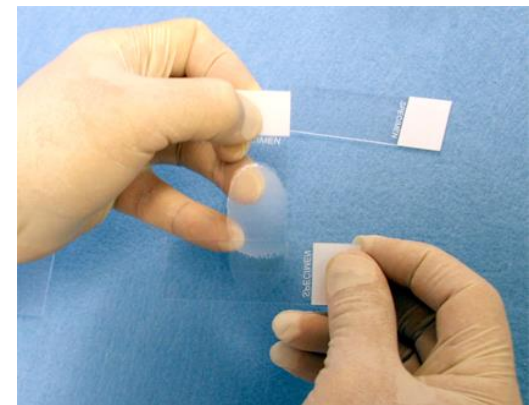
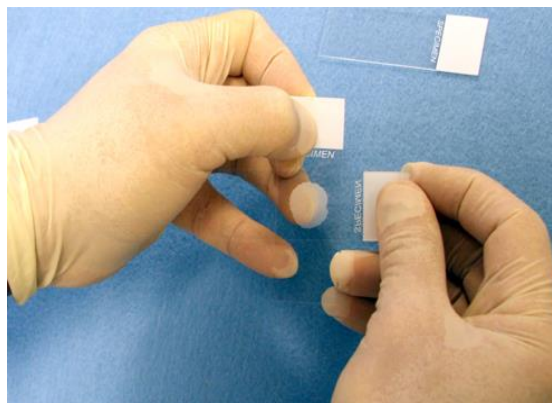
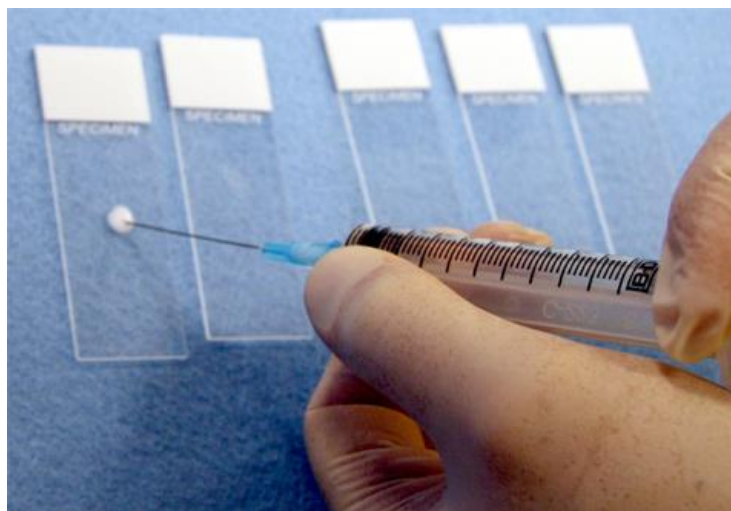
Standardized Reporting Terminology (Papanicolaou Society of Cytopathology)

- I. Nondiagnostic
- II. Negative: Normal tissue, benign conditions
- III. Atypical: Suggestive but not diagnostic of low grade neoplasm (e.g. neuroendocrine tumor); indeterminate bile duct lesions
- IV. Neoplastic:
 - Benign neoplasm (e.g. serous cystadenoma)
 - Other (e.g. mucinous cystic neoplasm)
- V. Suspicious: Suggestive but not diagnostic of malignancy
- VI. Positive/Malignant



Direct Smears:

fast, easy, and inexpensive

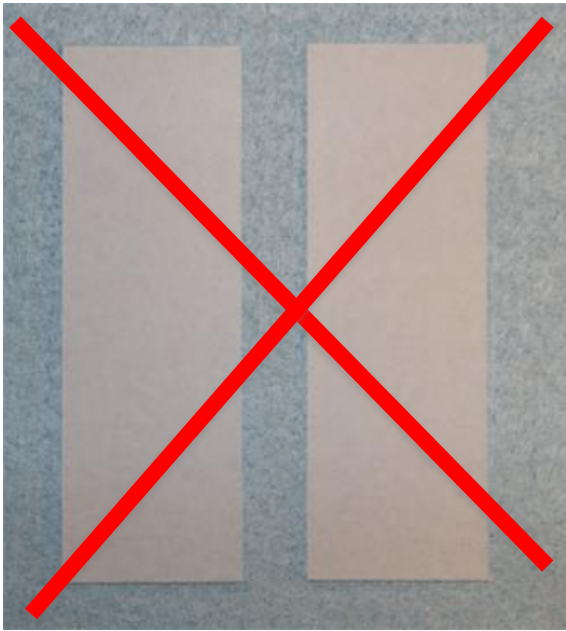




Preparing Direct Smears

- Goal: Create a monolayer of cells for ease of interpretation
 - At least 2 smears made per FNAB pass
 - Alcohol fixation for nuclear detail
 - Rapid H&E stain often used for ROSE
- FNA material contains delicate tissue fragments – do not crush!
- Spreader Slides should have little to no material on it, and can be discarded.

Slides for Direct Smears



Frosted slides

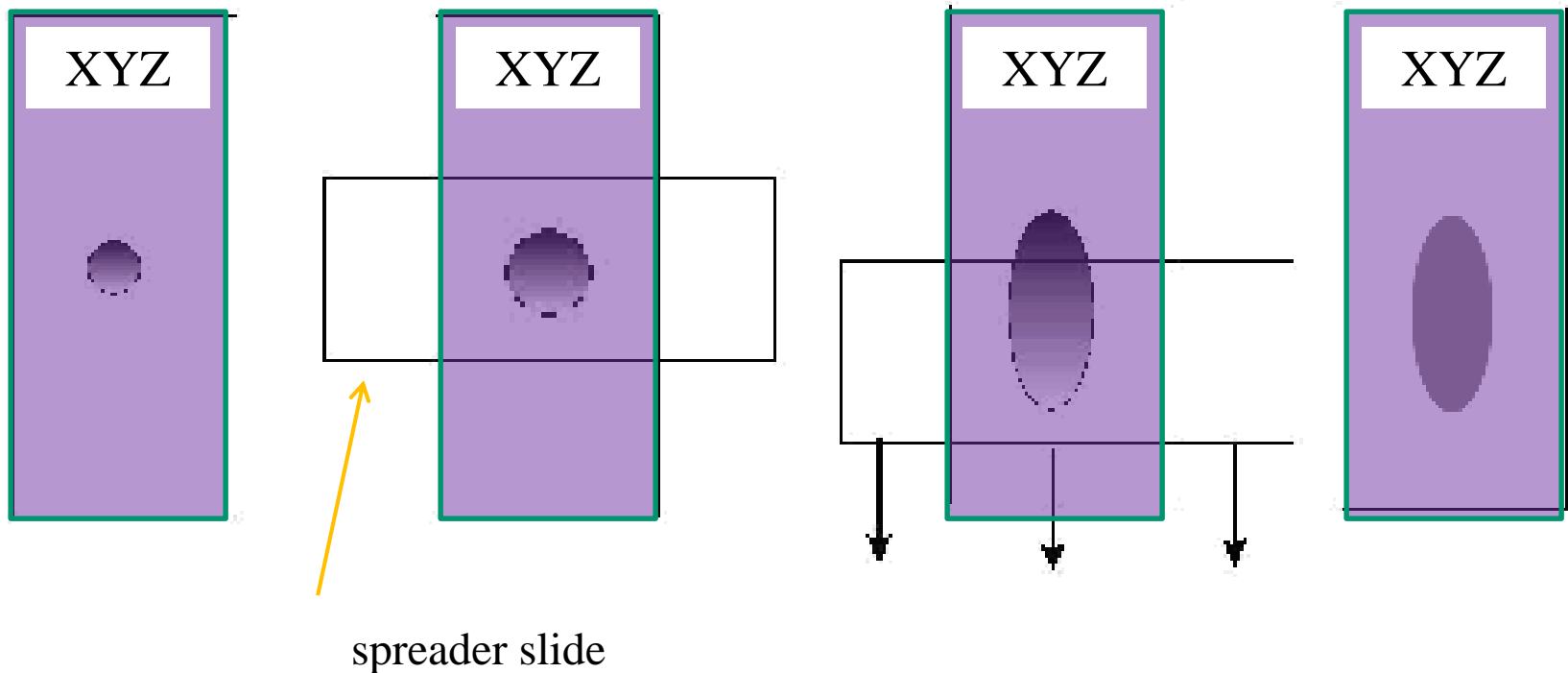


Non- Frosted slides



Best Method for Direct smears

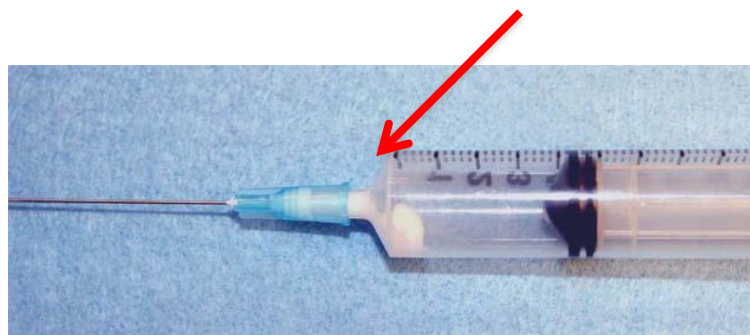
Apply gentle pressure and pull spreader slide towards yourself.



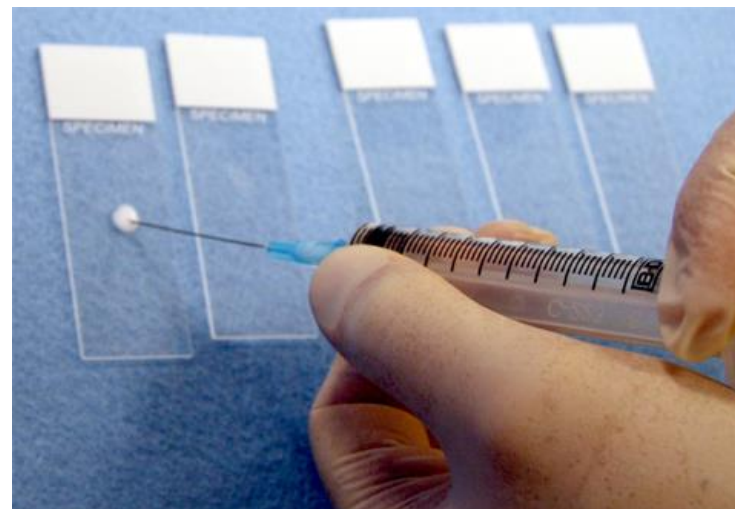


Best Method for Direct smears

Deposit the sample on slide

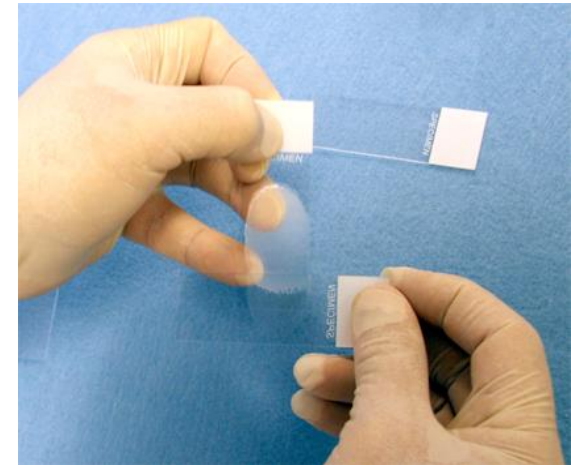
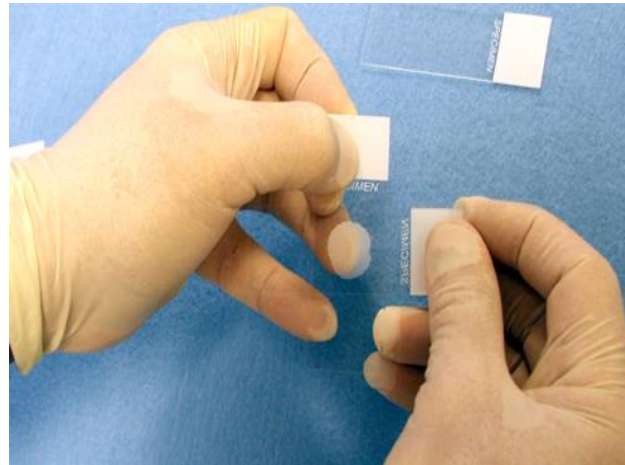


Needle and syringe with
aspirated specimen material



Use syringe to express
the material onto glass
slide

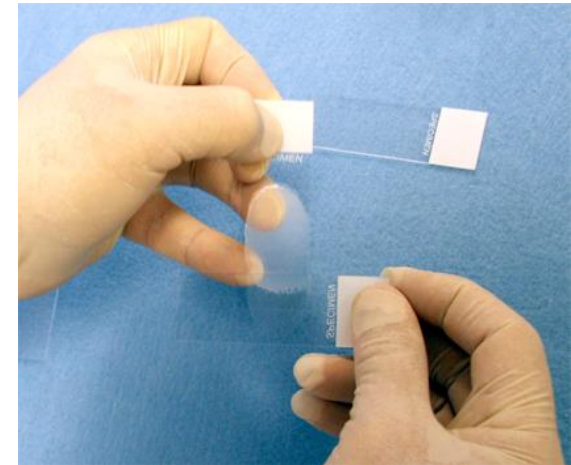
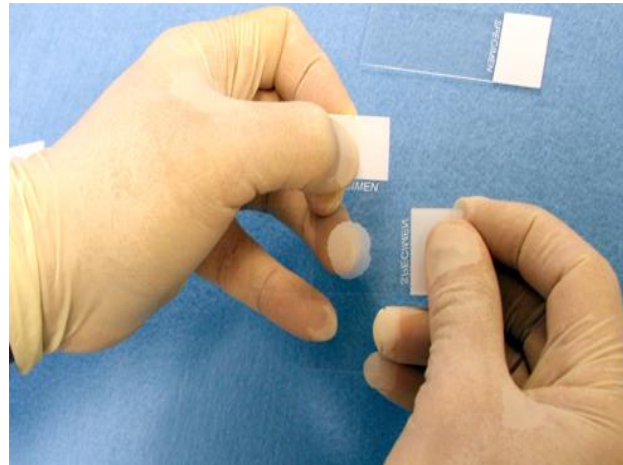
Best Method for Direct smears



Use perpendicular slides to 'open' the aspirate drop.
Do not crush the sample.

Ideal method as described by Britt-Marie Ljung
www.papsociety.org/fna.html

Best Method for Direct smears



Advantages:

- Allows separation of material into multiple smears
 - Preserves cellular and architectural detail
- Perfect ovals- easier to screen at the time of biopsy
- Practice smearing hand cream and a box of slides

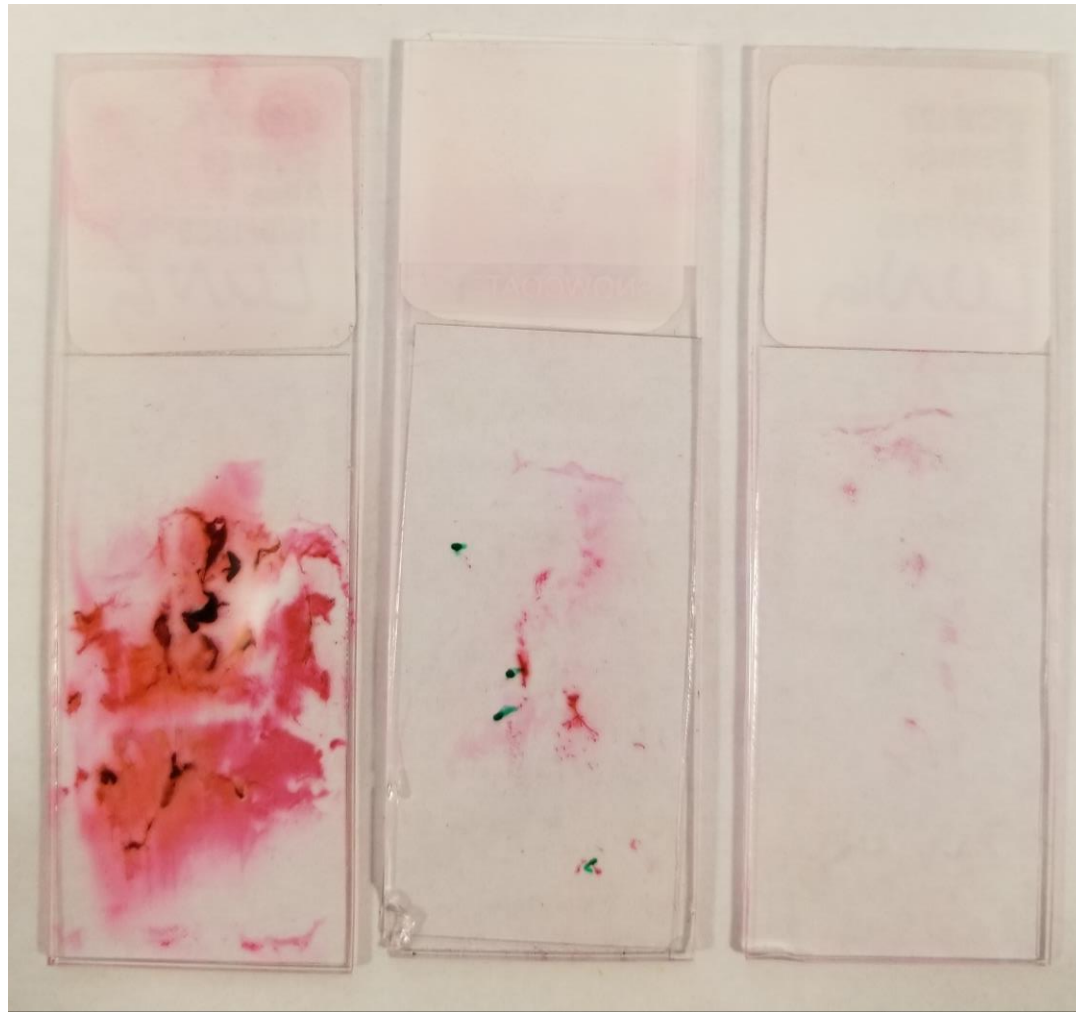


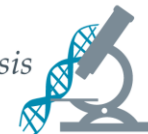
Rapid H&E staining kit for Direct Smears





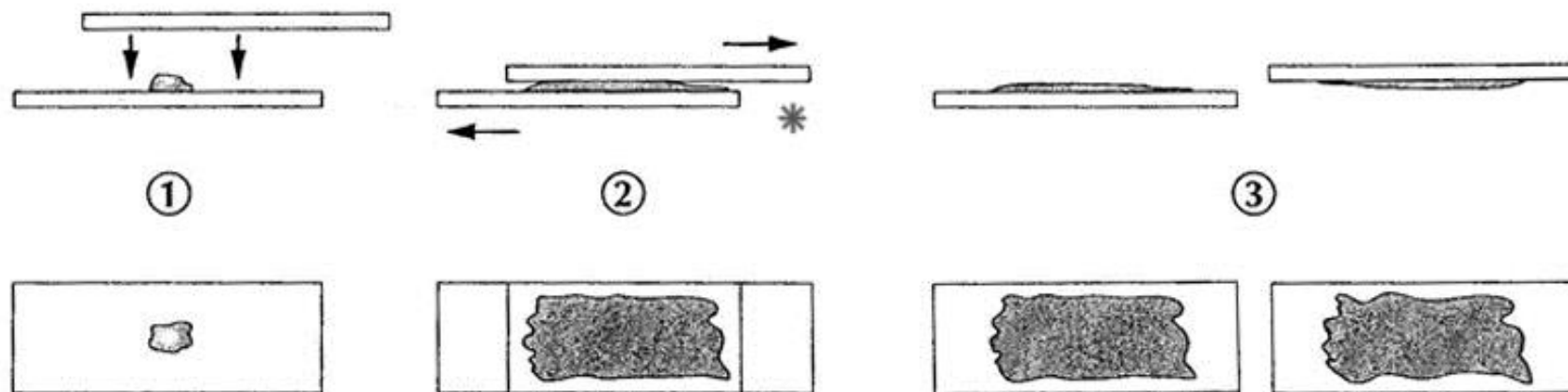
Rapid H&E Direct Smears





Less optimal direct smear preparation: “Pull apart” method

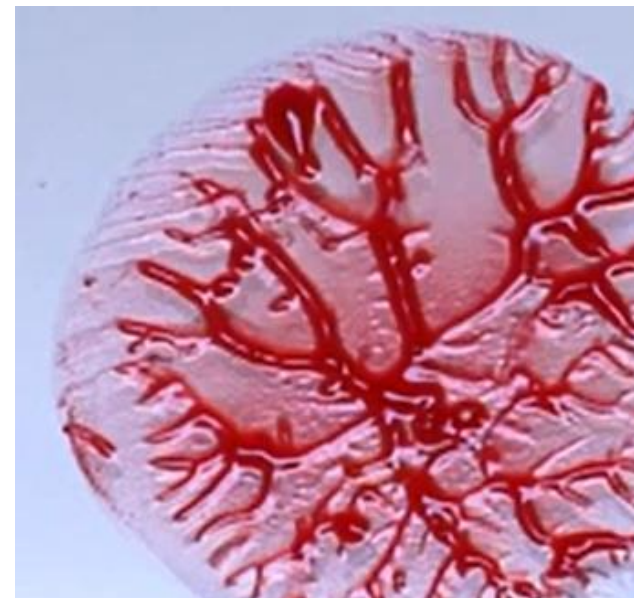
Apply gentle pressure and slide apart in parallel.



This method is best for peripheral blood smears.



Less optimal direct smear preparation: “Pop” method

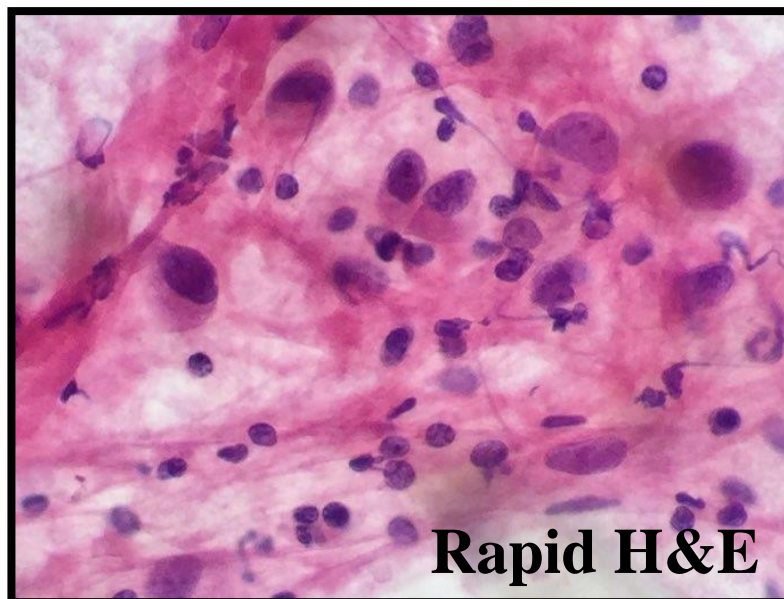


Pull apart and Pop methods are suboptimal

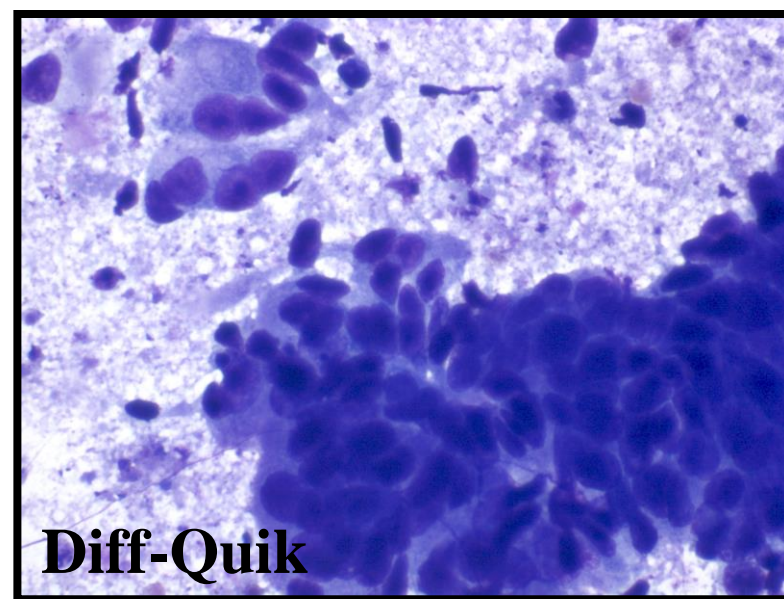
- Entire aspirate is used up on two slides
- Increased distortion, too thick for interpretation, loss of architecture and cellular detail



Staining Direct Smears



- Alcohol fixed smear
- Easier to interpret
- Nuclear detail
- Slower (2-3 min)
- Rapid Pap similar



- Air dried smear
- Harder to interpret
- Cytoplasmic detail
- Faster (30 seconds)

Liquid Based- Cytospin



Preferred method of processing fresh cyst fluid
 Provides cell button for cytology and
 supernatant for CFA
 Preserves background elements



Liquid Based-ThinPrep®



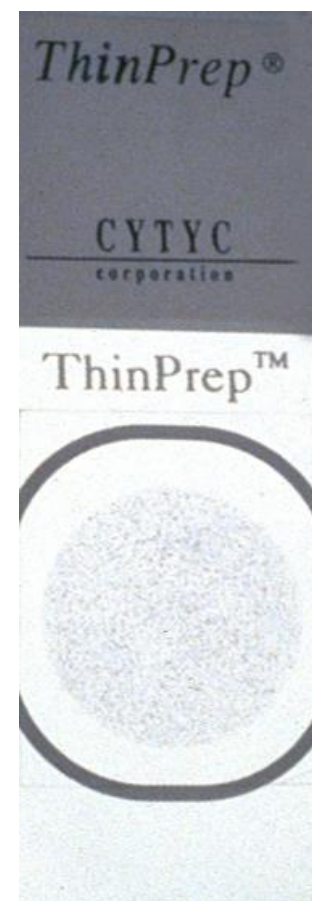
Dispersion



Recueil des cellules



Transfert des cellules



Cells are fixed in methanol
Cannot use aliquot for flow cytometry, but IHC is OK
DNA quality for molecular studies is good



Liquid Based SurePath Prep™

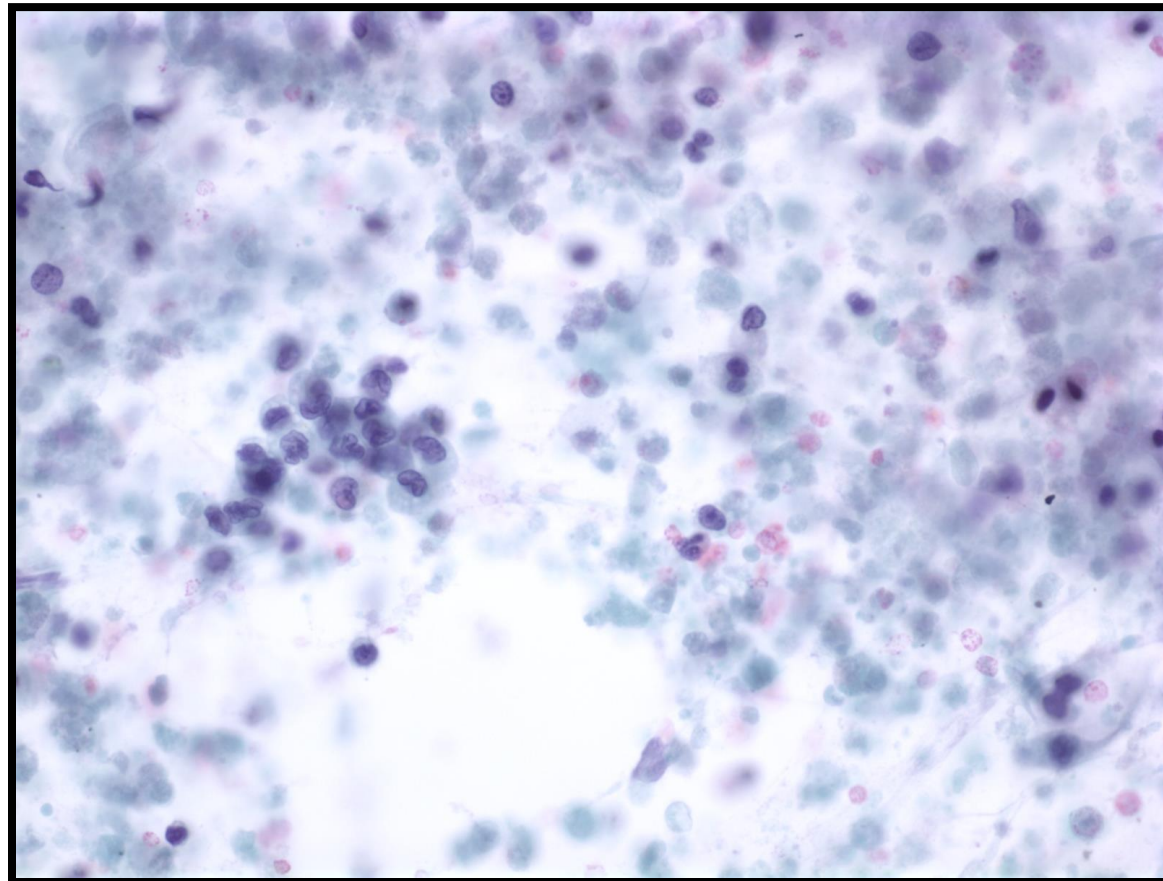


Cells are fixed in ethanol
 Cannot use aliquot for flow cytometry, but IHC is OK
 DNA quality for molecular studies is good



Specimen Quality

Quality of cells: Are they viable?

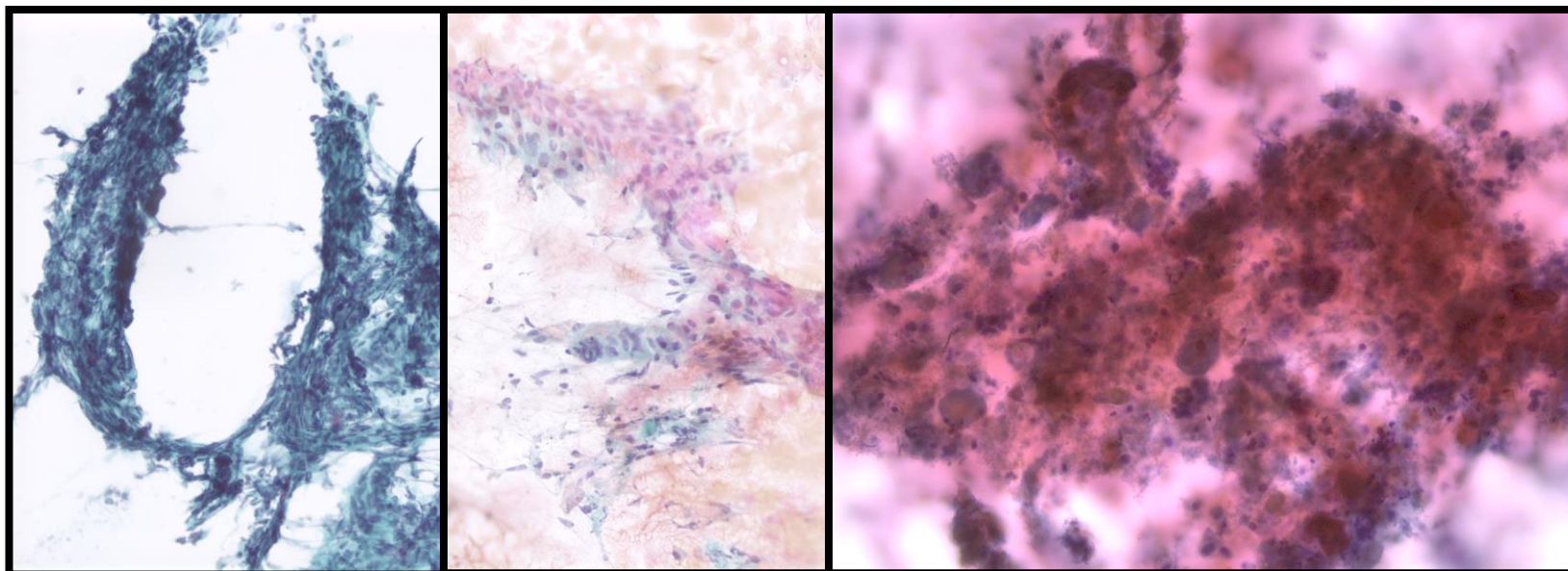


Necrosis



Specimen Quality

Quality of preparation: Interpretable?



Crush Artifact:

Cells delicate;
excess pressure
on smears

Air-dry Artifact:

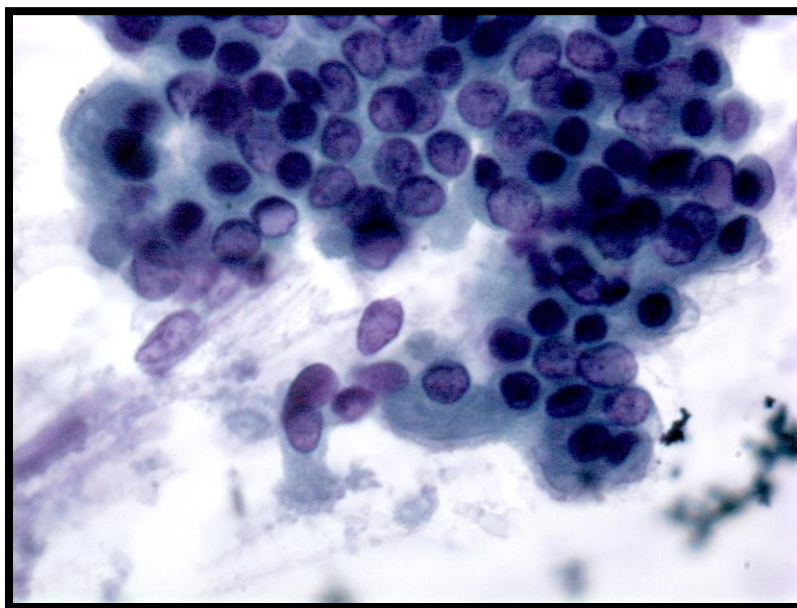
Drying began
before put into
alcohol fixative

Obscuring blood

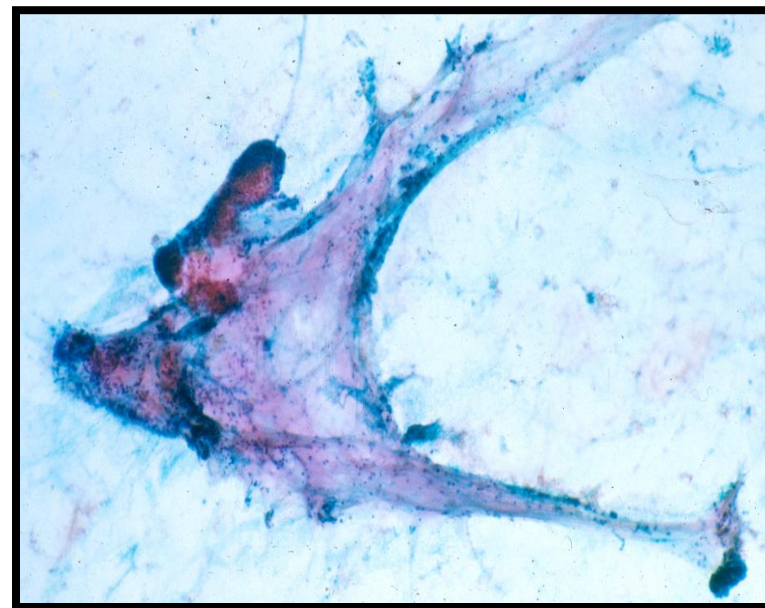


Specimen Quality

Is sample representative of the lesion?



Epithelial cells from surface
of esophagus, stomach, or duodenum



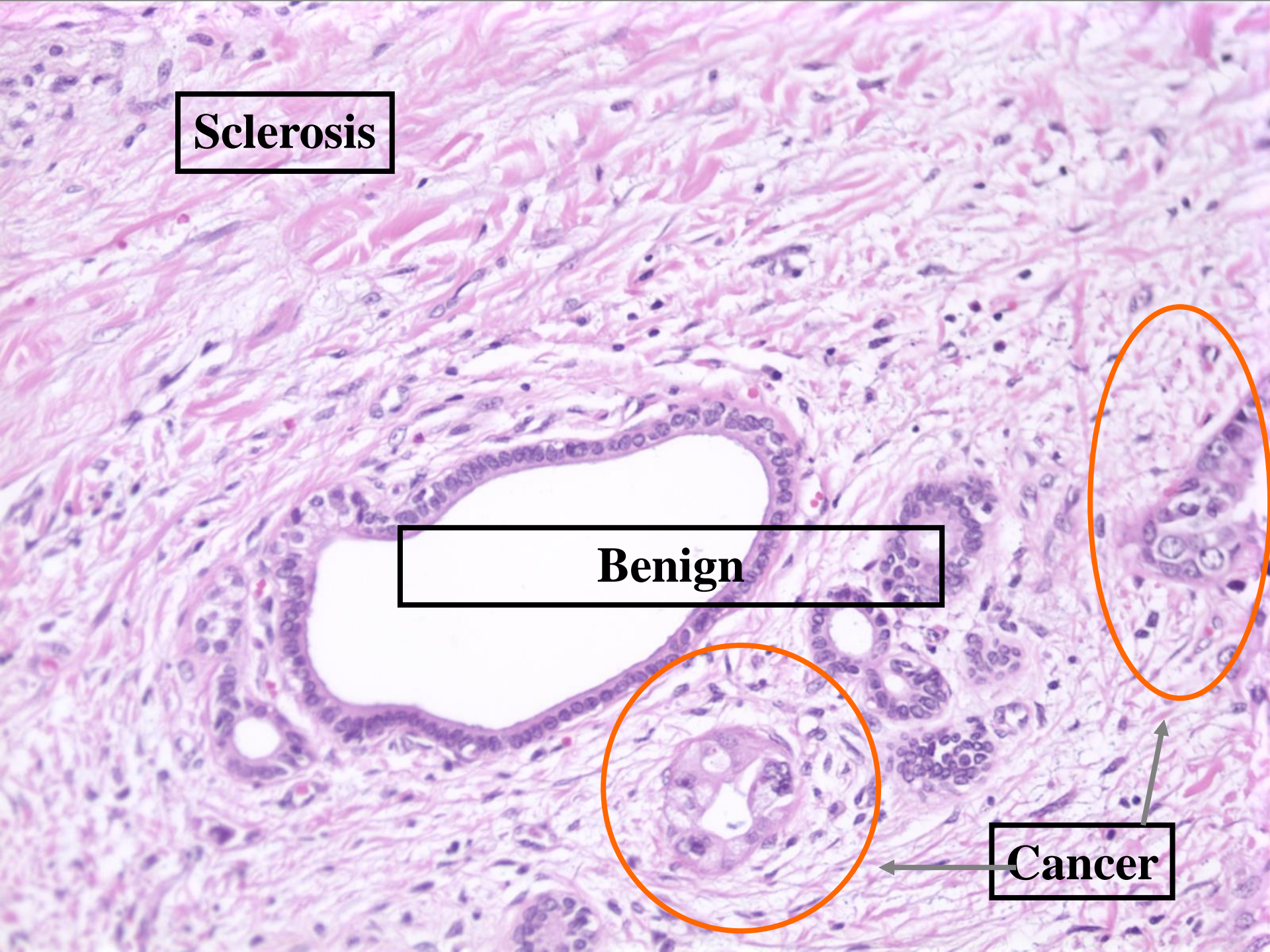
Mucus from GI tract

GI contamination is a significant problem

Sclerosis

Benign

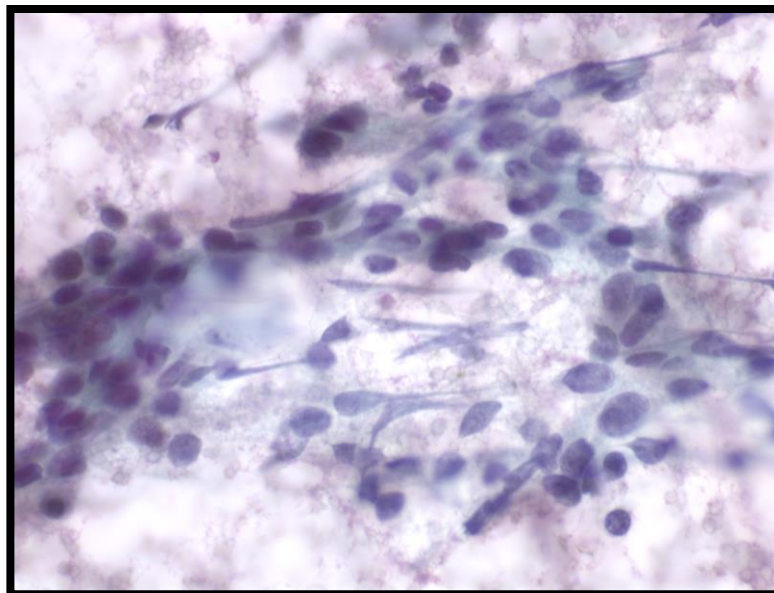
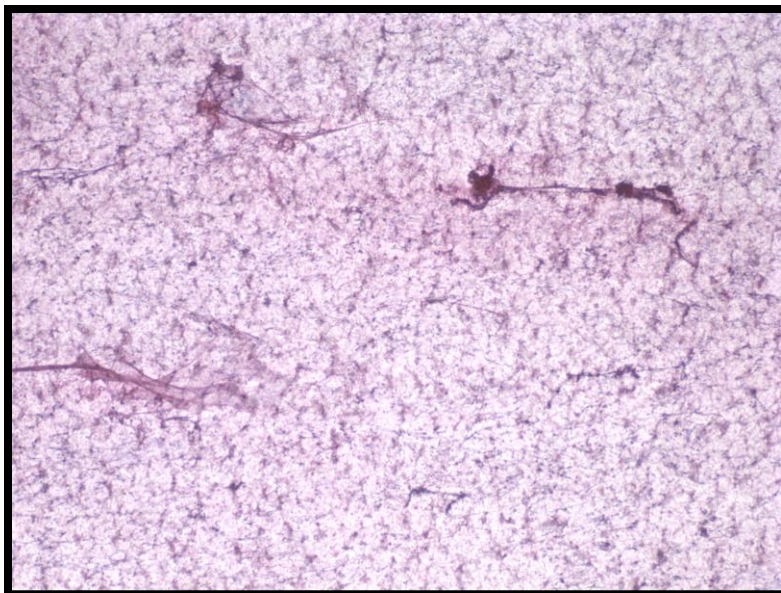
Cancer





Specimen Quality

Quantity of cells



Scant cellularity

Precludes definitive interpretation

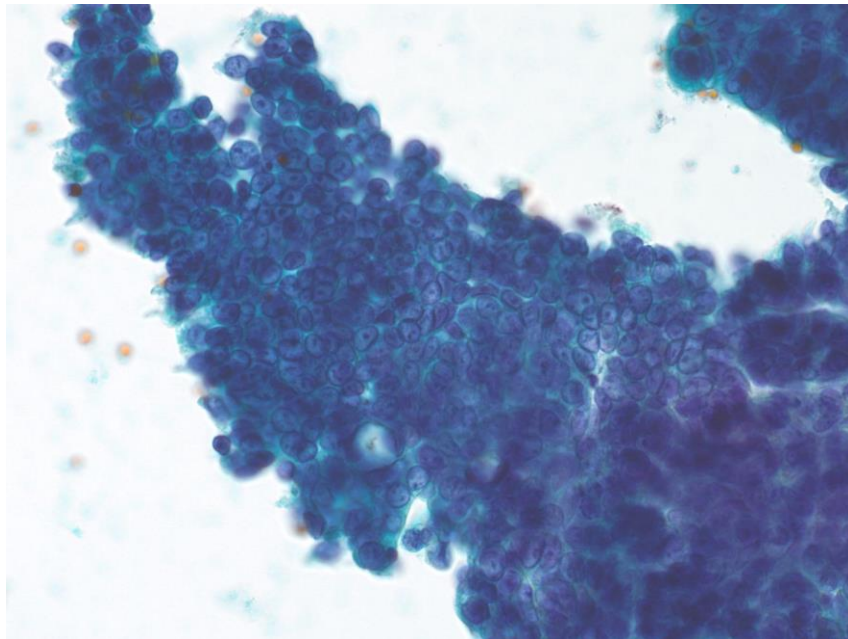
Largely blood

Too few cells;
Atypical, not malignant

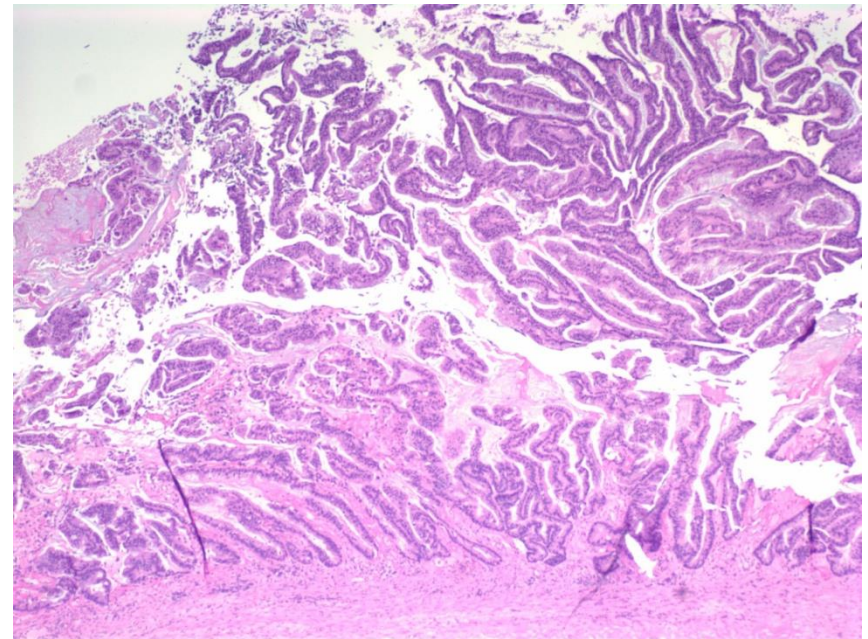


Cytology vs. Histology

Cytology: The study of cells



Histology: The study of tissue





Limitations of Cytology compared to Histology

- Lack of architecture
 - Cannot see distribution of ductal structures
 - Cannot see abnormal localization
 - Cannot see if ducts are adjacent to medium sized vessels, wrapping around nerves or isolated in fat
 - Cannot see contours or angulation of ducts
 - Cannot see luminal contents
 - Cannot see stromal reaction



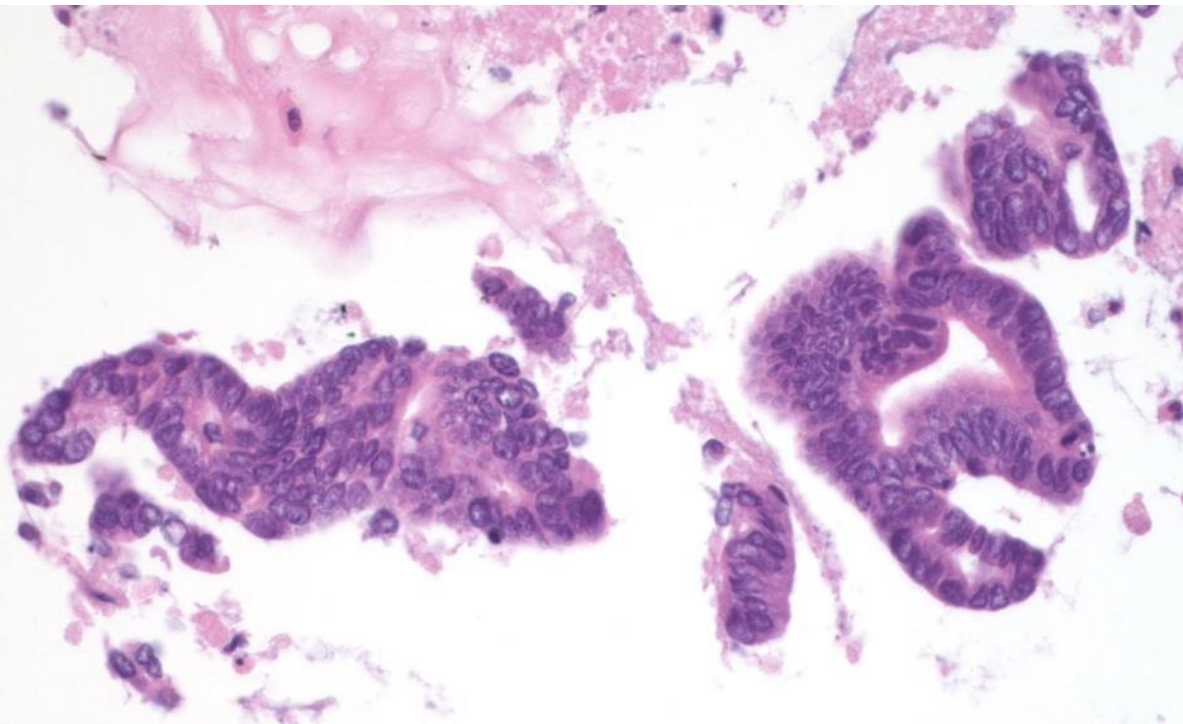
“Tissue worm”

“Tissue worm” left on a Direct Smear

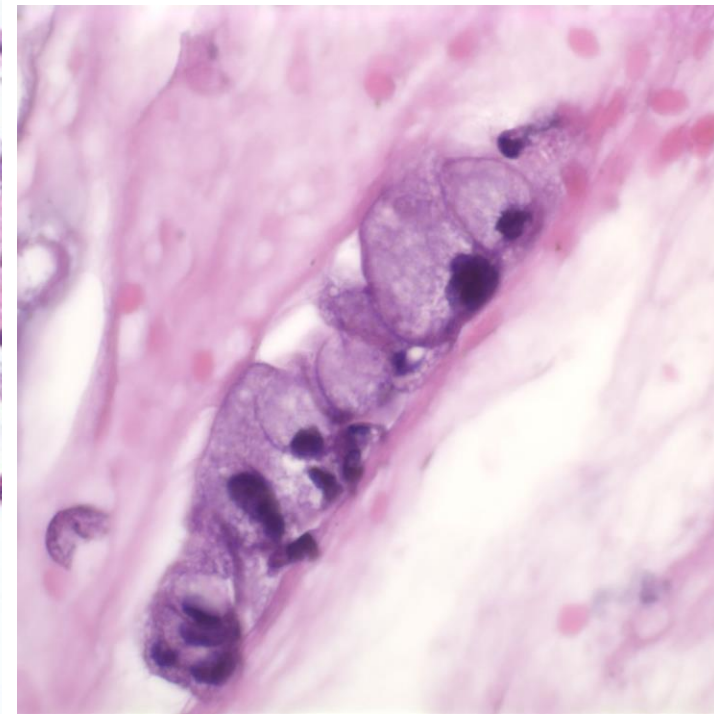




Cell Blocks for Cytohistology



IPMN-HGA



IPMN-LGA

“Tissue worms” are perfect for Cell Block preparations



Cell Blocks for Cytohistology



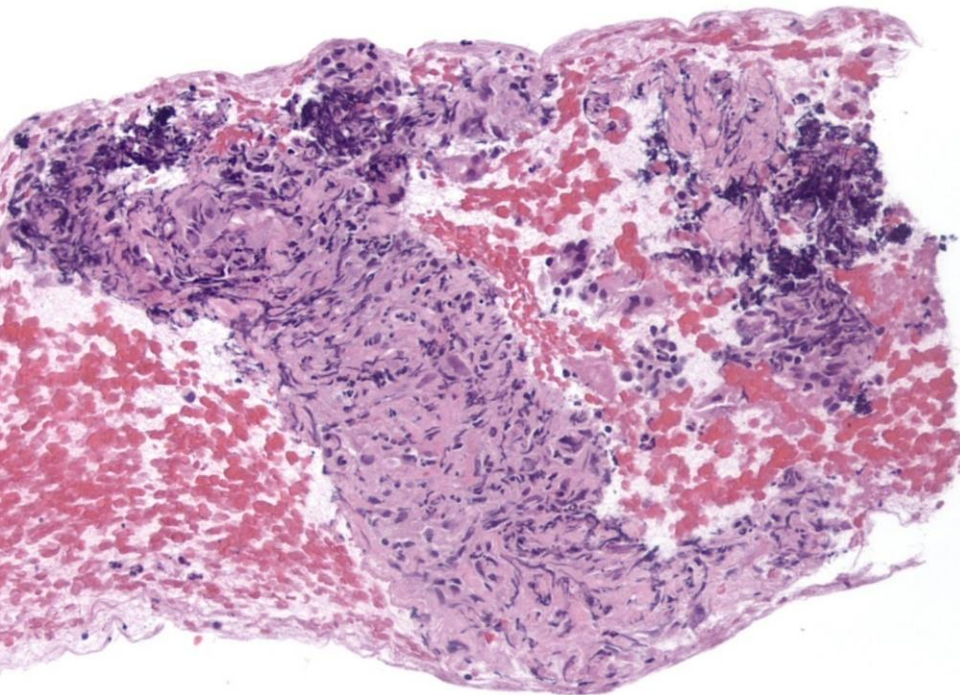
Any material left in the syringe can be used for cell block preparation.
Wait for it to clot before disturbing it.



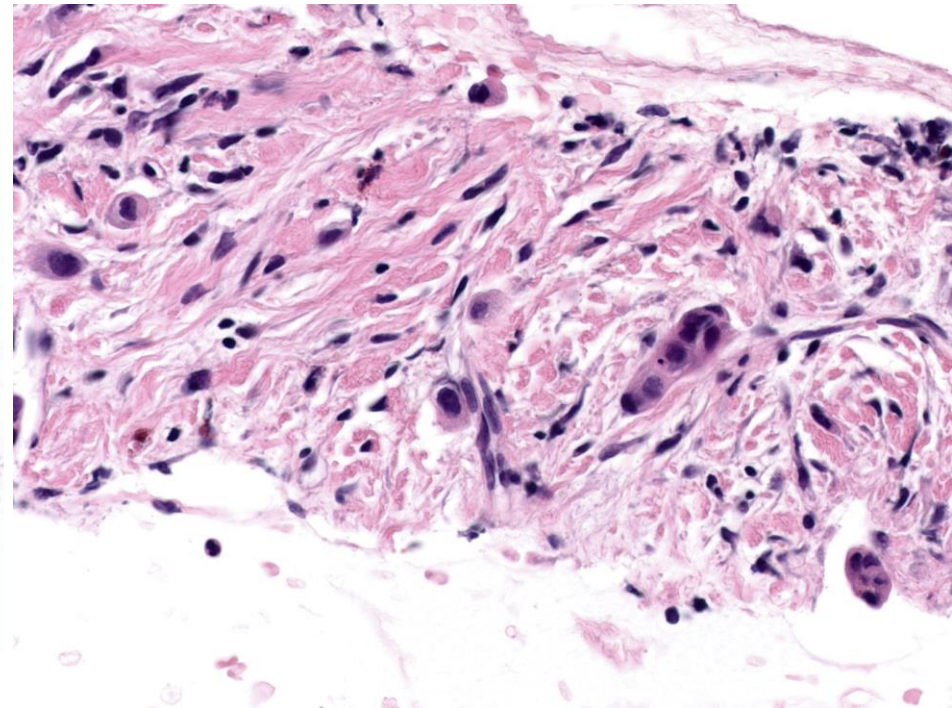
Gently wash the clot into formalin and submit to pathology for cell block preparation. Use separate container for core biopsy.



Cell Blocks for Cytohistology



Autoimmune pancreatitis

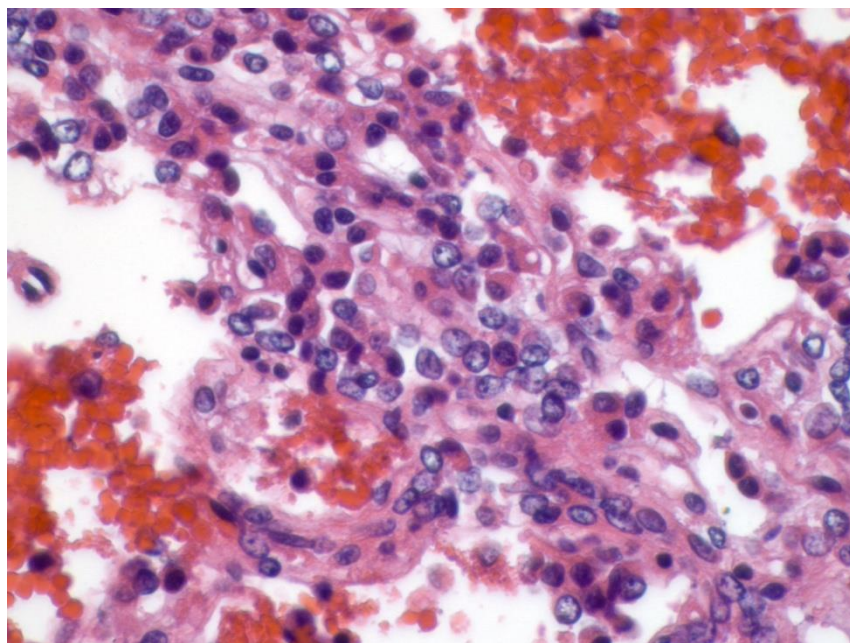


Poorly-differentiated PDAC

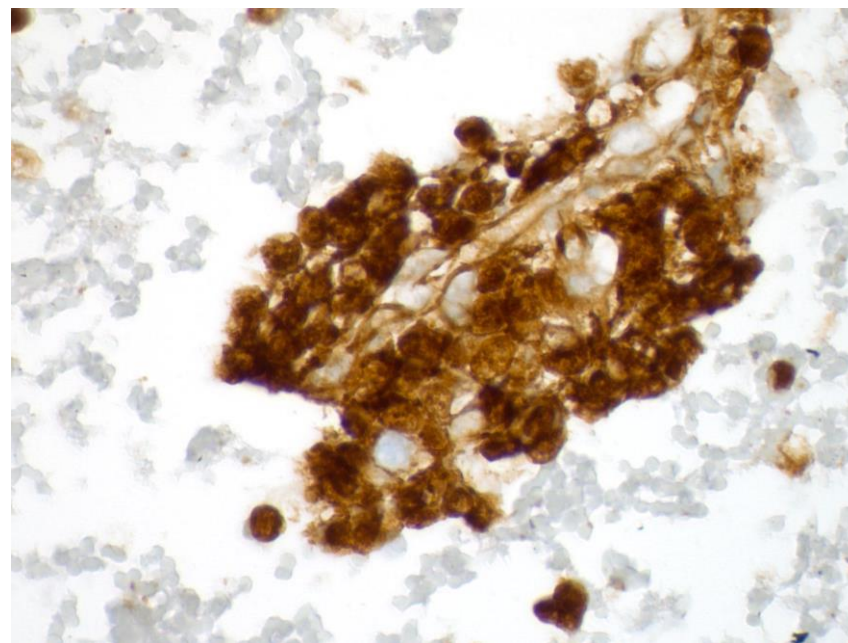


Cell Blocks for Cytohistology

Pancreas- Solid Pseudopapillary Neoplasm

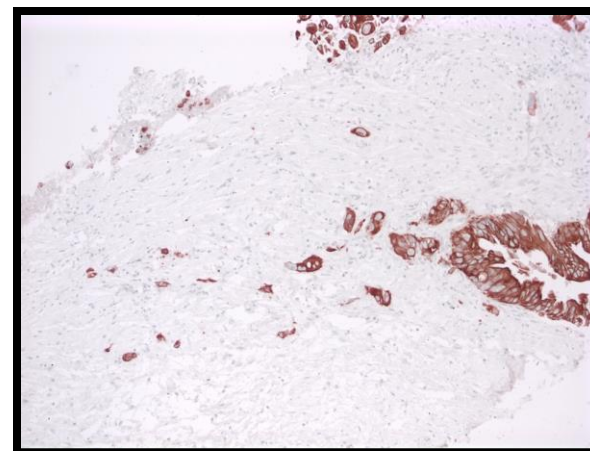
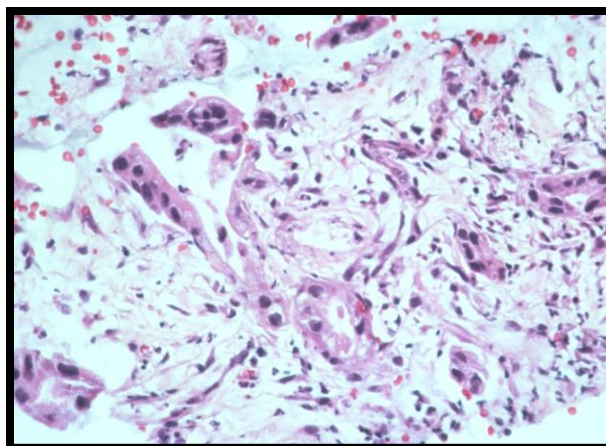


Immunohistochemical staining with Beta-Catenin



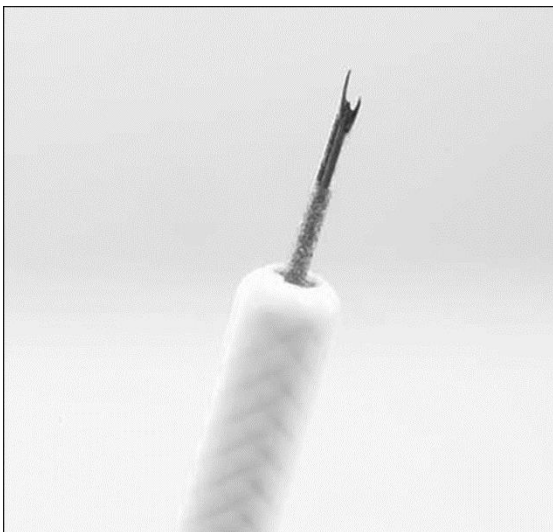


Cell Blocks prepped like Core Biopsies



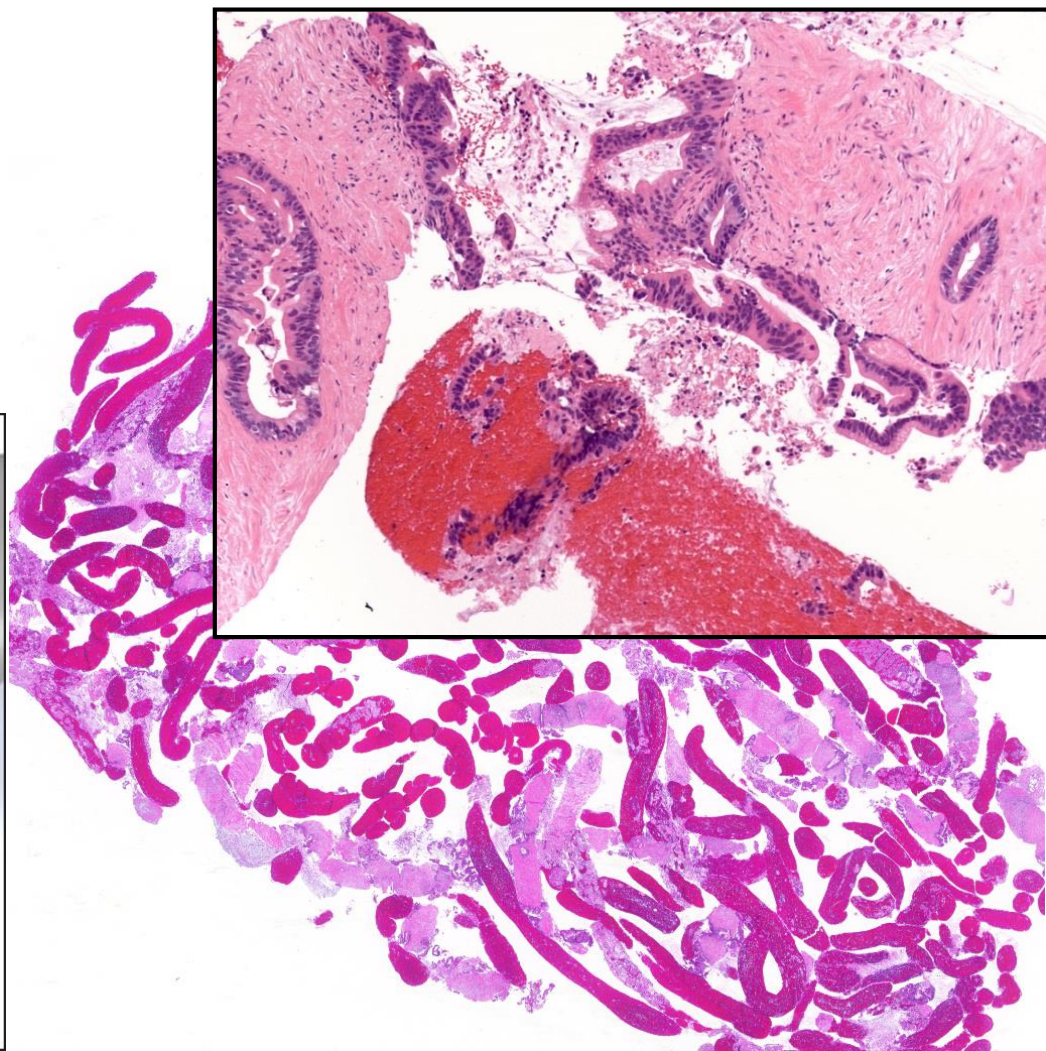
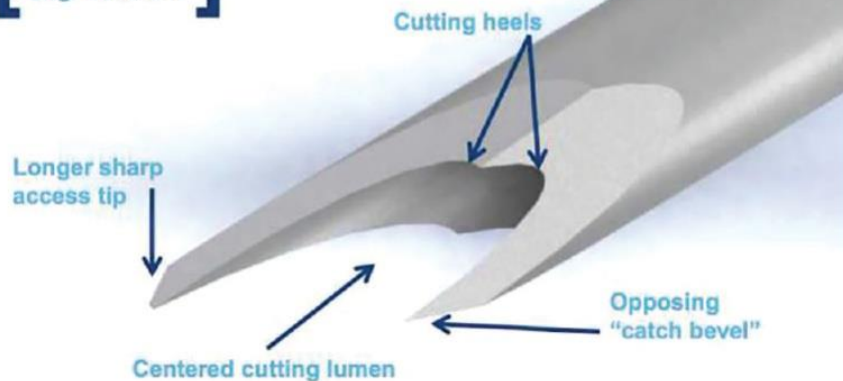


SharkCore (Medtronic)



SharkCore™ FNB

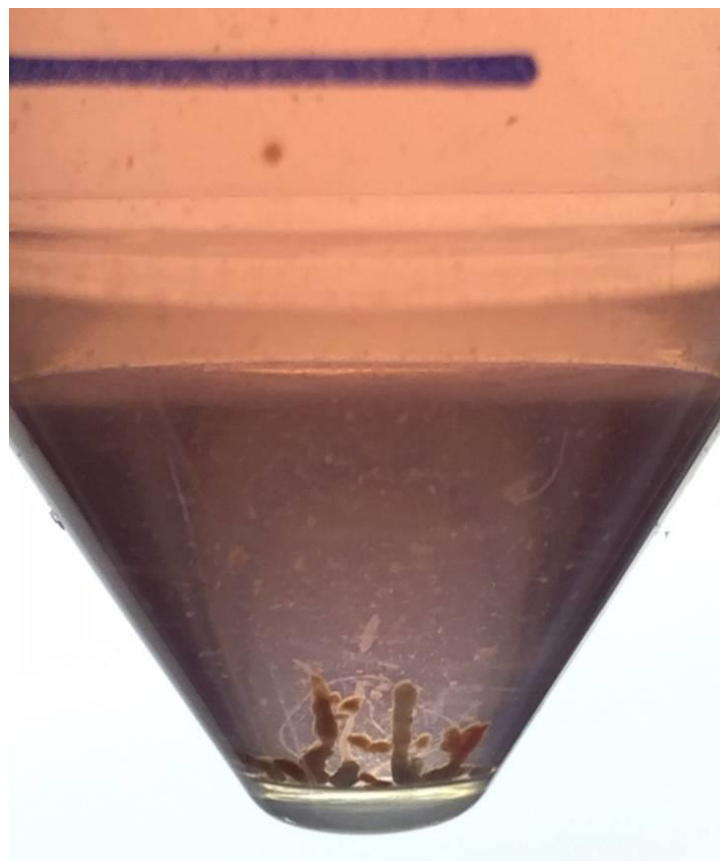
[Six cutting
edge surfaces]





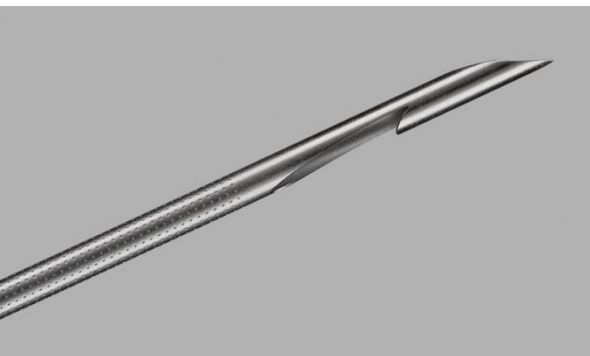
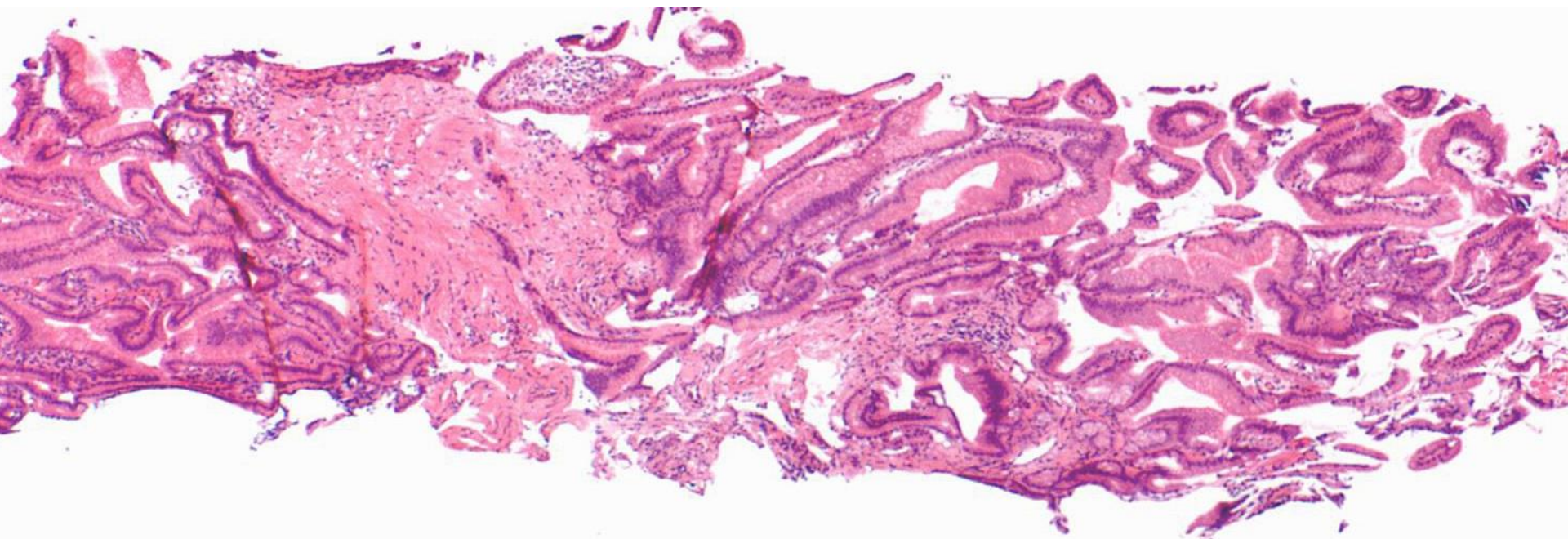
Acquire

(Boston Scientific)





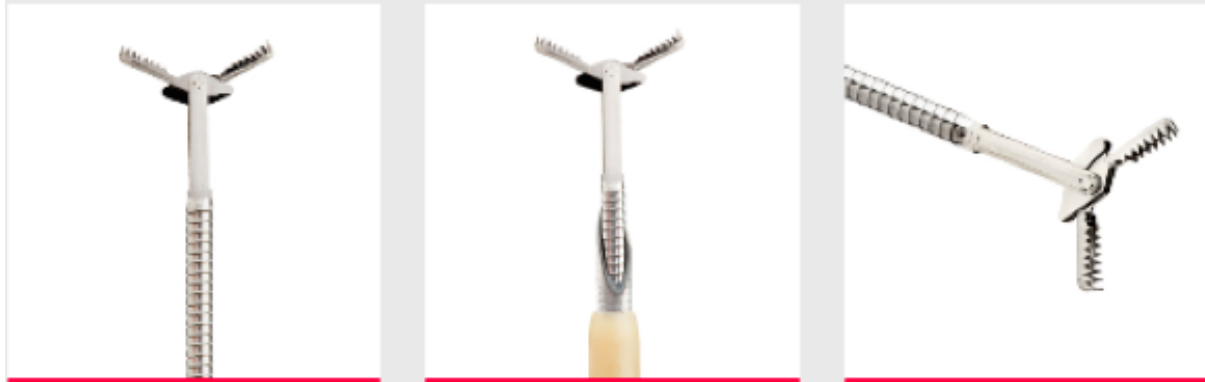
Procore Biopsy (Cook-Medical)



IPMN-LGD

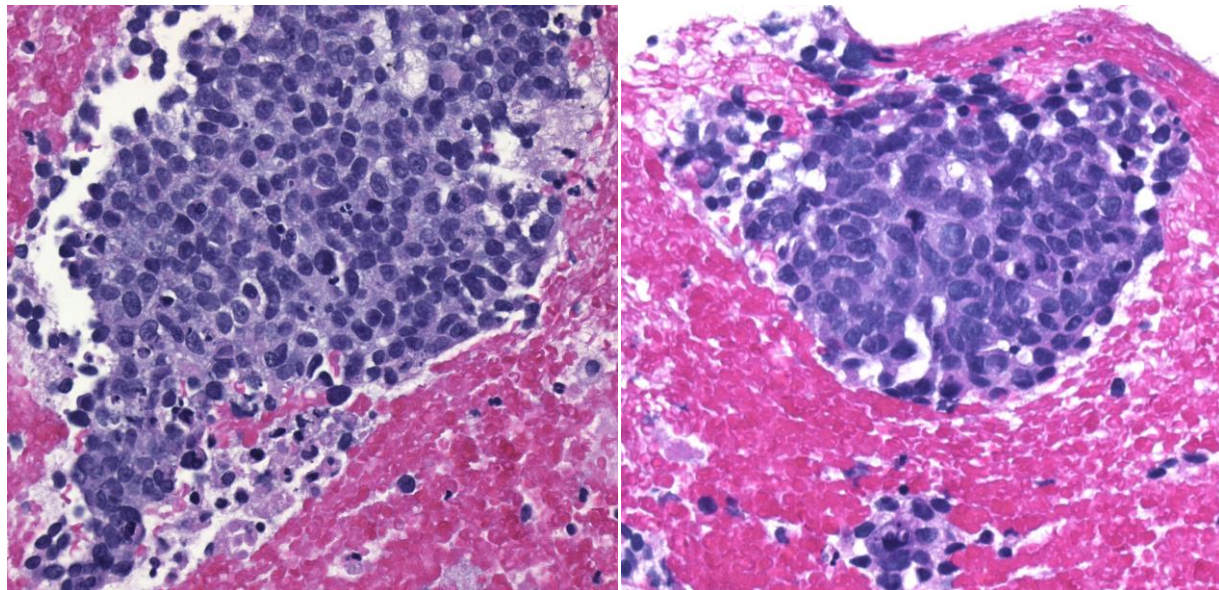


Moray Micro-forceps biopsy (US Endoscopy)

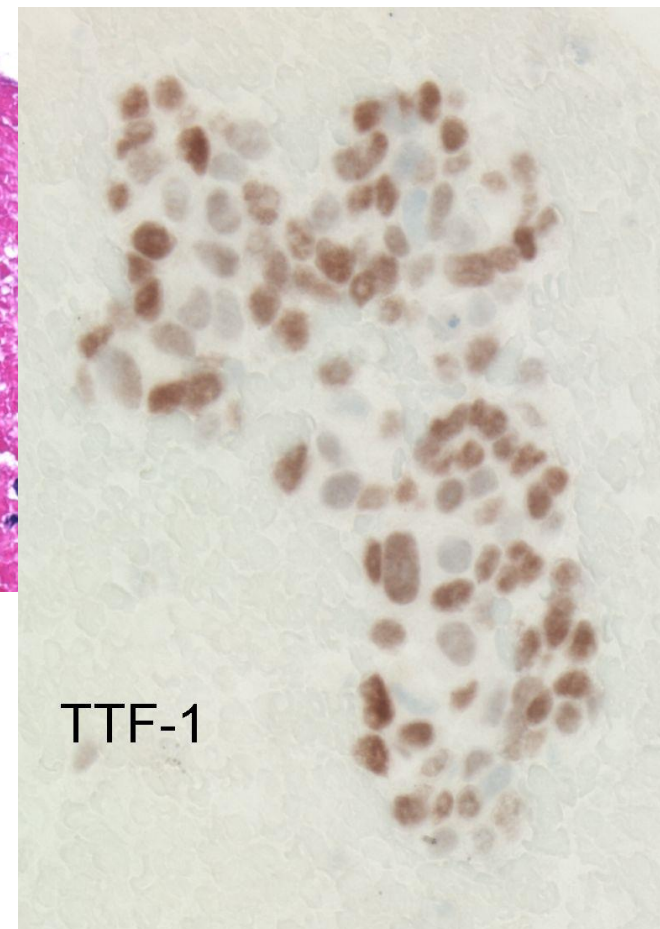


Cell Blocks/Core Biopsy

Allow for ancillary testing: IHC, molecular etc



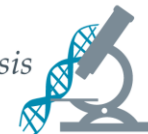
Poorly differentiated metastatic
lung adenocarcinoma





Ancillary Testing Refines Diagnosis

- Special Stains
 - Cellblocks; Smears
- Immunohistochemistry
 - Cellblocks; Smears
- Biochemical testing
 - Pancreas cyst fluid: CEA, amylase
- Molecular Analysis [FISH, Specific Mutations (e.g. *KRAS*, *BRAF*) and NGS]
 - Cellblocks
 - Fresh cyst fluid- Pancreas
 - Liquid-Based Cytology (ThinPrep/SurePath)



Quality Cytology

- Quality of the Specimen
 - Quantity of cells
 - Quality of the cells
 - Tissue available for ancillary studies
- Quality of the interpretation
 - Training of the interpreter
 - Experience of the interpreter
 - Rapid or immediate interpretation
 - Cooperation of the diagnostic team



Quality Interpretation

- Pathologist trained in cytology
 - Preferably with boards in cytopathology
- Pathologist experienced in the interpretation of FNAB material, particularly from GI tract via EUS
- Team approach to diagnosis
 - Cooperative interaction between biopsy physician and interpretation group (cytotechnologist and pathologist)

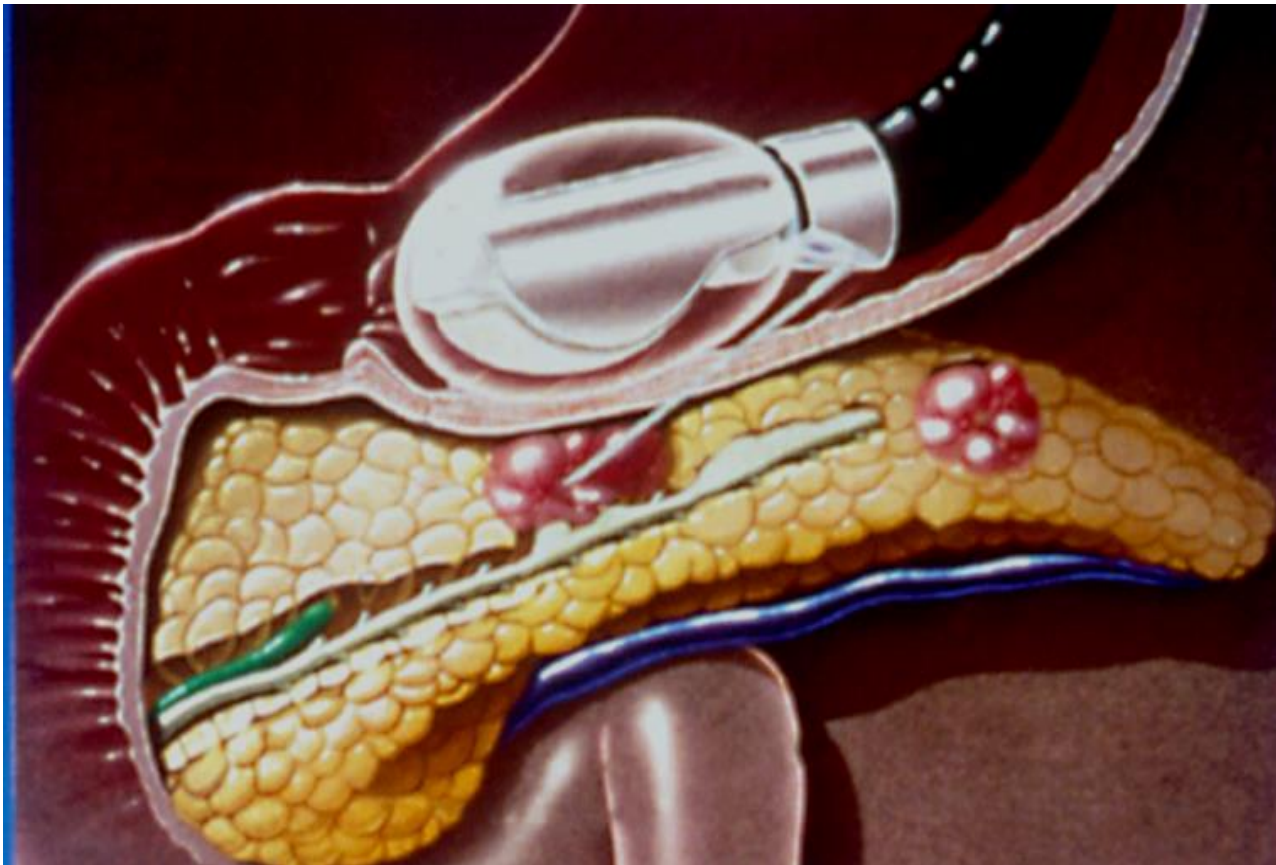


Cytology Interpretation

- Multimodal Approach
 - Patient clinical Information
 - Age and gender
 - Symptoms
 - Past medical history
 - Radiological Information
 - Location of mass (and organ traversed for EUS)
 - Mass characteristics
 - Solid or cystic
 - » Size, contours, invasion
 - » Cystic lesions: single or multilocular; wall thickness, Ca⁺⁺, intramural nodule
 - » Gross cyst contents: thick/viscous, thin/watery, clear, brown
 - Ancillary tests: CEA, amylase, molecular analysis



Quality Interpretation: Familiarity with GI Contamination

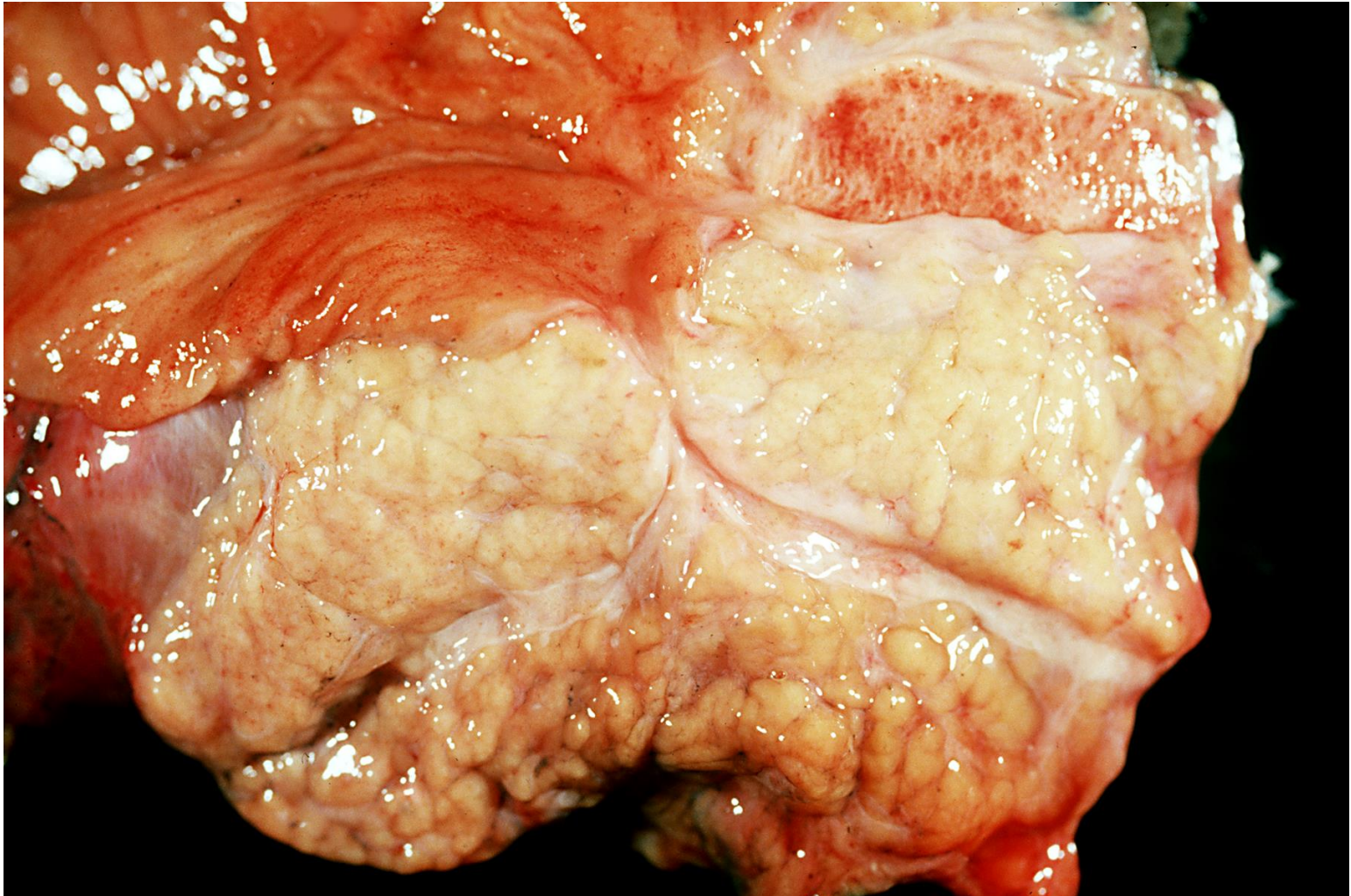


Transgastric: pancreatic body and tail
Transduodenal: pancreatic head



Normal Pancreas

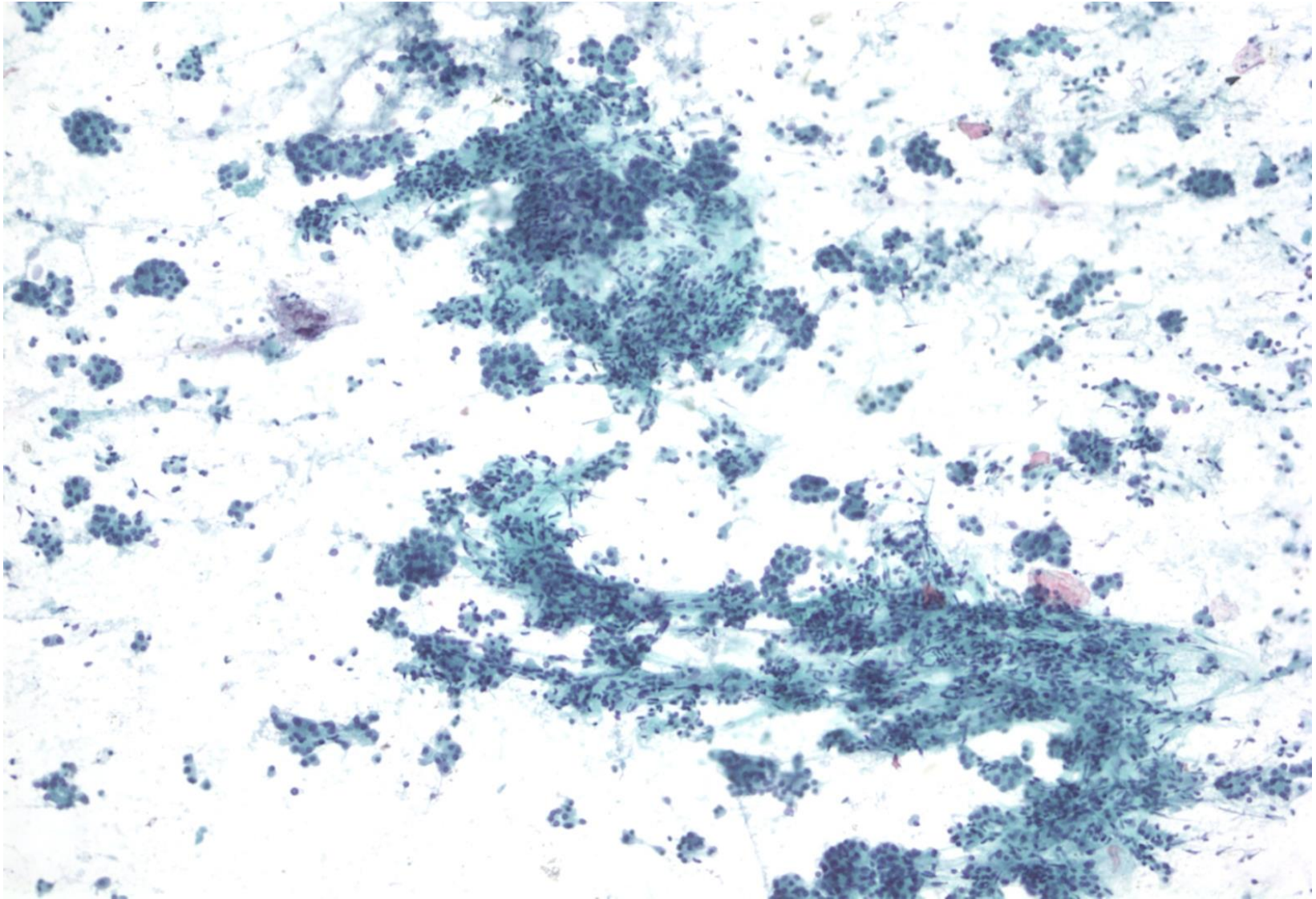
(bivalved pancreatic head)



Courtesy of 4th Series AFIP Fascicle on Tumors of the Pancreas



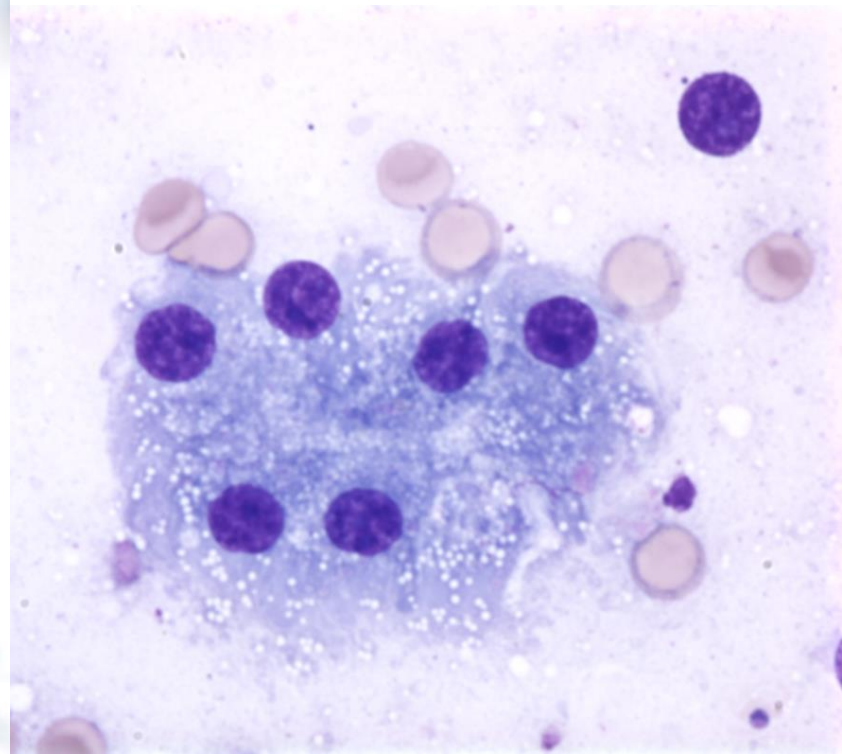
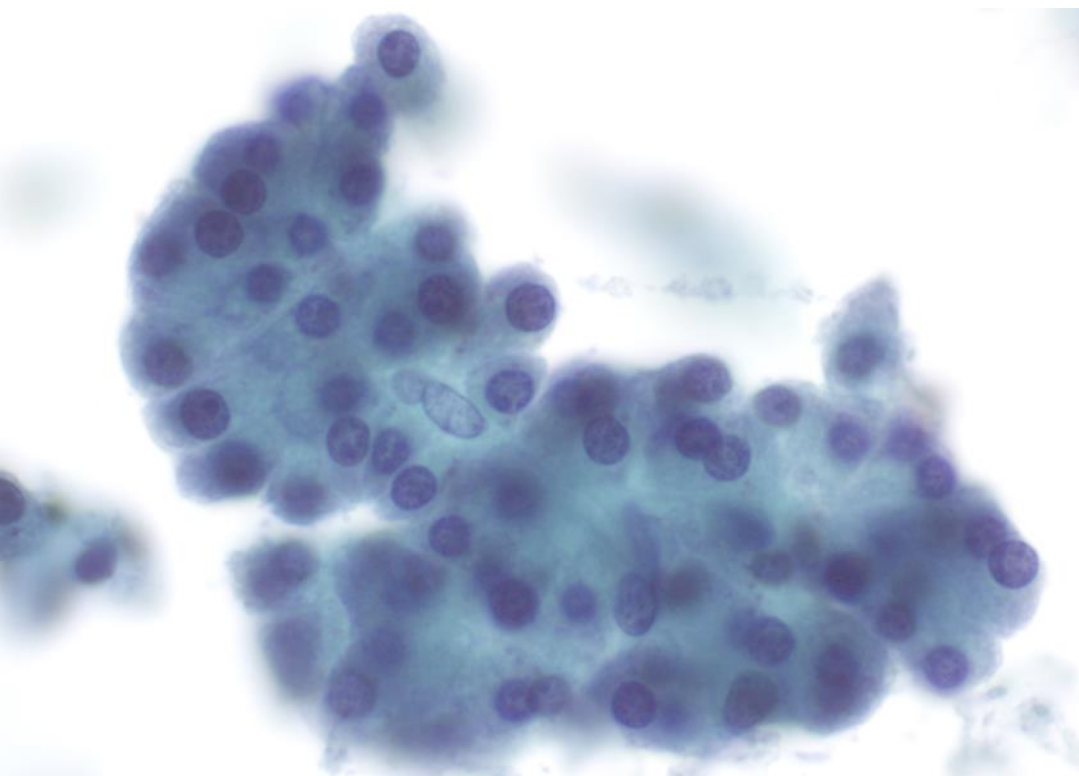
Normal Pancreas





Normal Pancreas

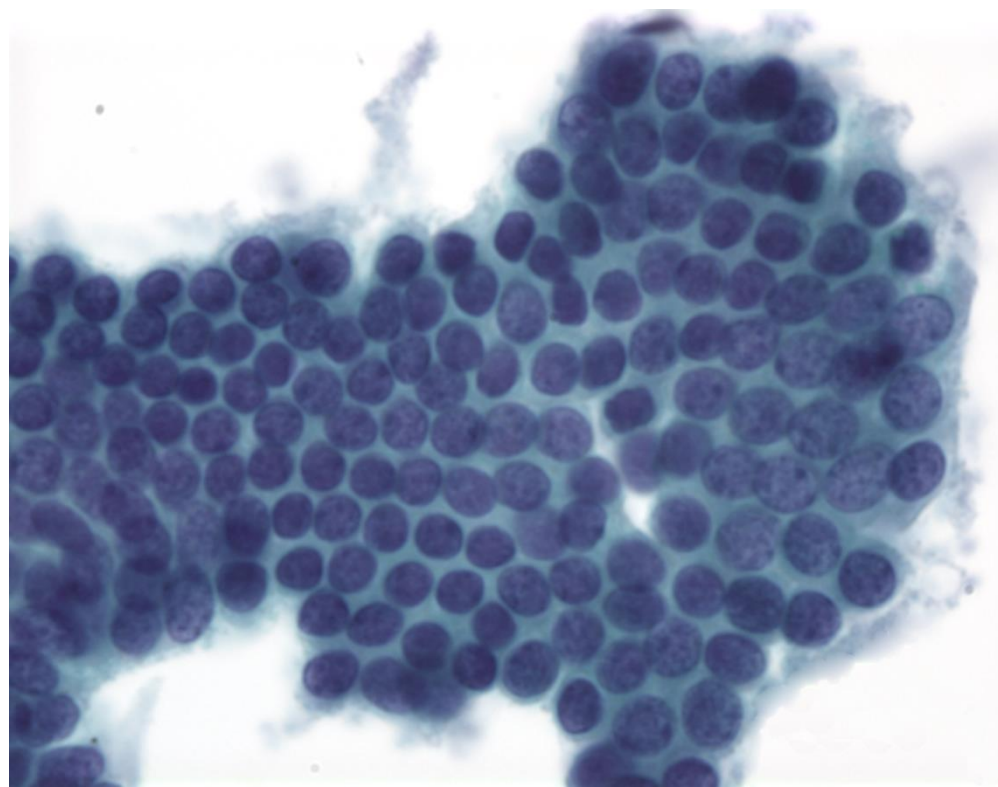
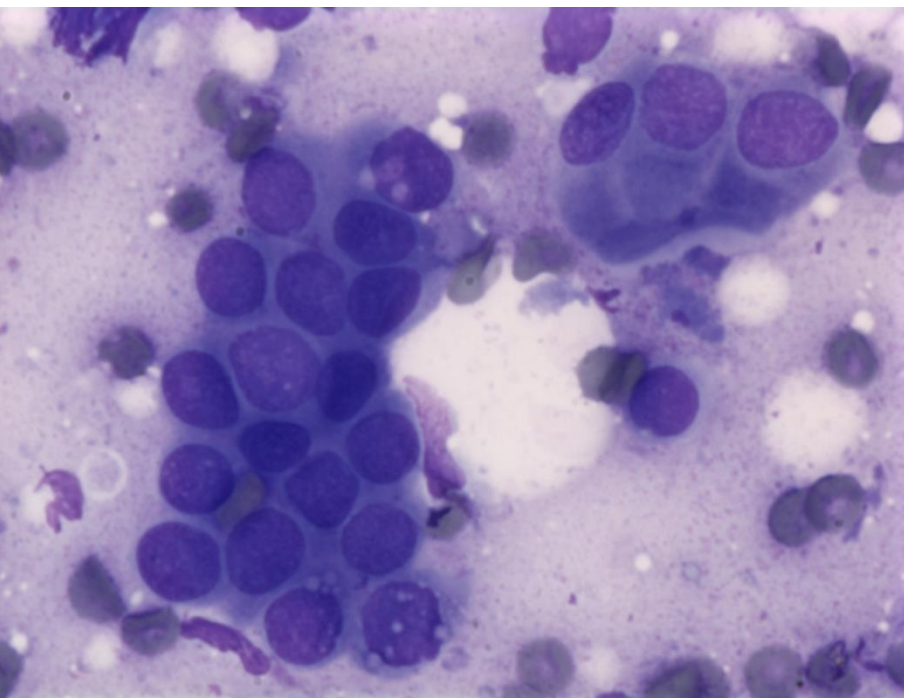
Acinar Cells





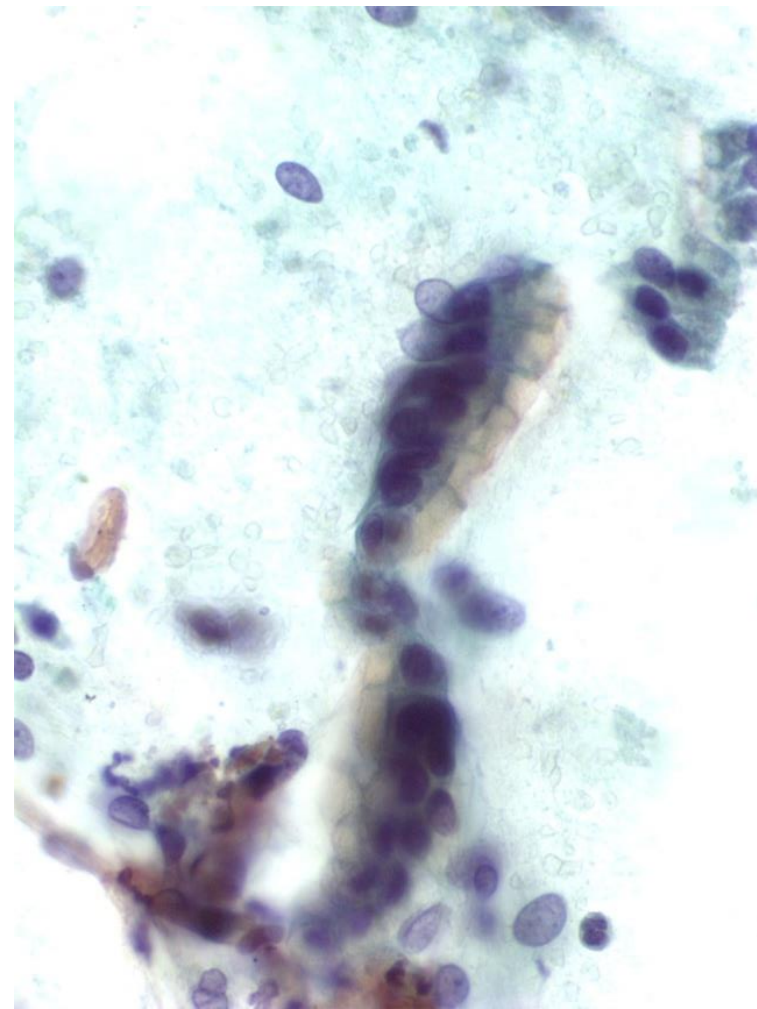
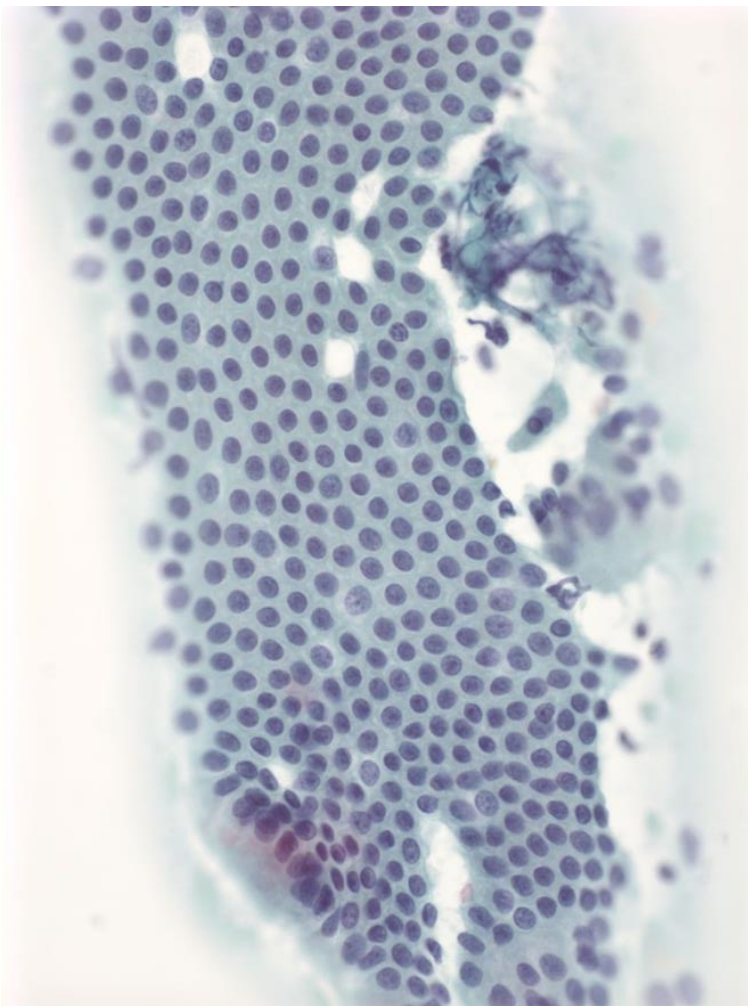
Normal Pancreas

Ductal Cells



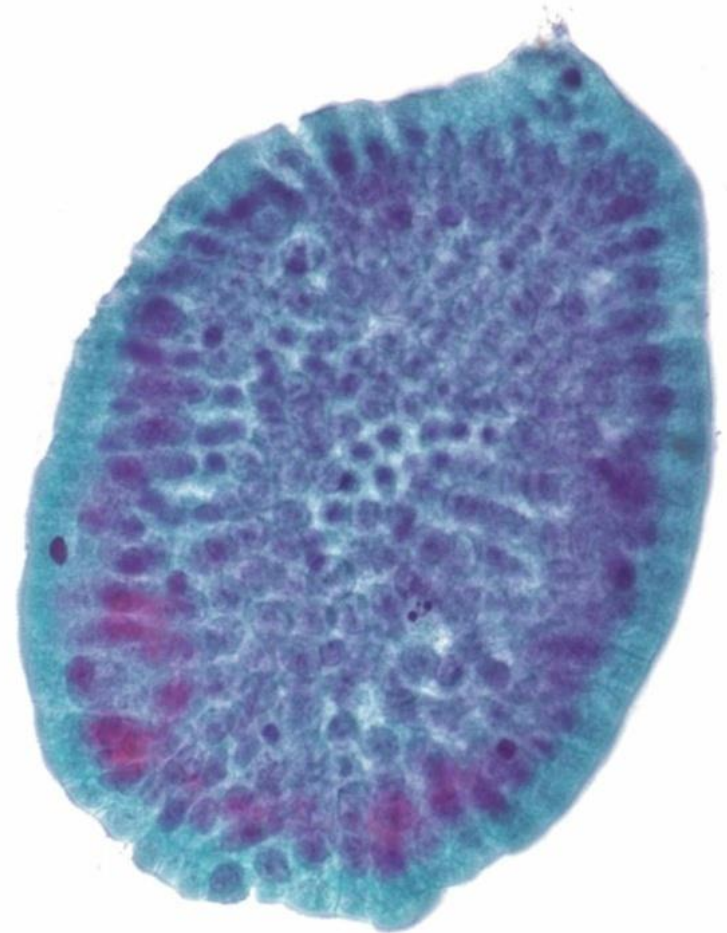
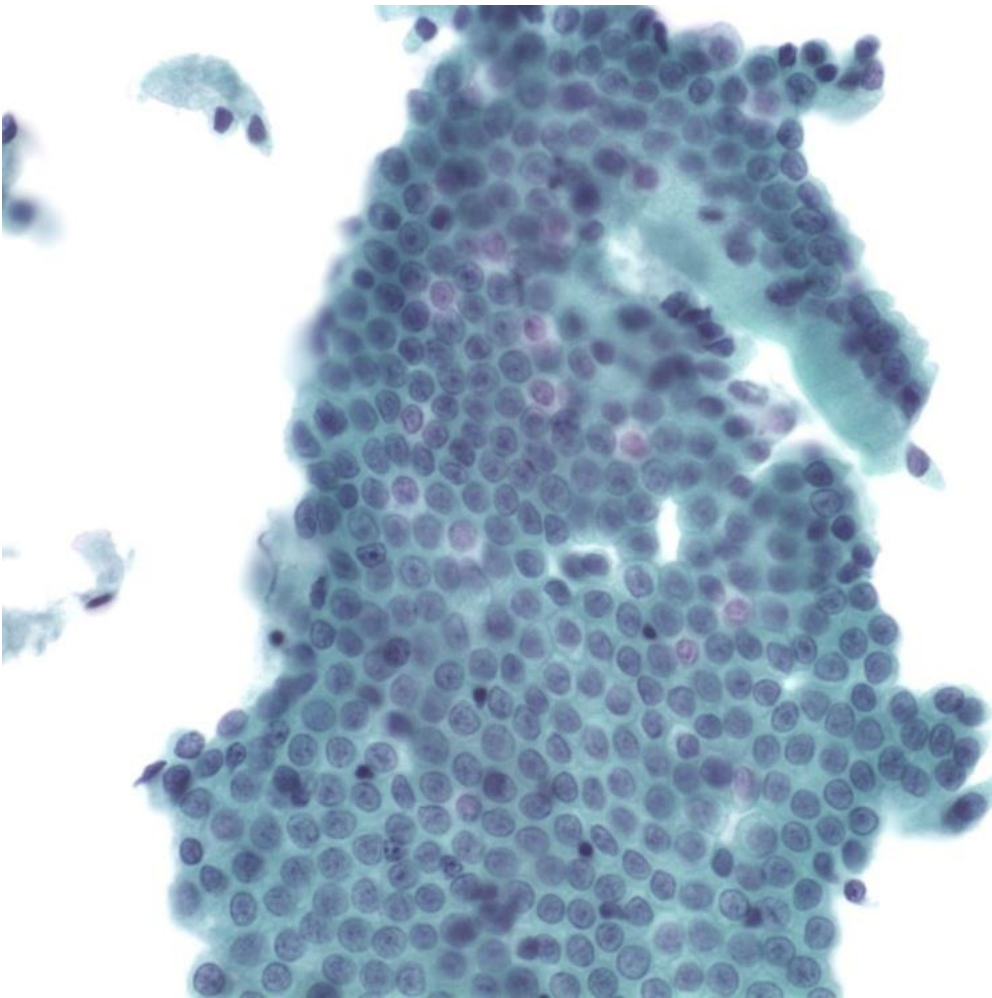


Gastric Contamination





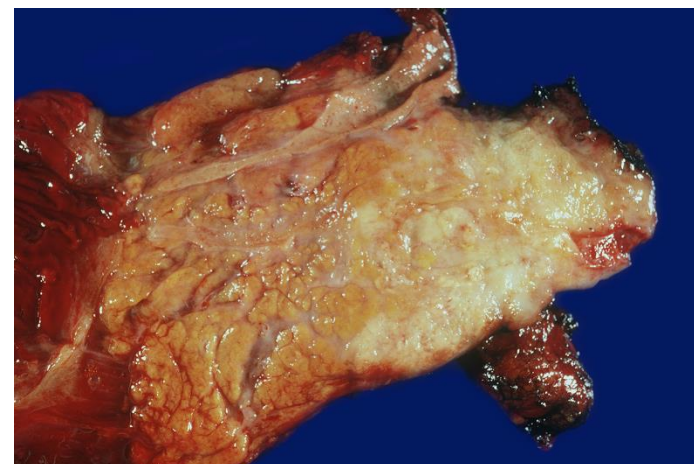
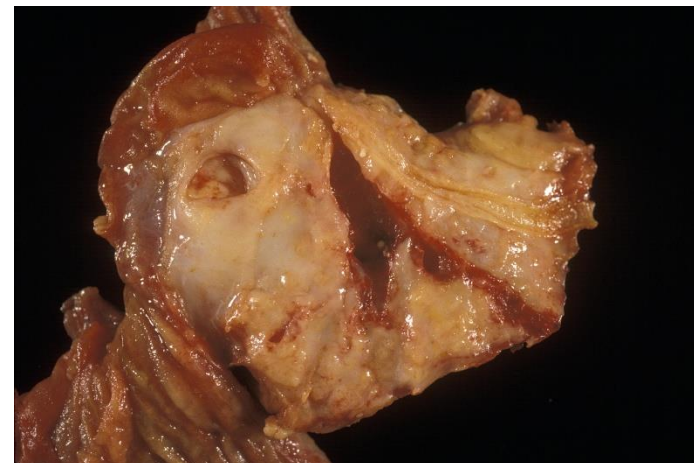
Duodenal Contamination





Differential Diagnosis of Solid Pancreatic Masses

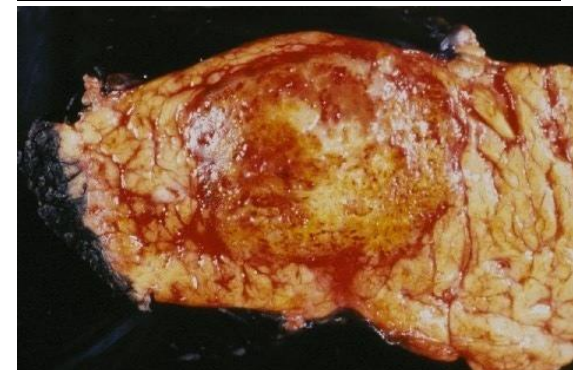
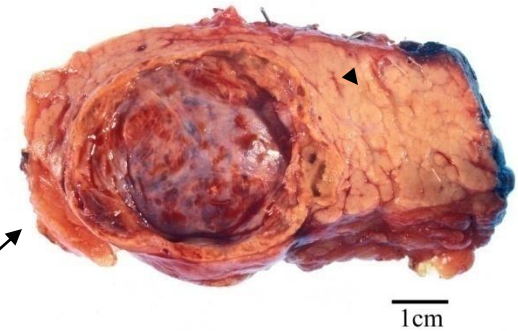
- Solid
 - Chronic pancreatitis →
 - Ductal adenocarcinoma →
 - Metastasis
 - Pancreatic neuroendocrine tumor
 - Acinar cell carcinoma
 - Pancreatoblastoma
 - Solid-pseudopapillary neoplasm



Differential Diagnosis of Solid Pancreatic Masses

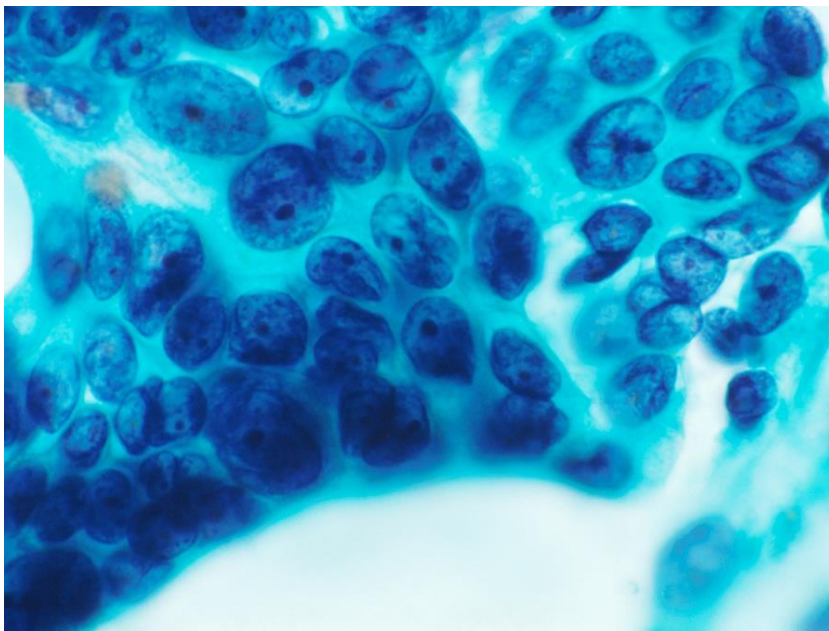
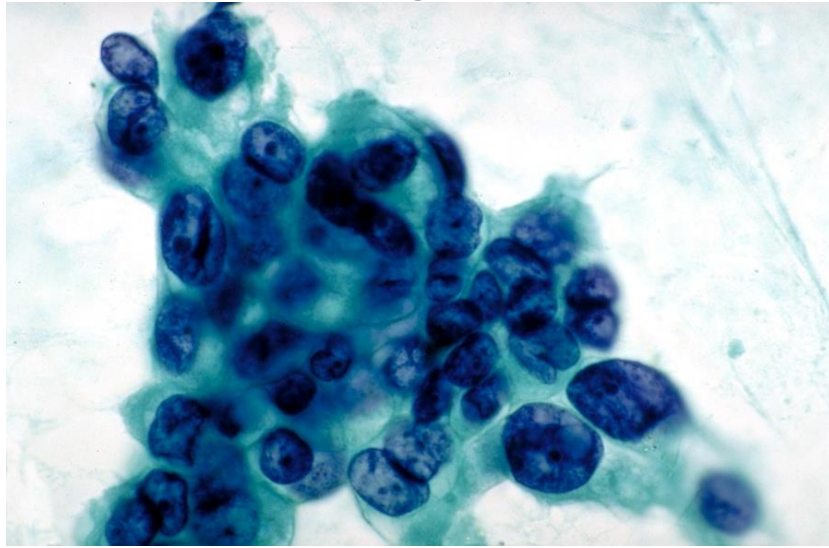


- Solid
 - Chronic pancreatitis
 - Ductal adenocarcinoma
 - Metastasis
 - Pancreatic neuroendocrine tumor
 - Acinar cell carcinoma
 - Solid-pseudopapillary neoplasm

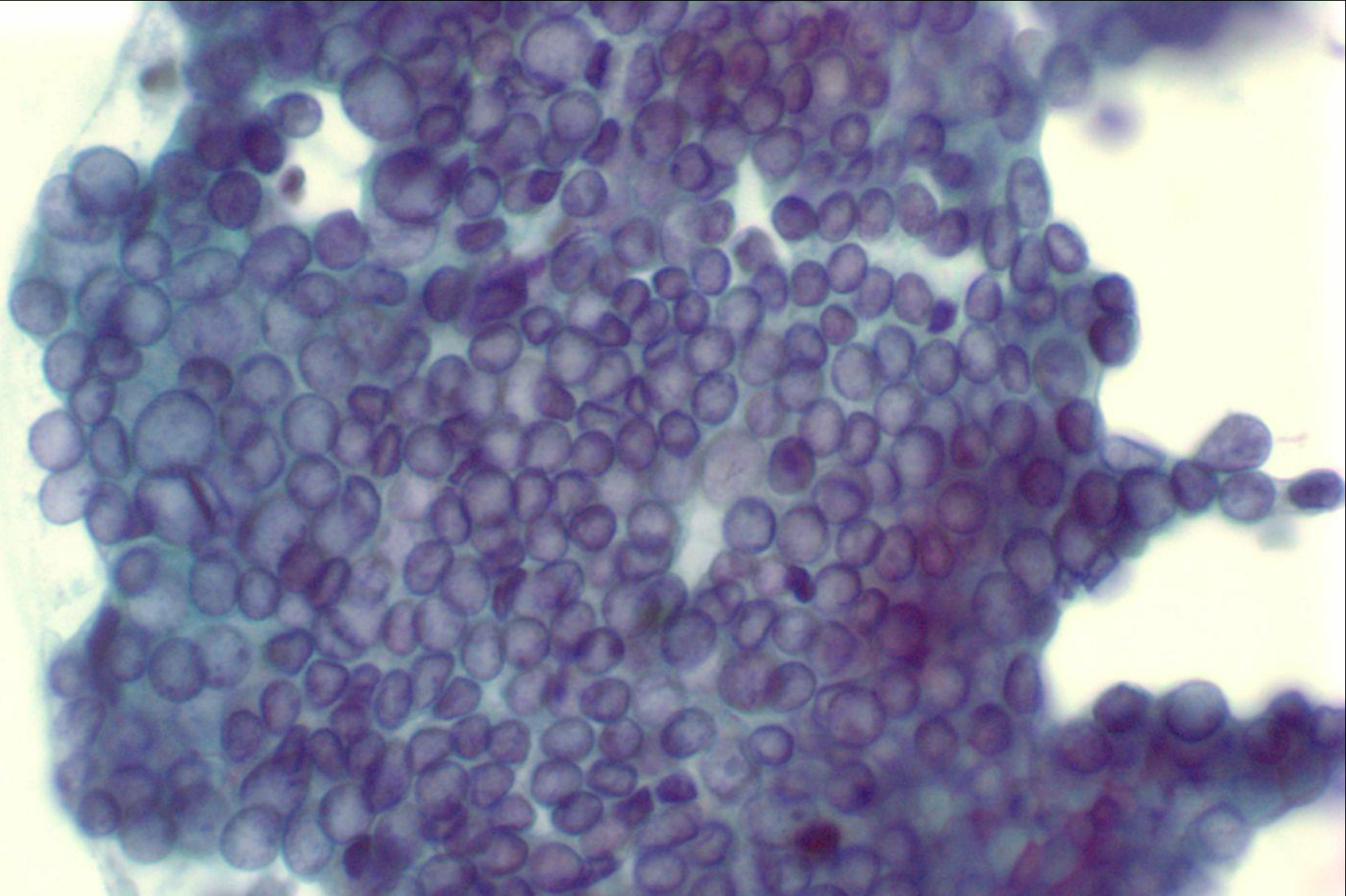




High Grade Adenocarcinoma

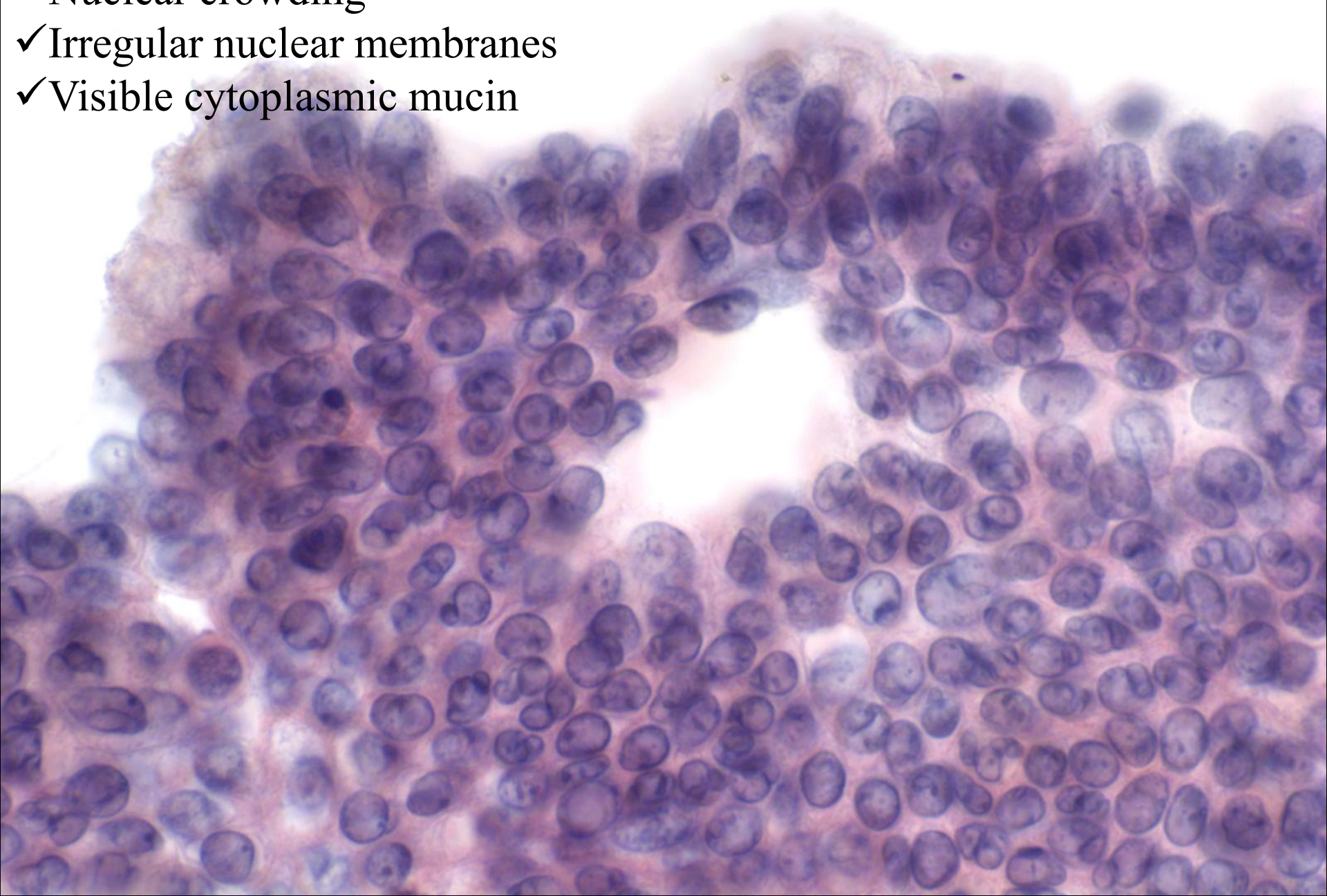


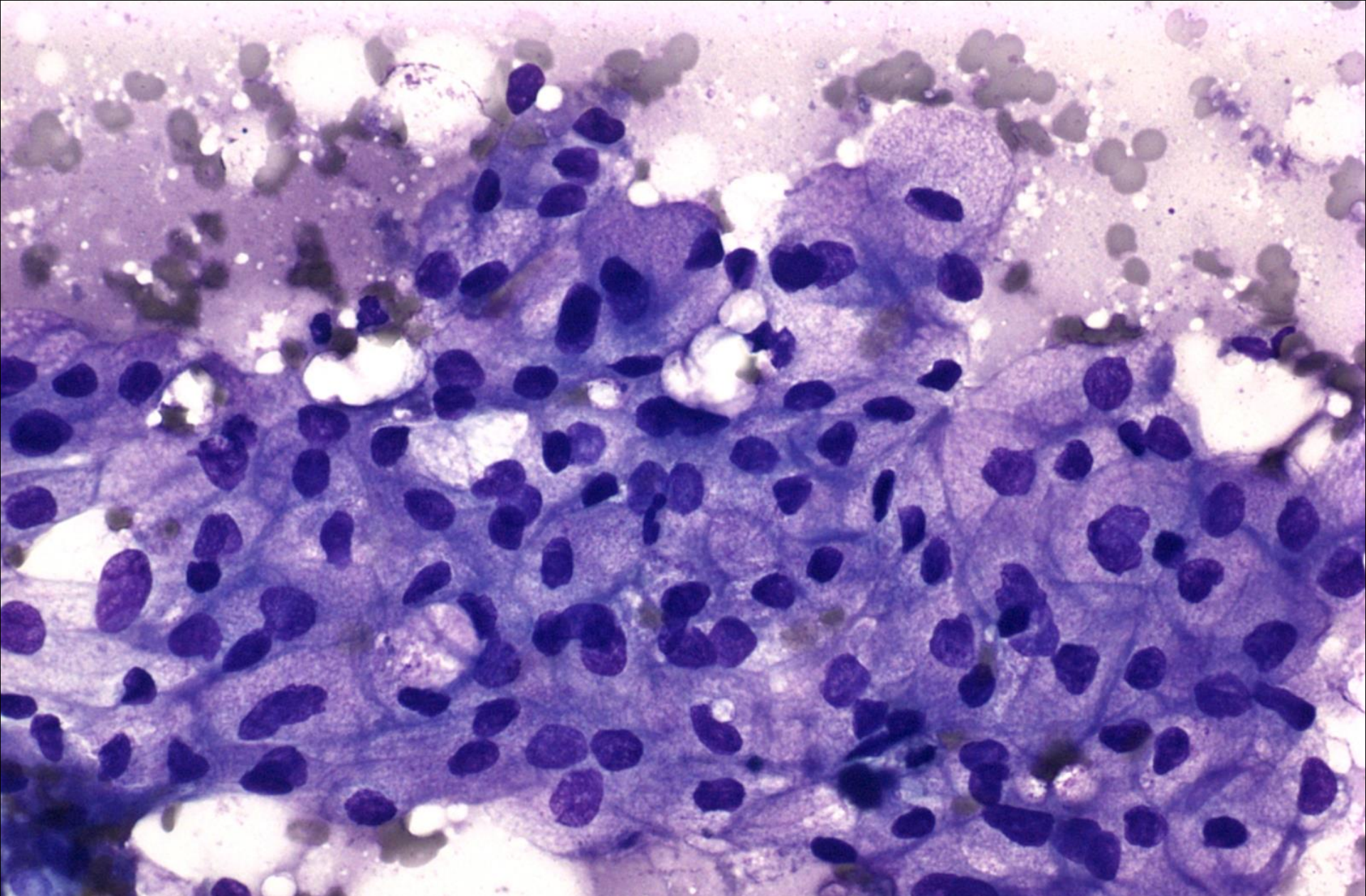
- Marked nuclear
 - atypia
 - hyperchromasia
 - pleomorphism
 - overlapping
- Prominent nucleoli
- Single atypical cells
- Mitoses
- Coagulative Necrosis



- ✓ Drunken Honeycomb
- ✓ Anisonucleosis (4:1)
- ✓ Parachromatin clearing
- ✓ Nuclear membrane irregularity

- ✓ Parachromatin clearing
- ✓ Nuclear crowding
- ✓ Irregular nuclear membranes
- ✓ Visible cytoplasmic mucin



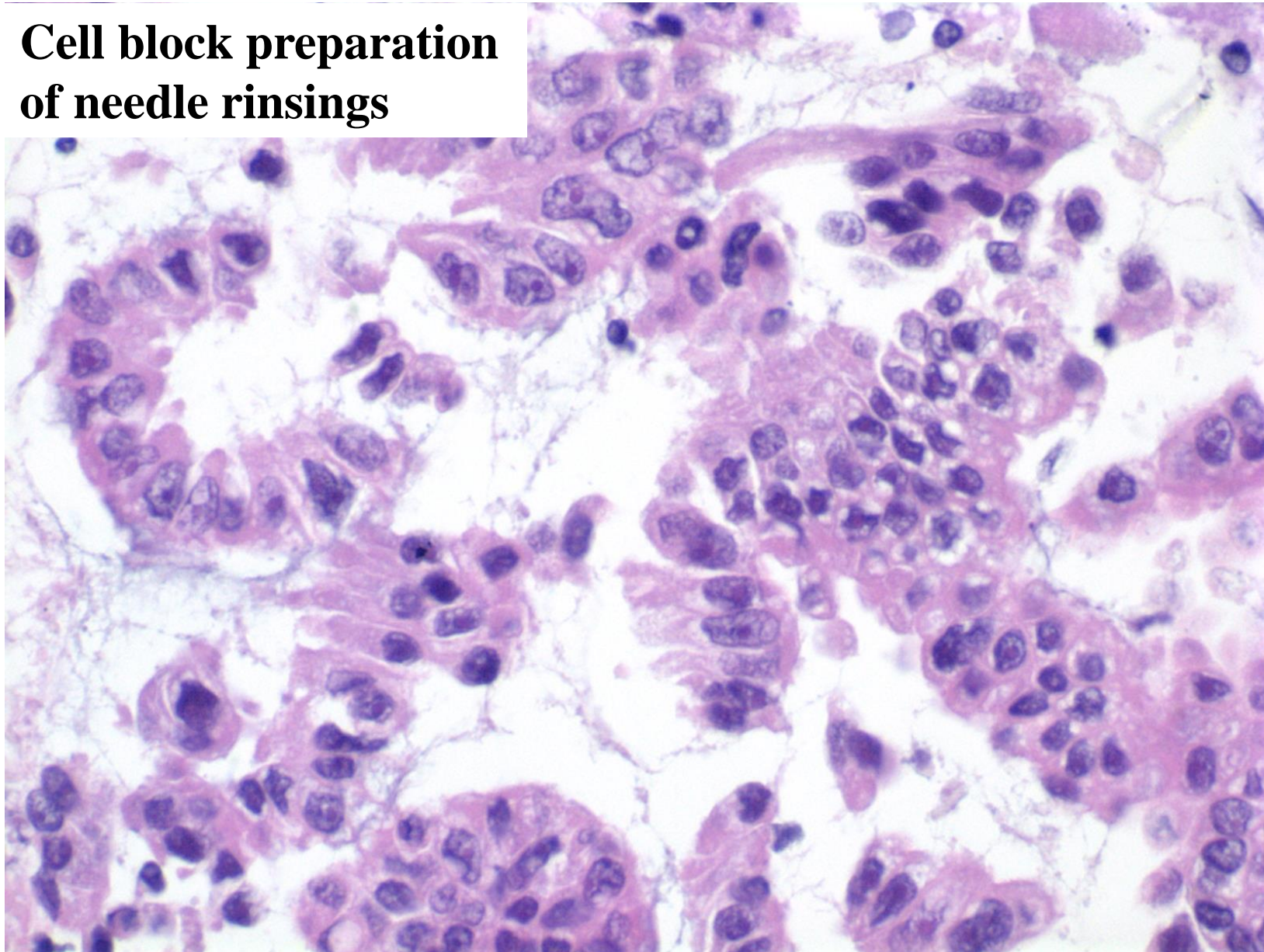


- ✓ Drunken honeycomb
- ✓ Exaggerated vacuolated cytoplasm



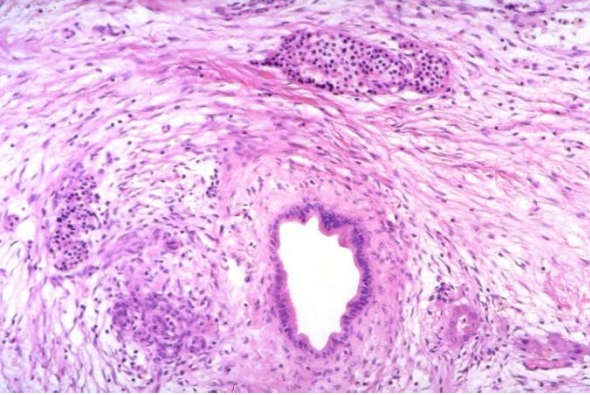
Well-differentiated Adenocarcinoma

**Cell block preparation
of needle rinsings**



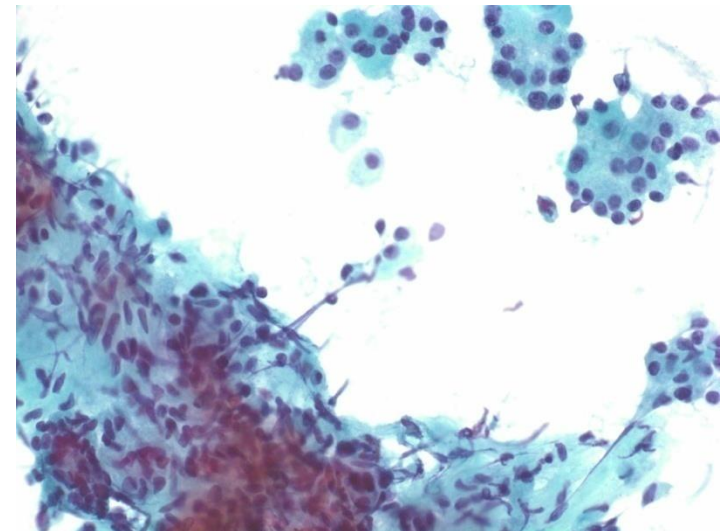
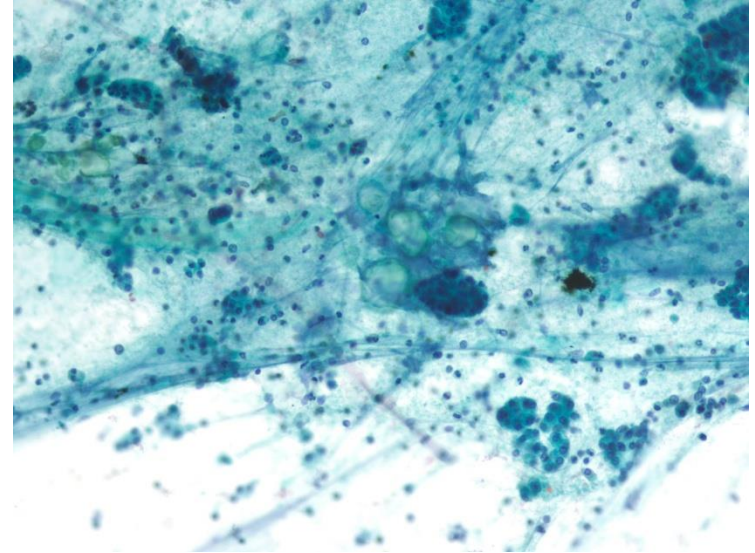
Chronic Pancreatitis

Advancing Diagnosis
and Discovery



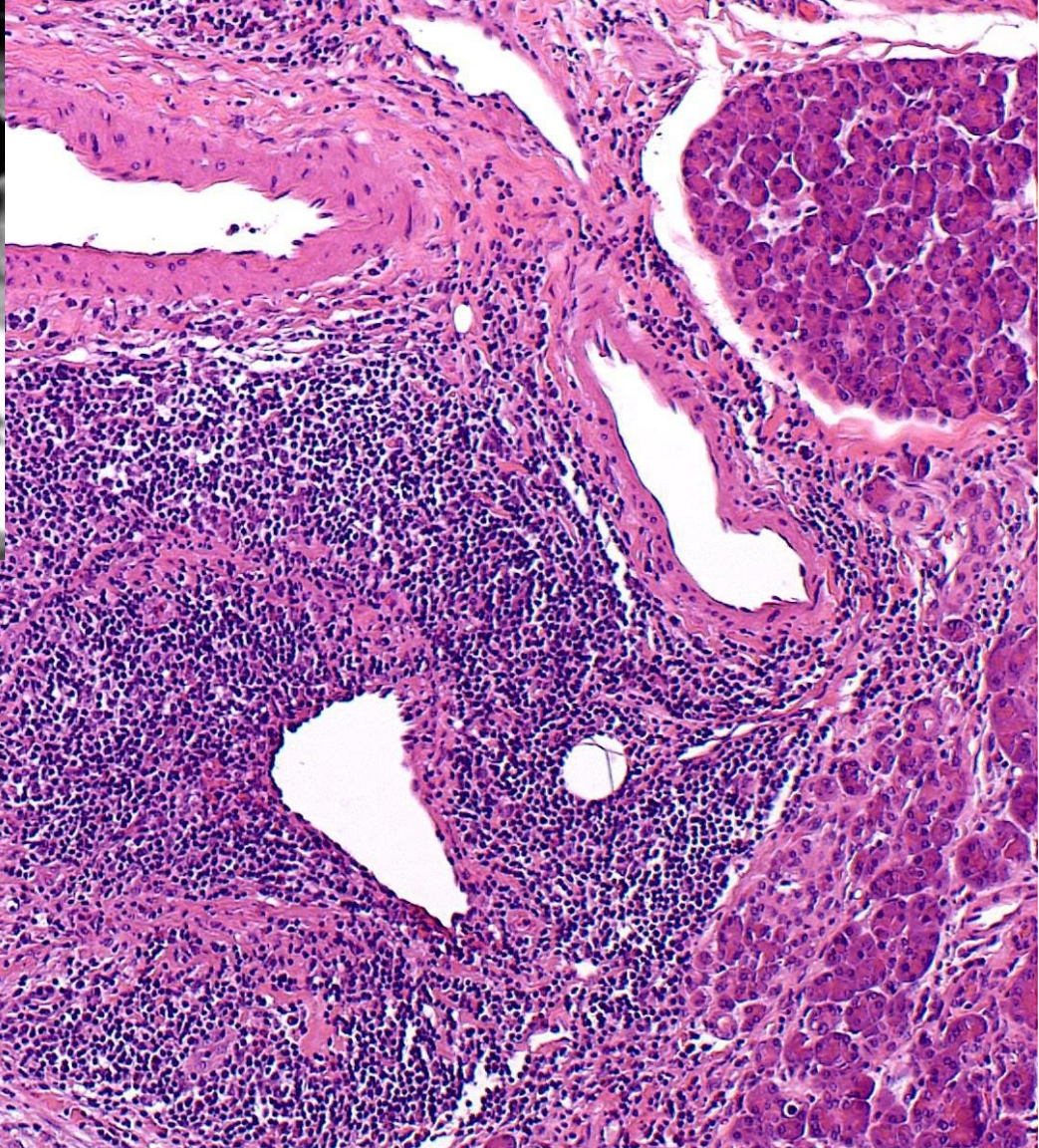
Key Cytologic Features:

- Fragments of acinar tissue with acini splayed apart by fibrosis
- Stromal fragments
- Inflammatory cells (lymphocytes, plasma cells, macrophages and siderophages)
- Background debris and calcification
- Ductal epithelium with only mild cytologic atypia
- No definite features of neoplasia



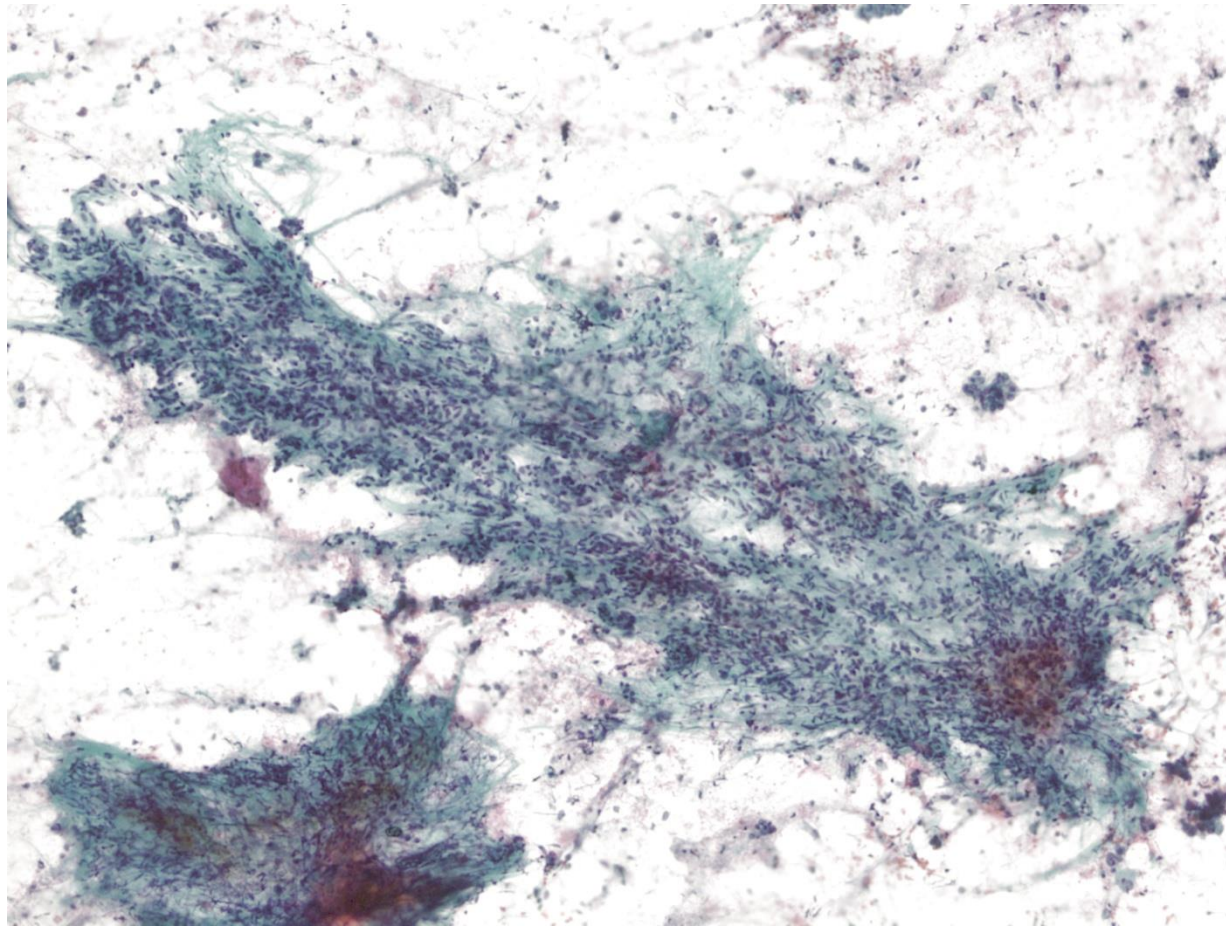
Autoimmune Pancreatitis: *Advancing Diagnosis and Discovery*

Mass Forming Lesion





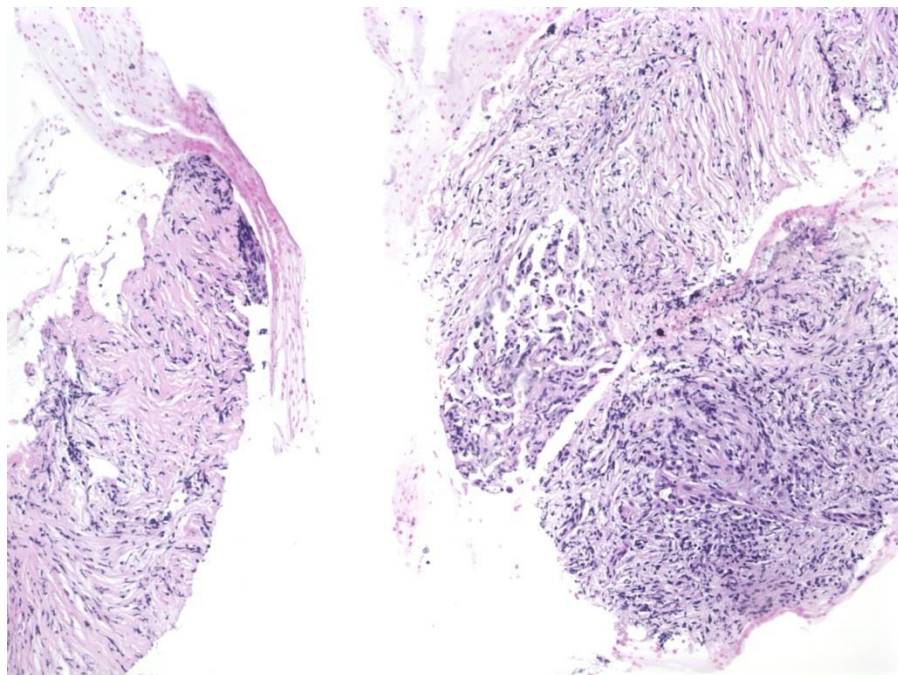
Autoimmune Pancreatitis



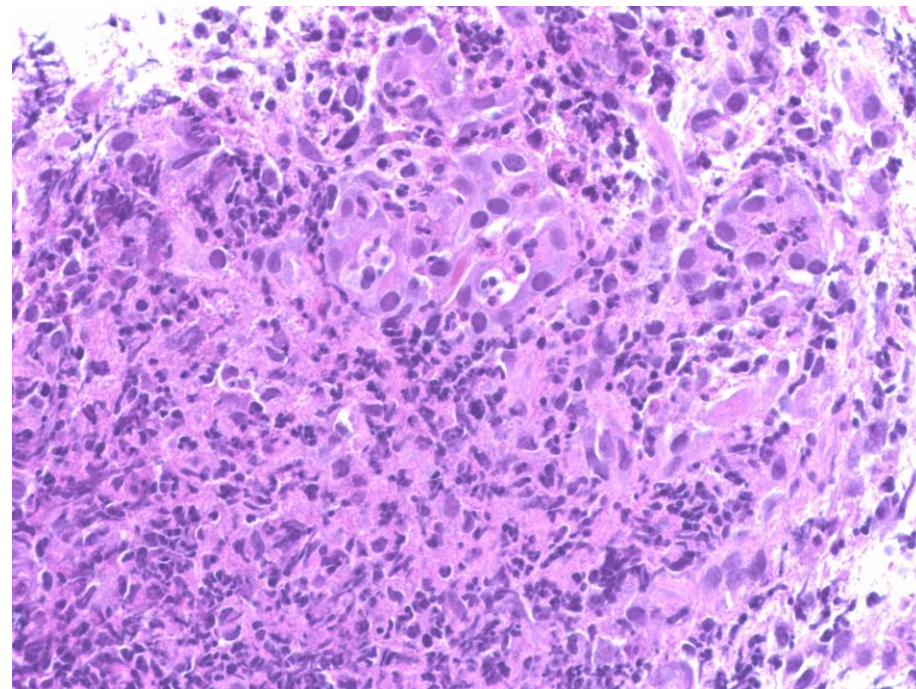
**Deshpande V, Mino-Kenudson M, Brugge WR, Pitman MB, Castill CF, Warshaw AL, Lauwers GY.
Am J Surg Pathol. 2005; 29; 1464-1471.**



AIP: Core Biopsy



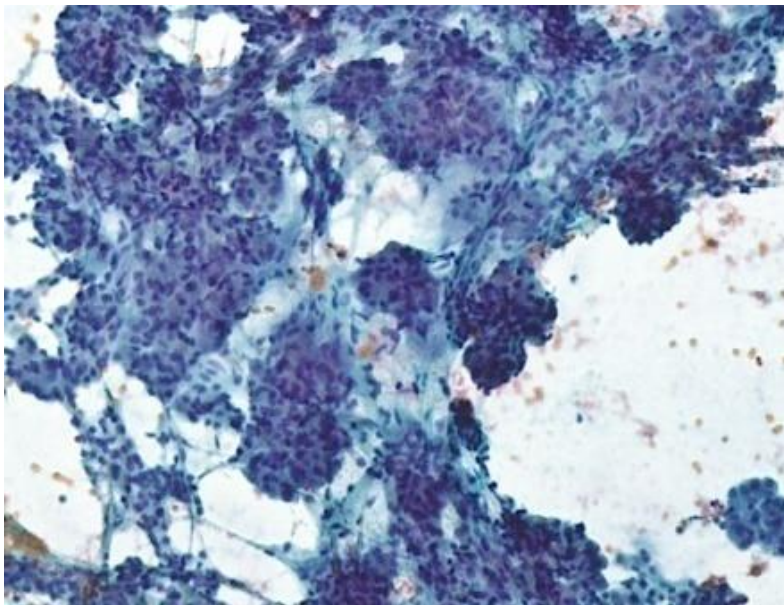
Type 1



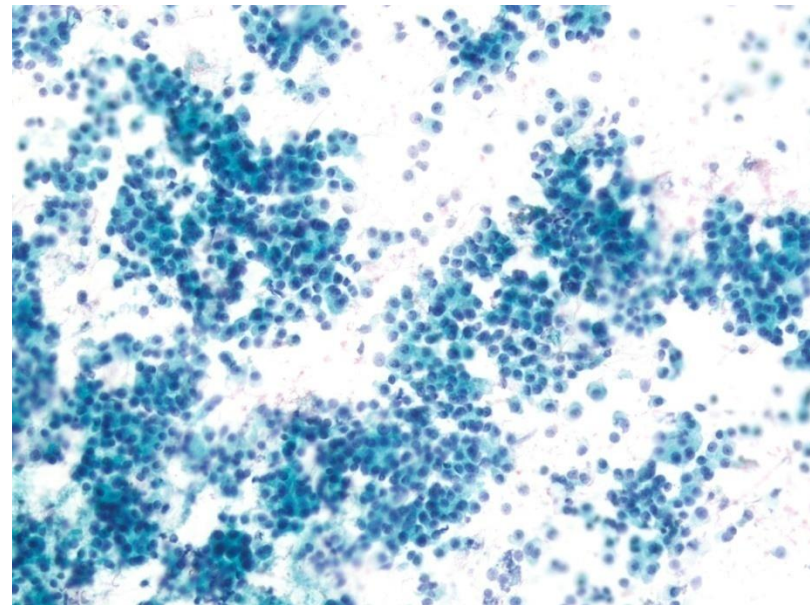
Type 2



Benign vs Malignant Acinar Cell Population



Benign



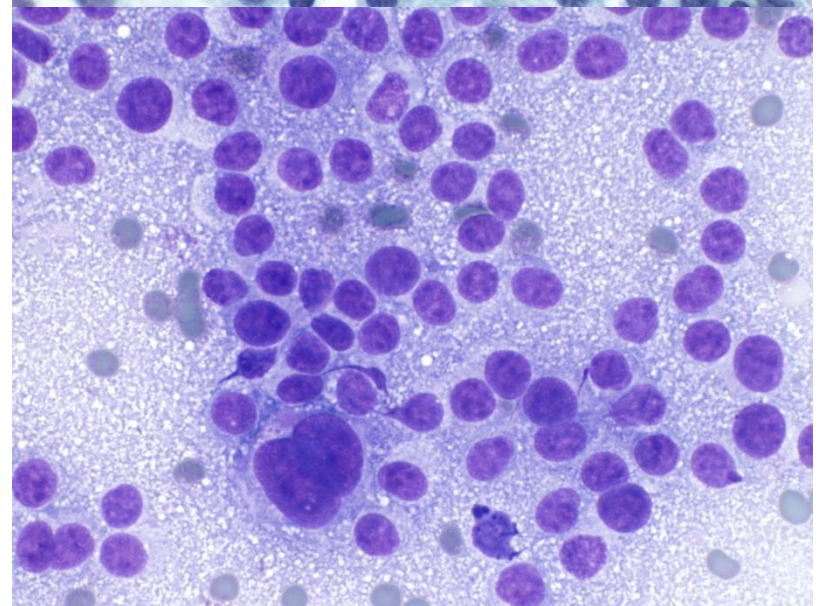
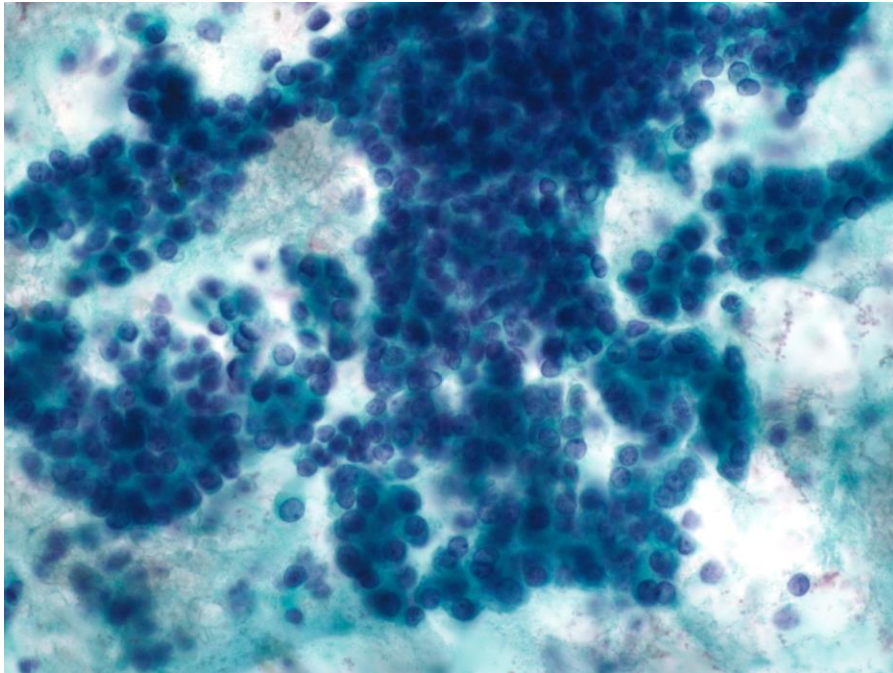
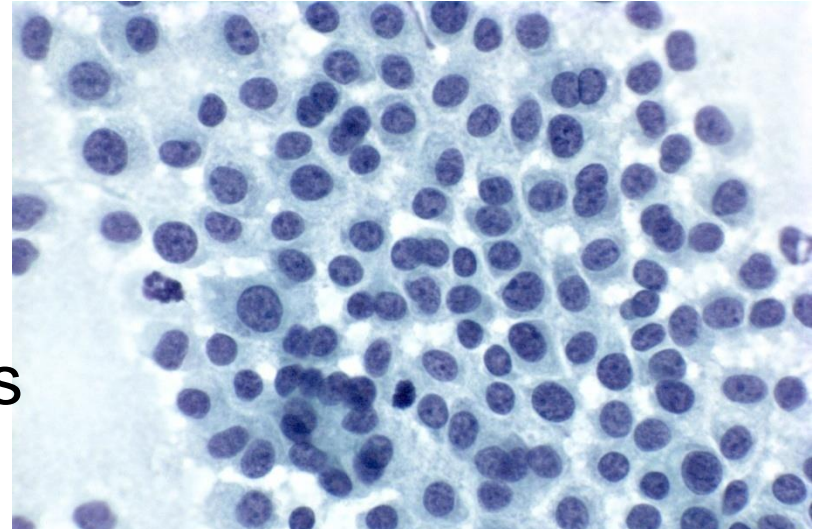
Malignant



Acinar Cell Carcinoma

- ✓ Cohesive groups and single cells
- ✓ Many stripped naked nuclei
- ✓ Granular cytoplasm (and background)
- ✓ +/- nucleoli

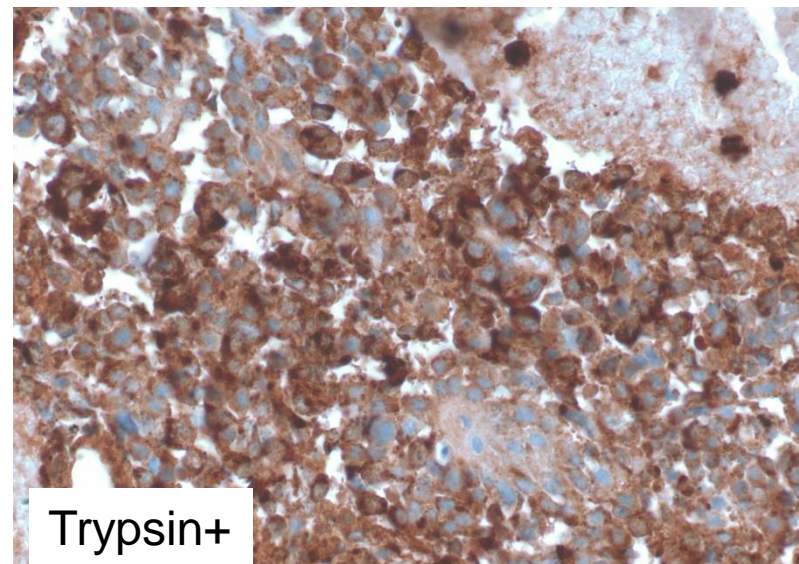
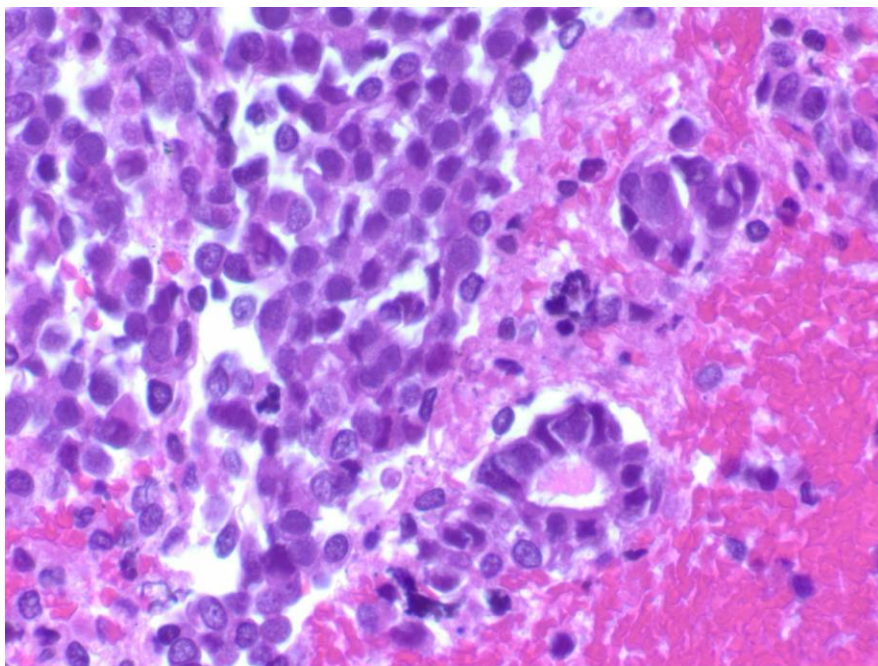
Direct Smears





Acinar Cell Carcinoma

Cell Block



Trypsin+

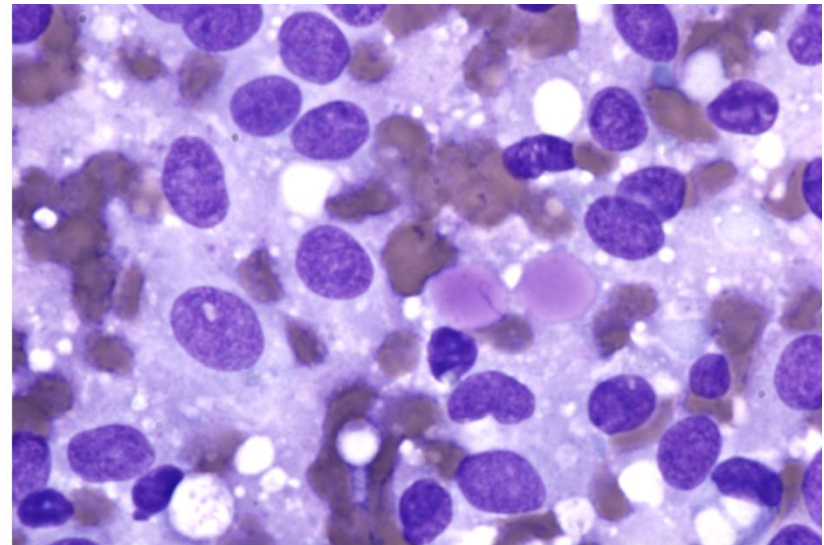
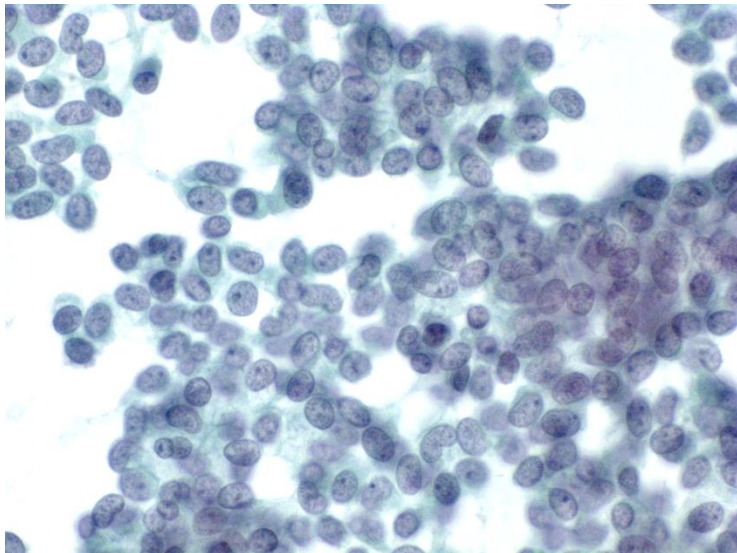
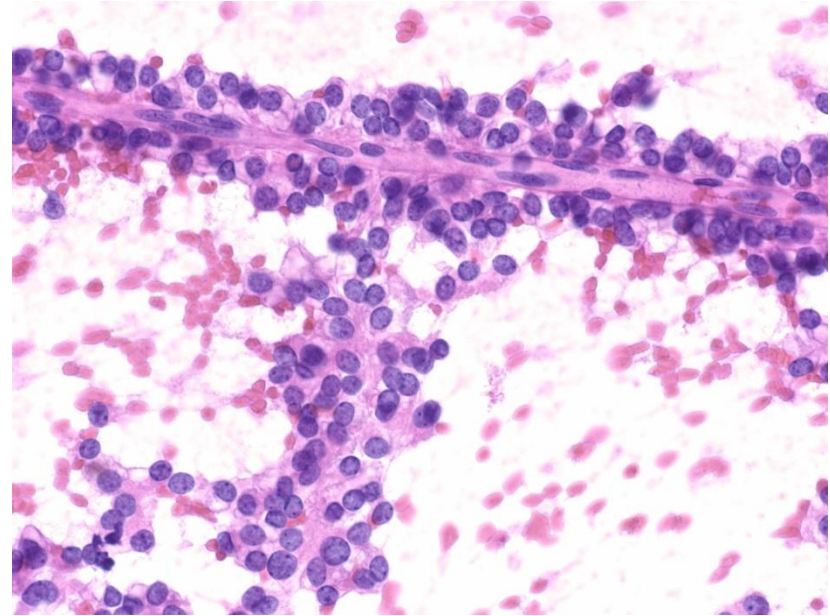


Endocrine markers-

Solid Pseudopapillary Neoplasm



- ✓ Papillary branching
- ✓ Myxoid stroma
- ✓ Clinging cells and single cells
- ✓ Euchromatin
- ✓ Oval, indented, grooved nuclei
- ✓ Perinuclear vacuoles/globules

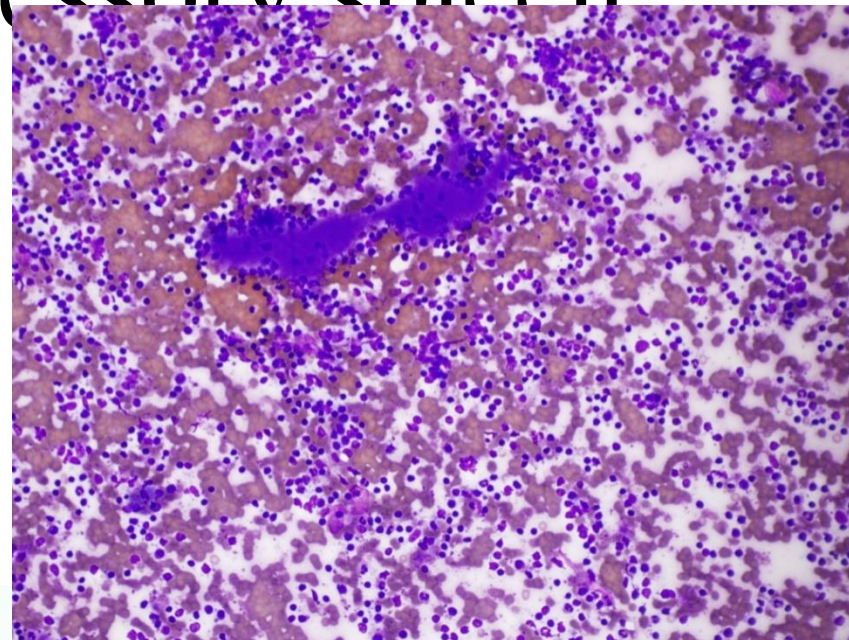


Direct Smears

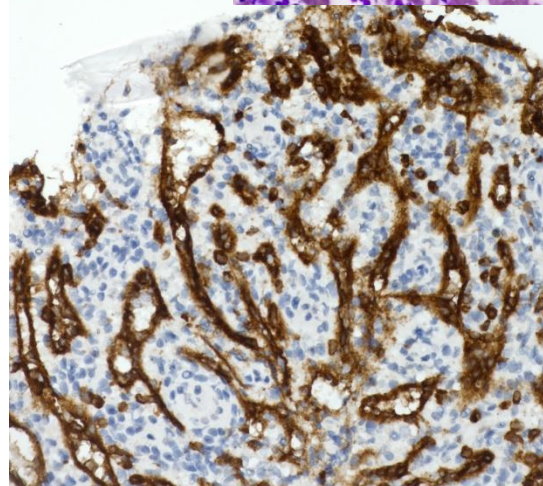
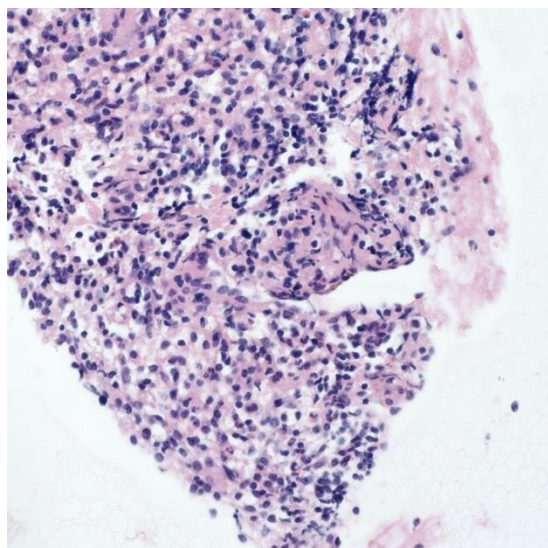


Splenule/accessory spleen

- Lymphoid tissue
- Histiocytes
- Blood vessels
- CD8+ cells indicating splenic endothelial cells



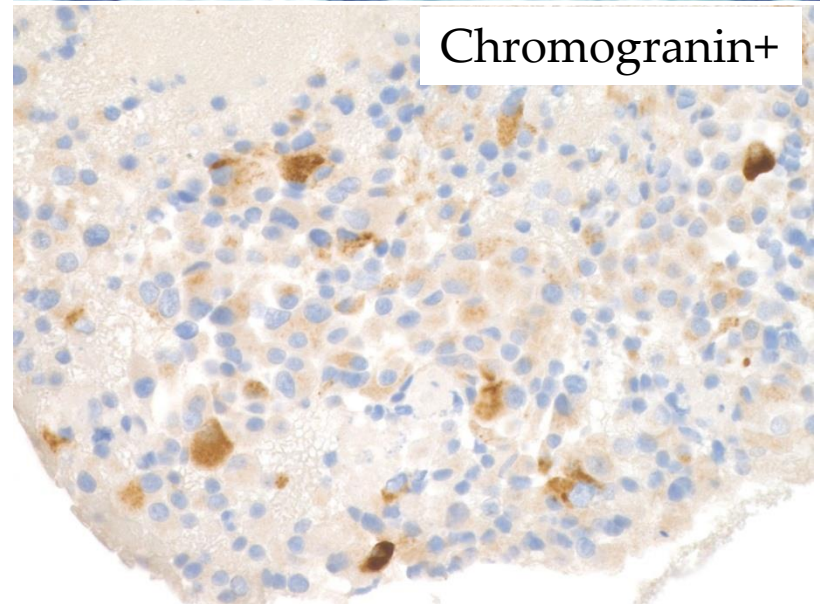
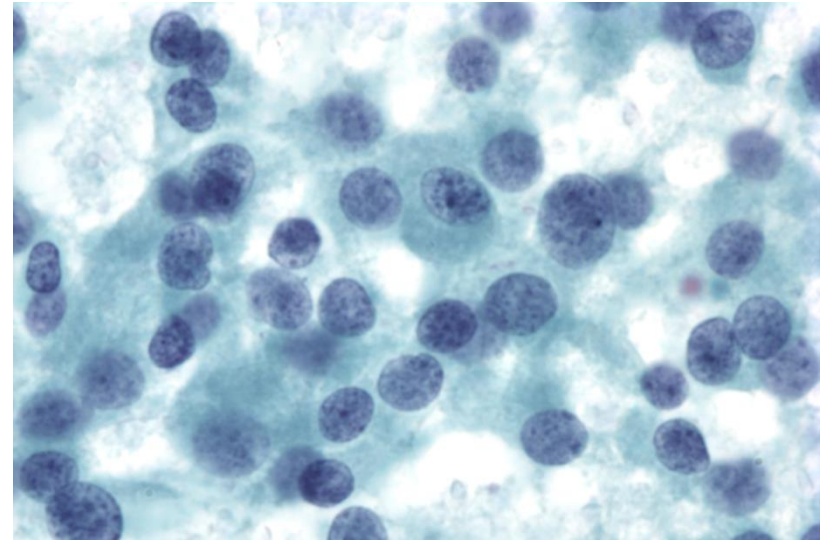
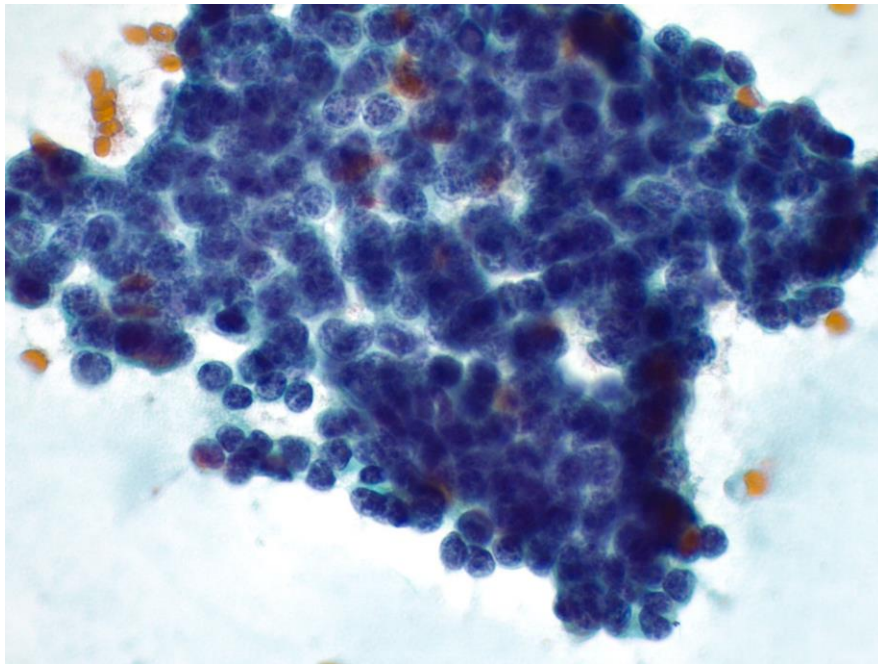
Direct Smear



Cell Block

Classic Pancreatic Neuroendocrine Tumor

- ✓ Single cells mostly
- ✓ Plasmacytoid
- ✓ Coarse, stippled chromatin
- ✓ -/+ nucleoli



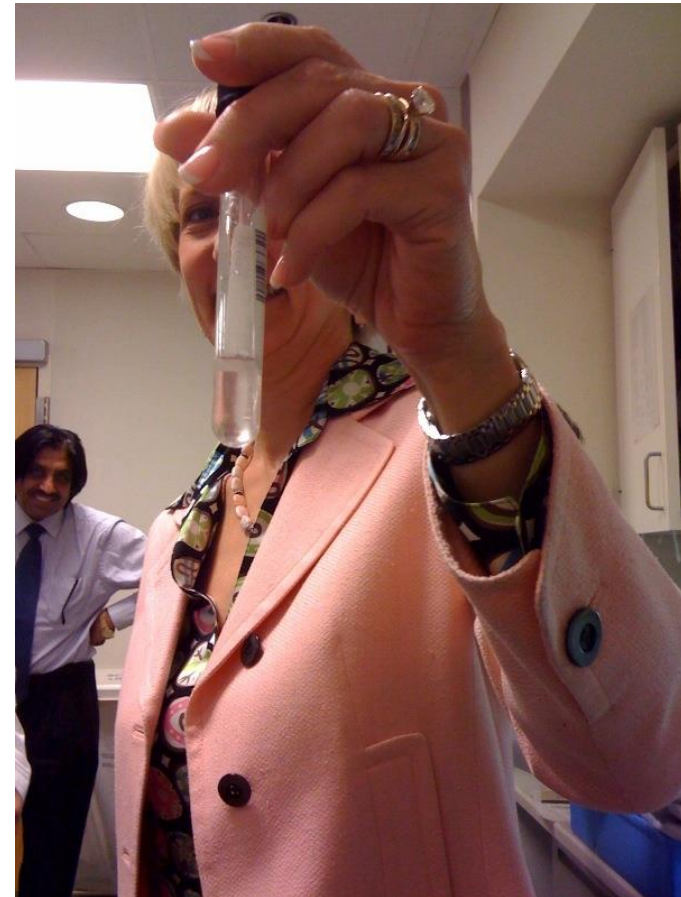
Special Case: Cyst Fluid Evaluation

A. Is the cyst mucinous or not?

- 1) Gross examination
- 2) CEA (best test)
- 3) Cytology

B. Is the cyst low- or high-grade?

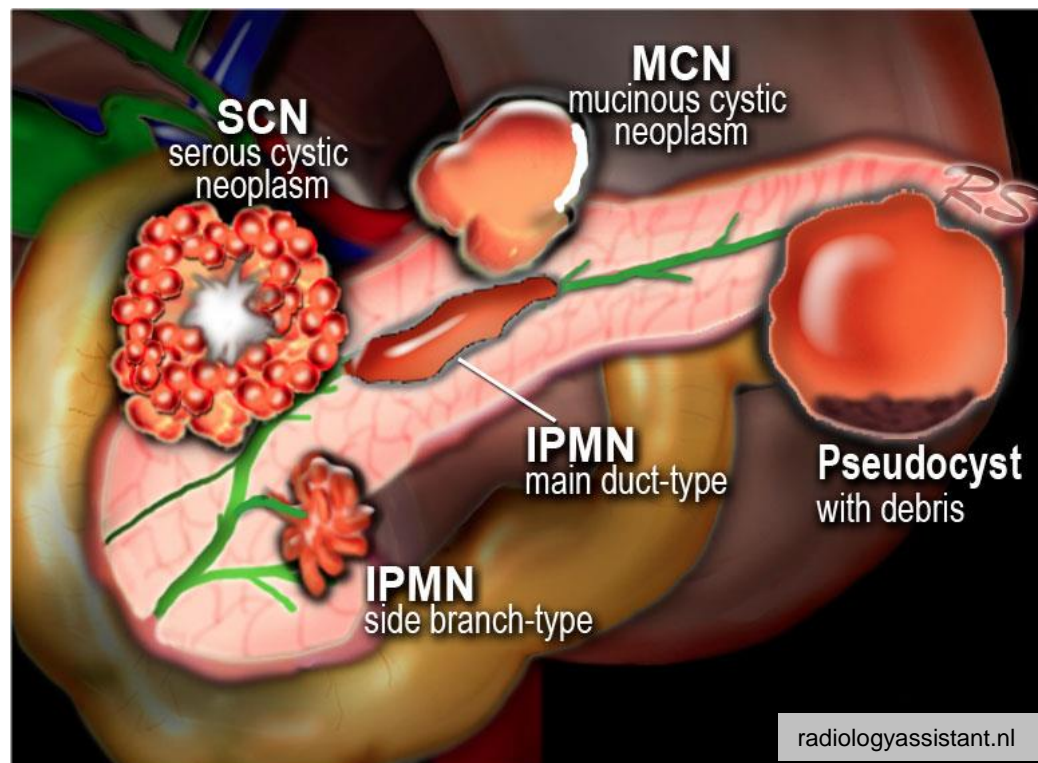
Cytology!!





Pancreatic Cysts

- Differential Diagnosis
 - Pseudocyst
 - Lymphoepithelial cyst
 - Serous cyst
 - Mucinous cyst
 - (MCN and IPMN)
 - Cystic degeneration of typically solid tumors
 - PanNET
 - SPN
 - other
 - Other more rare cysts





Management Options

- Surgical
 - Distal pancreatectomy
 - Middle pancreatectomy
 - Pancreatoduodenectomy (Whipple)
- Medical
 - Drain
 - Ablate
- Observation

Current Recommendations for Pancreatic Cyst Management

- Surgery-recommended
 - MCN, all grades
 - IPMN-HGD
 - IPMN-invasive
 - Cystic PanNET
 - SPN
 - Cystic Acinar Cell Ca.
 - Cystic PDAC
- Surgery-optional
 - PCT
 - LEC
 - SCA
 - IPMN-LGD
 - IPMN-IGD??

Cytology is critical for cyst classification and management.
Decision to operate is based on surgical risk vs malignancy risk.

Surgical procedures

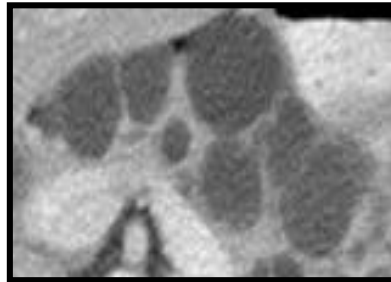
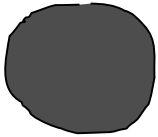
	Whipple	Middle pancreatectomy	Distal pancreatectomy	Other
Frequency, (%)	368, (43.2%)	63, (7.4%)	373, (43.8%)	47, (5.5%)
Complications (%)	40%	49.2%	36.4%	32.4%
Pancreatic fistula	12.5%	35.5%	18.2%	8.8%
Delayed gastric emptying	6.5%	0%	0.3%	0%
Other major complication	12.9%	12.7%	12.6%	11.8%
Median length of stay, days	8 days	6 days	6 days	8 days
Operative mortality, n	2	0	1	1

Outcomes

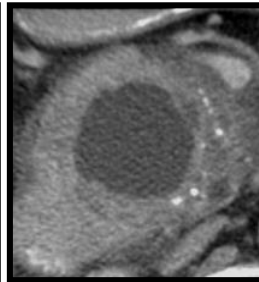
	MCN	MD IPMN	BD IPMN	SCA	CNET	SPN
n	199	180	146	137	62	29
Malignant (%)	10.3%	33.7%	13.7%	0.0%	10.7%	0.0%
Outcome						
3-year survival (%)	94.0%	83.0%	88.0%	97.0%	98.0%	100.0%
5-year survival (%)	90.0%	78.0%	80.0%	90.0%	98.0%	100.0%

Pancreatic Cysts: CT

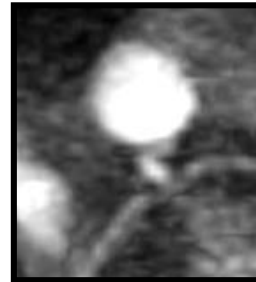
unilocular



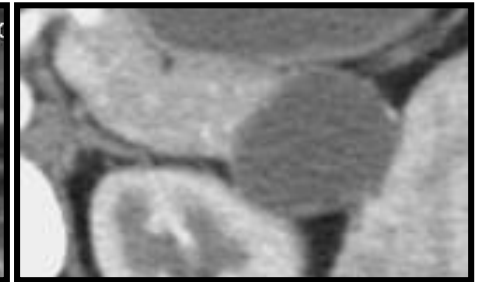
Simple cysts



PCT



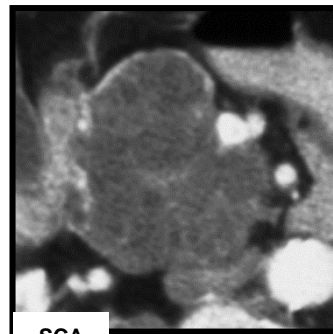
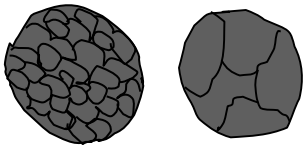
BD-IPMN w/ LGD



MCN w/ LGD

Benign imaging

multilocular



SCA



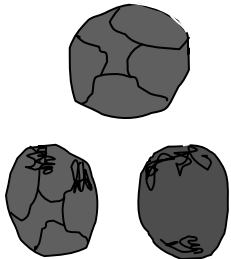
BD-IPMN w/ LGD



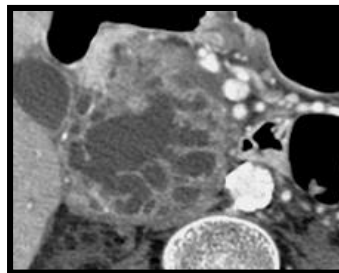
Small or non-enhancing MN: IPMN with HGD

Benign to Worrisome imaging

complex



MCN w/ inv. Ca.



IPMN w/ inv. Ca.



SPN



cPanNET

Worrisome to High-risk imaging



EUS Recommended (2012 guidelines)

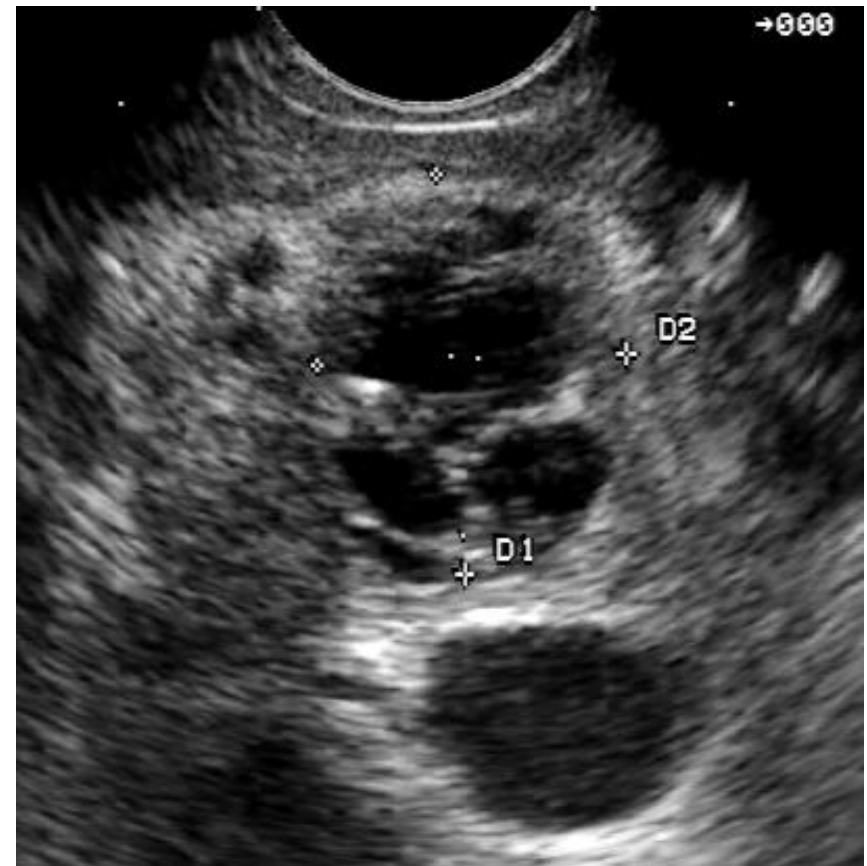
- Worrisome Imaging
 - Cyst $> 3\text{cm}$
 - Thickened/enhanced cyst walls
 - MPD 5-9 mm
 - Nonenhancing mural nodule
 - Abrupt change in caliber of MPD with distal atrophy

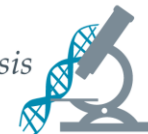




Nonspecific EUS Imaging

- Broad differential diagnosis:
 - Mucinous
 - BD-IPMN
 - MCN
 - Nonmucinous
 - Macrocystic SCA
 - Lymphangioma
 - Benign
 - Malignant (\geq HGD)

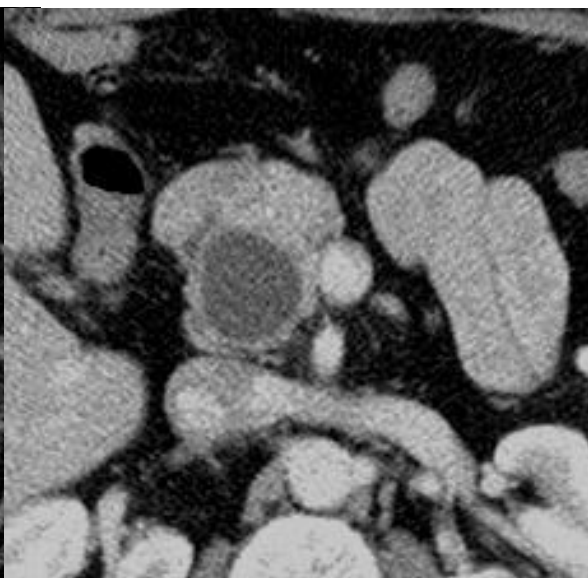




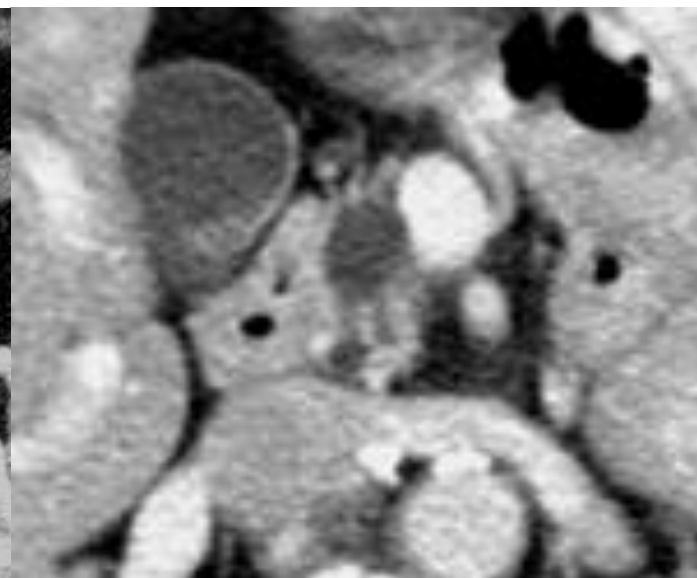
Challenges in Cyst Characterization: Morphologic Overlap



MCN



Pseudocyst



IPMN

Cohen-Scali F et al. Radiology 2003

Khurana B et al. AJR 2003

Kim S et al. AJR 2006



Cystic Pancreatic Neuroendocrine Tumors: The Value of Cytology in Pre-Operative Diagnosis

Vicente Morales-Oyarvide MD, Won Jae Yoon, MD2, Thun Ingkakul MD, David G Forcione MD, Brenna Casey, MD, William R Brugge MD, Carlos Fernández-del Castillo MD, and Martha B Pitman MD
Cancer Cytopathology. 2014; 122:435-444..

TABLE 2. Accuracy of Cytology and EUS for the Diagnosis of Cystic Pancreatic Neuroendocrine

	<u>N</u>	<u>Diagnostic</u>	<u>Suspicious</u>	<u>HR</u>	<u>Benign or indeterminate</u>
Cytology	35	71%	77%	86%	5%
EUS	34	38%	47%	56%	15%

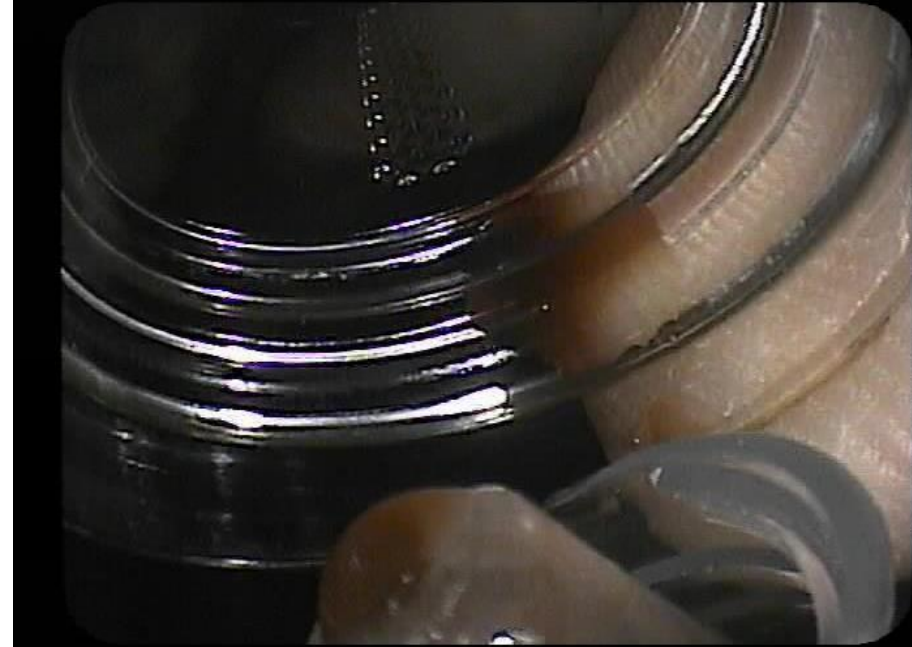
Key: EUS, endoscopic ultrasound; HR, high-risk



Pancreatic Cyst Fluid



**Mucinous cyst fluid:
Thick and viscous**

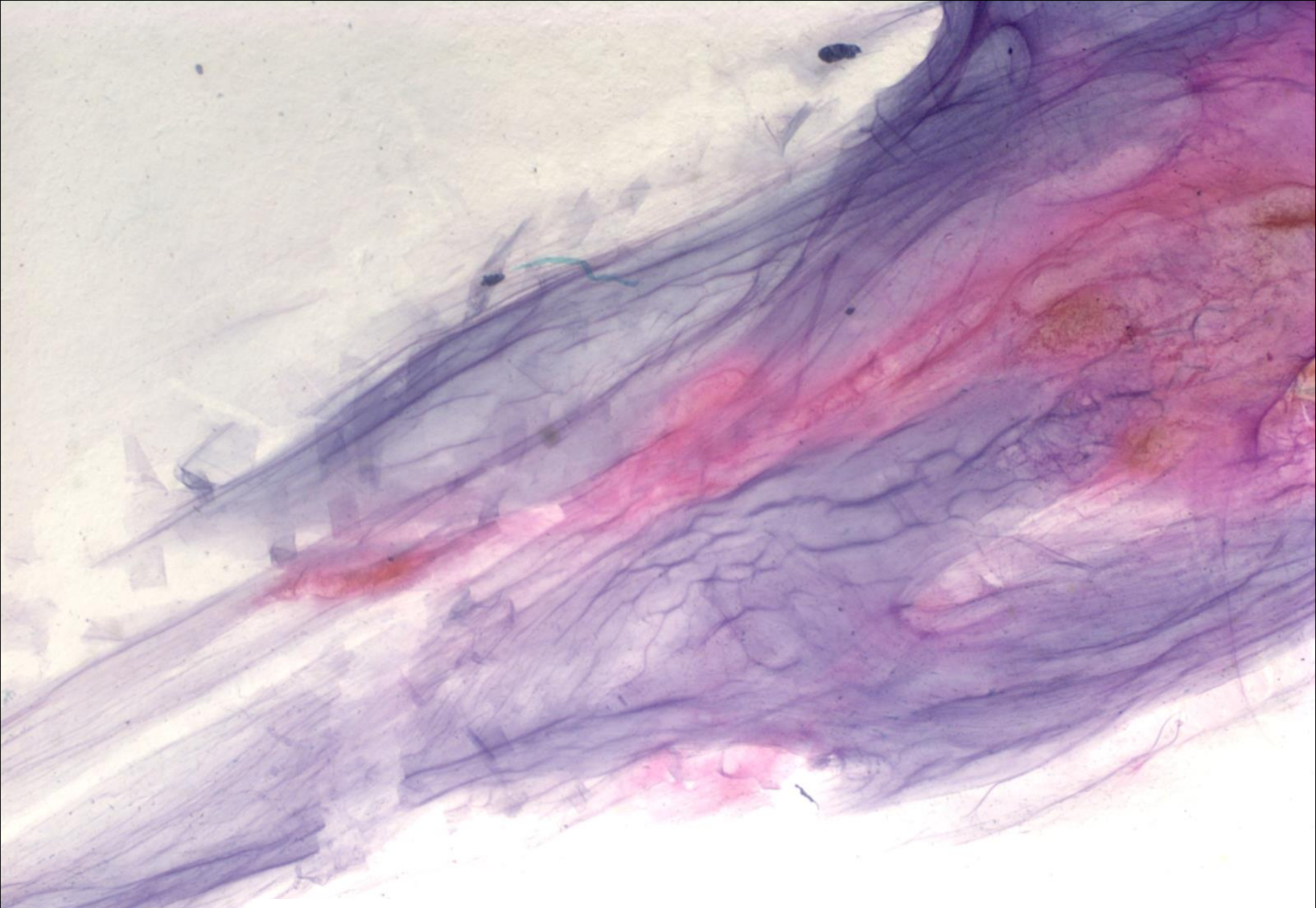


**Pseudocyst fluid:
Thin, watery, brown**

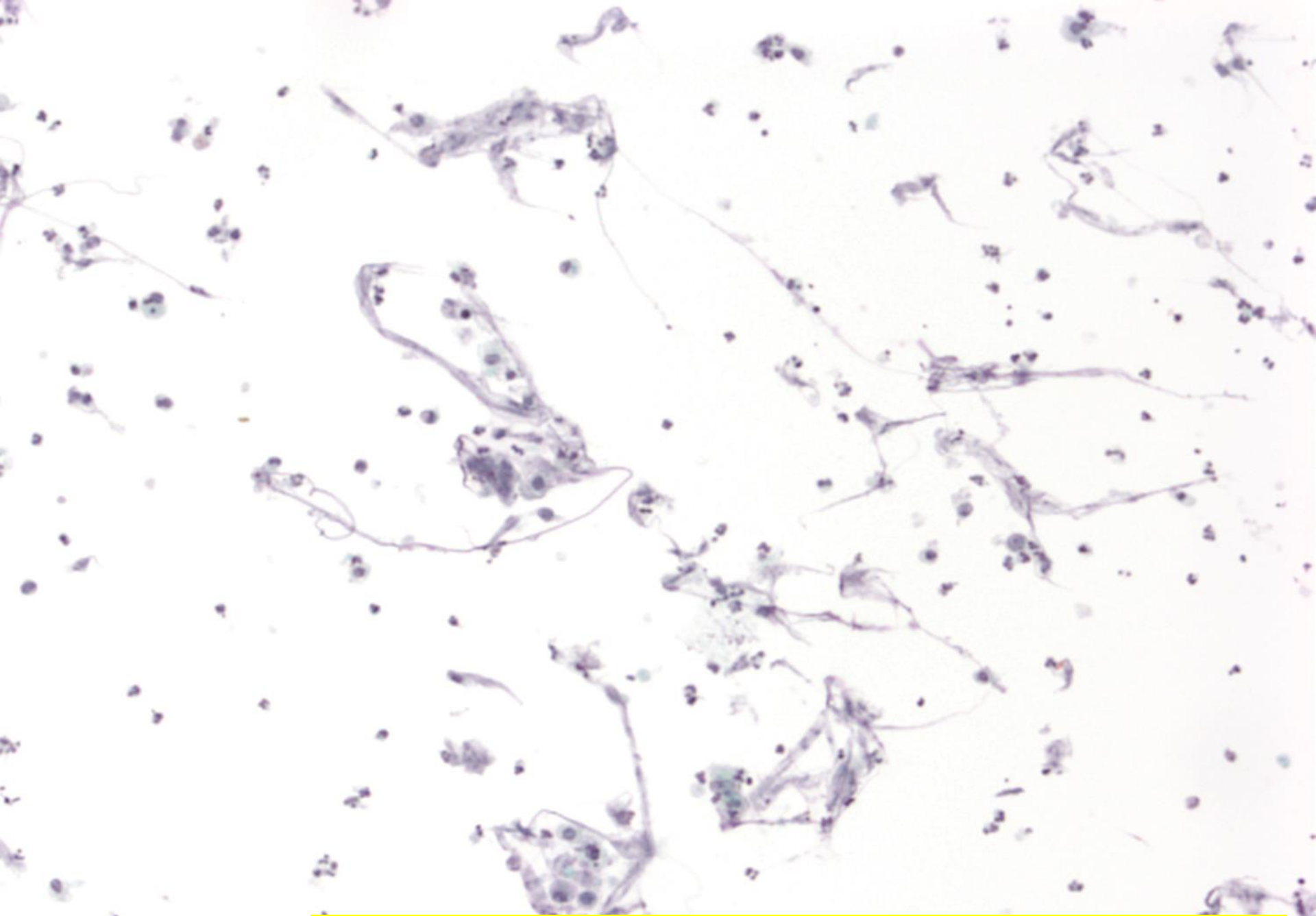


CEA and Amylase: Key Points

- Elevated CEA (≥ 192 ng/ml) supports a mucinous cyst
 - Does not distinguish IPMN from MCN
 - Level does not correlate with malignancy
 - Rare FP: PCT, GI duplication cyst, LEC
- Amylase levels
 - Elevated in the 1000's for most PCT
 - Low amylase level tends to exclude a PCT
 - Level does not distinguish IPMN from MCN



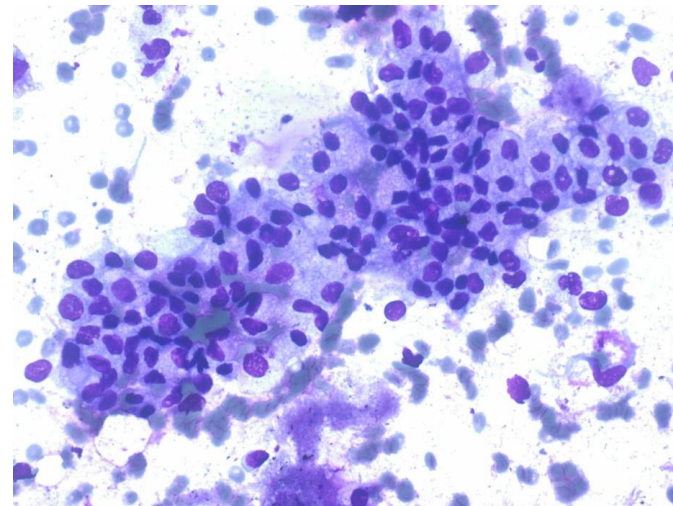
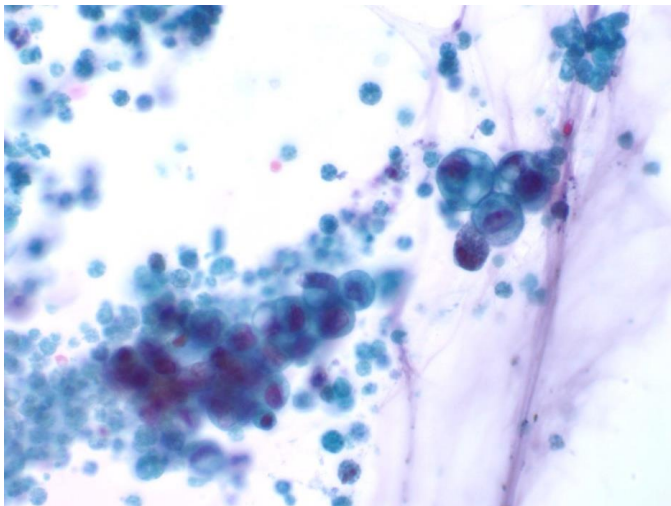
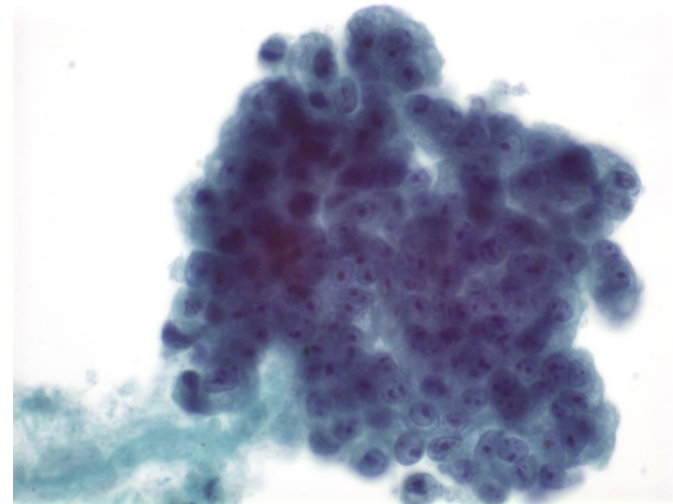
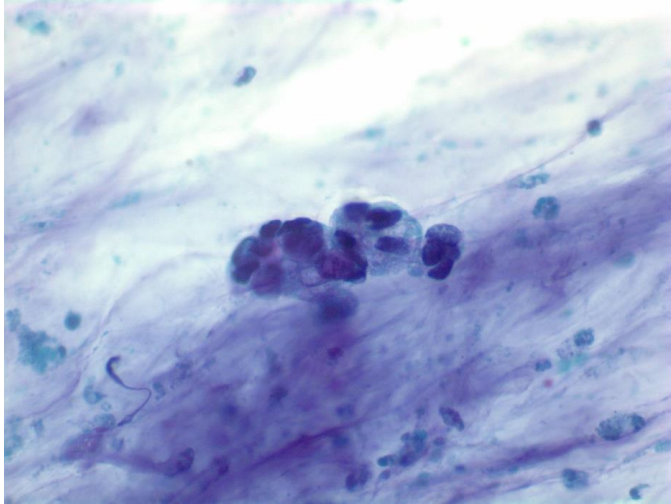
Direct Smear Preparation: Acellular thick mucin



Mucin appears stringy on LBC processing



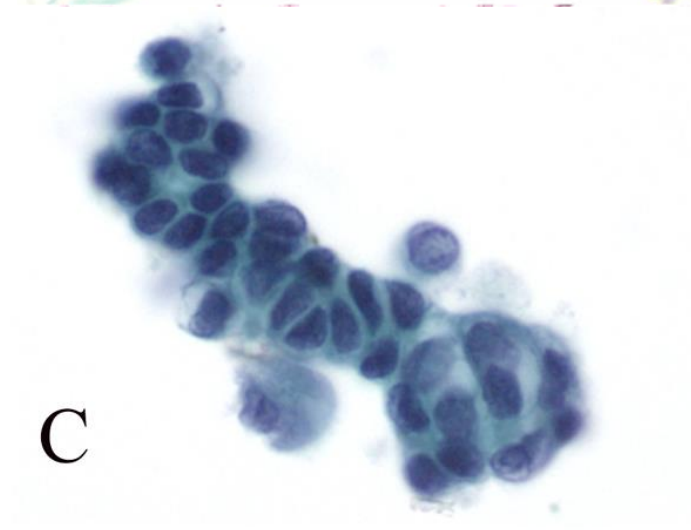
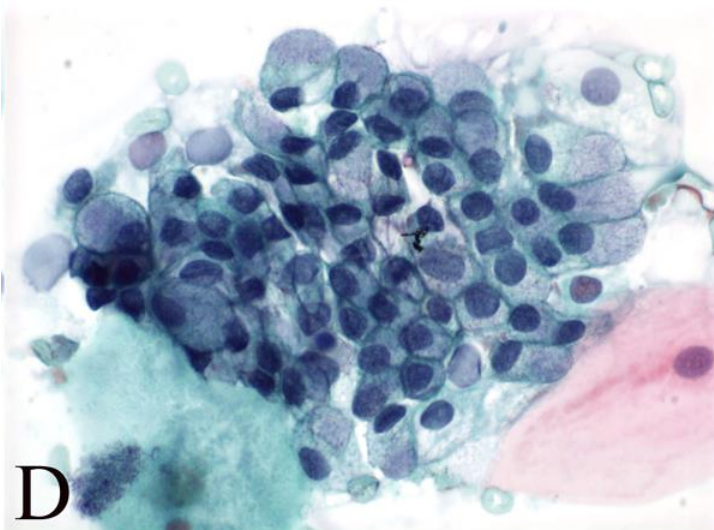
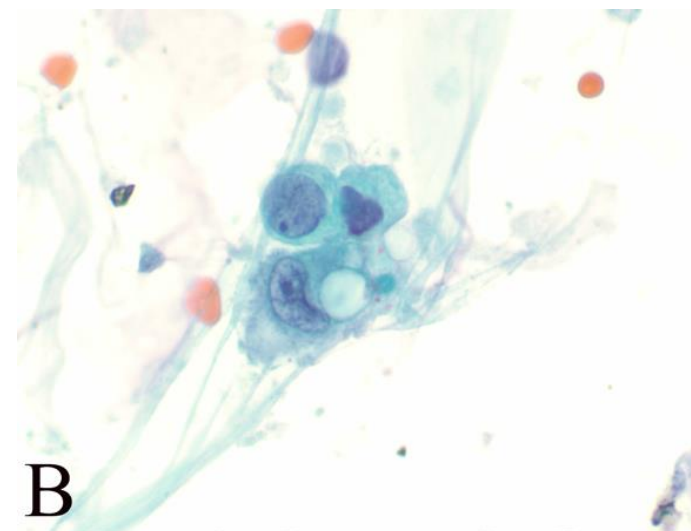
Atypical Glandular Cells





Low Grade

High Grade



High-Grade Atypical Epithelial Cells in Pancreatic Mucinous Cysts are a More Accurate Predictor of Malignancy than “Positive” Cytology
Martha Bishop Pitman M.D, et.al. (Cancer Cytopath 2010)



Cytological Preparations from Cysts

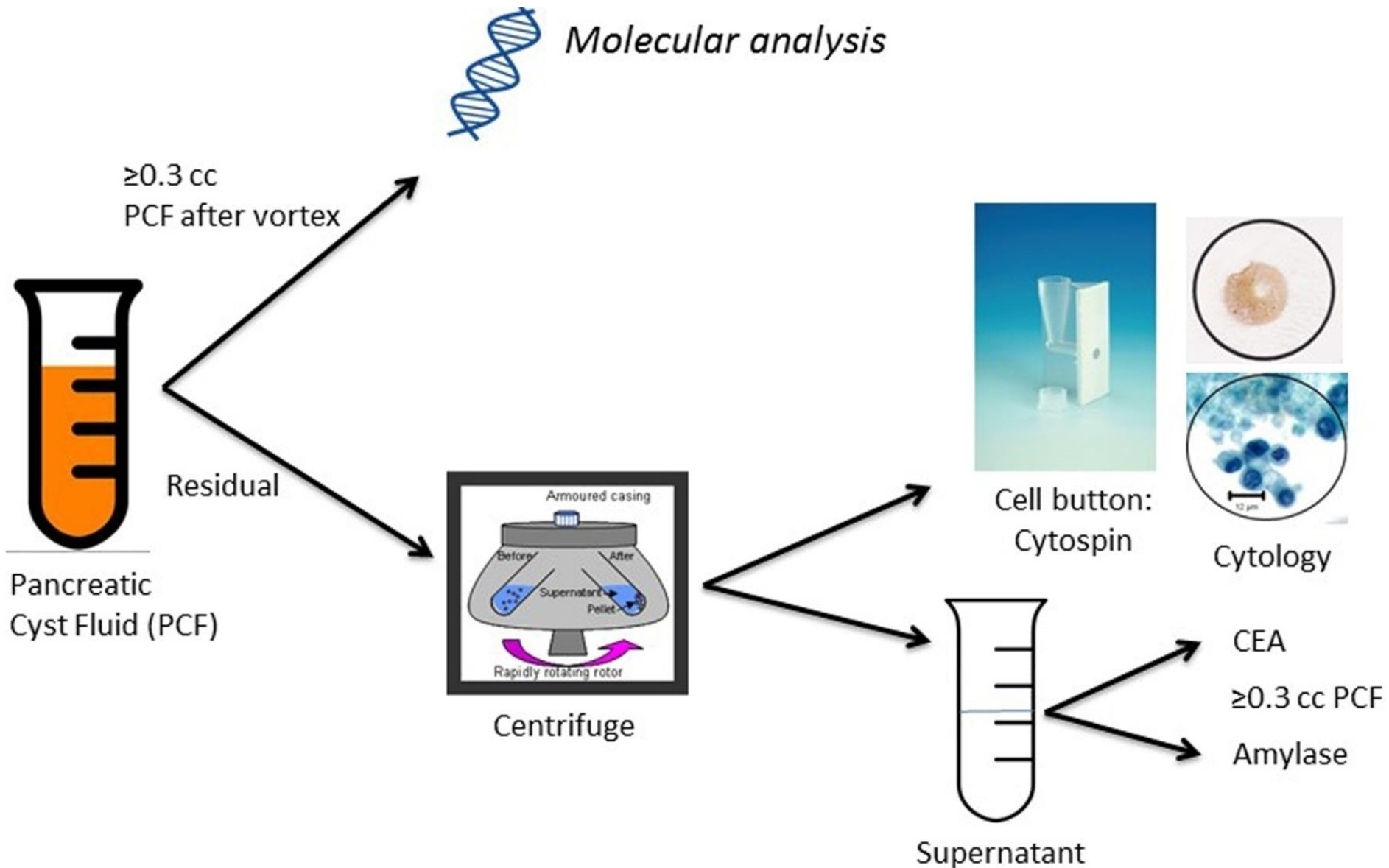
No ROSE

- Direct smears if fluid thick enough
- Send Fresh undiluted cyst fluid for:
 - CEA; Amylase
 - Molecular
 - Cytology
 - Cytospin
 - Cellblock





Pancreatic Cyst Fluid Triage





Impact of Next-Generation Sequencing on the Clinical Impression of Pancreatic Cysts

Martin Jones, MBBS^{1*}, Zongli Zheng, MD, PhD^{1*}, Jessica Wang, MD¹, Emily Albanese¹, Abdurrahman Kadayifci, MD², Dora Dias-Santagata, PhD¹, Long Le, MD¹, William R. Brugge, MD², Carlos Fernandez-del Castillo, MD³, Mari Mino-Kenudson¹, MD, A. John Iafrate, MD, PhD^{1^}, and Martha Pitman, MD^{1^} States | *Co-first authors | ^Co-senior authors
Gastrointestinal Endoscopy (in press)

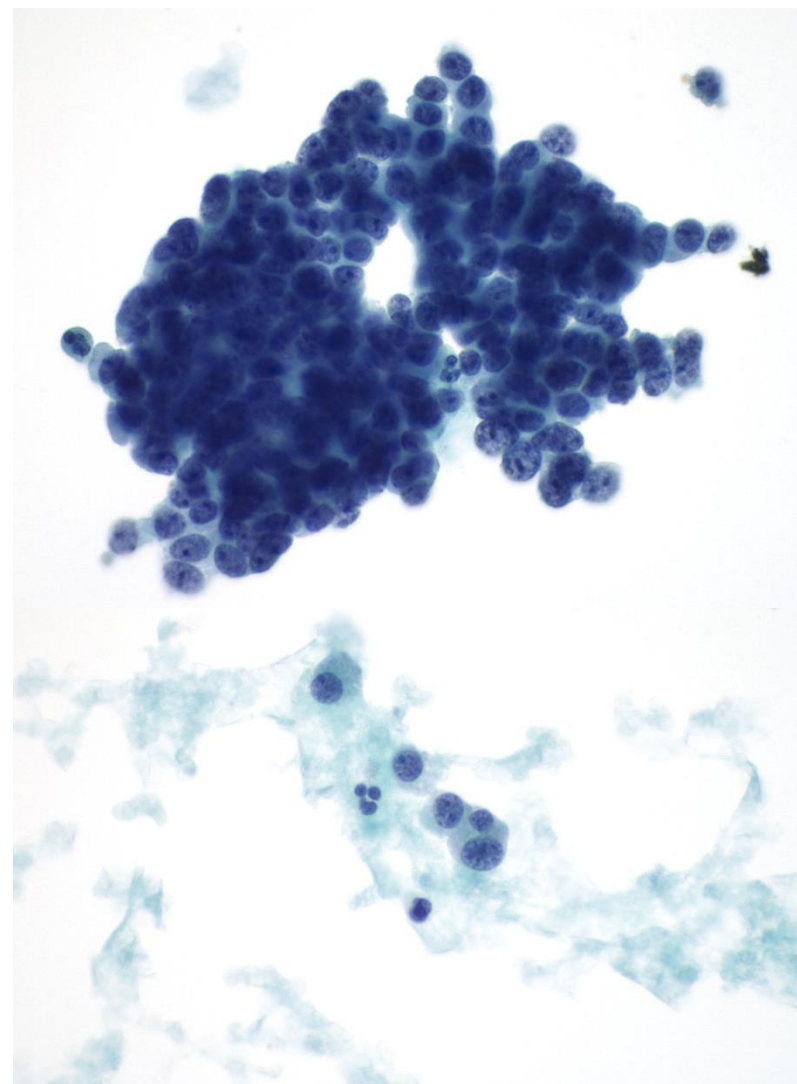
¹Massachusetts General Hospital, Department of Pathology, Boston, MA, United States | ²Massachusetts General Hospital, Department of Medicine, Boston, MA, United States | ³Massachusetts General Hospital, Department of Surgery, Boston, MA, United States

- NGS supported the imaging impression in 78% but changed it in 12%
- NGS defined a cyst as mucinous in 48% of cysts with a non-elevated CEA
- *KRAS* and/or *GNAS* mutations supported a diagnosis of IPMN in 71% of cases without an elevated CEA
- *KRAS* mutation reclassified 19% of cysts non-neoplastic by imaging and with low CEA



Cystic PanNETS

- Imaging Nonspecific
 - Thick cyst wall
 - Solid and cystic
- **Cytology is THE diagnostic test**
 - CEA low
 - Amylase low
 - *KRAS/GNAS* negative
- Cells usually diagnostic when present



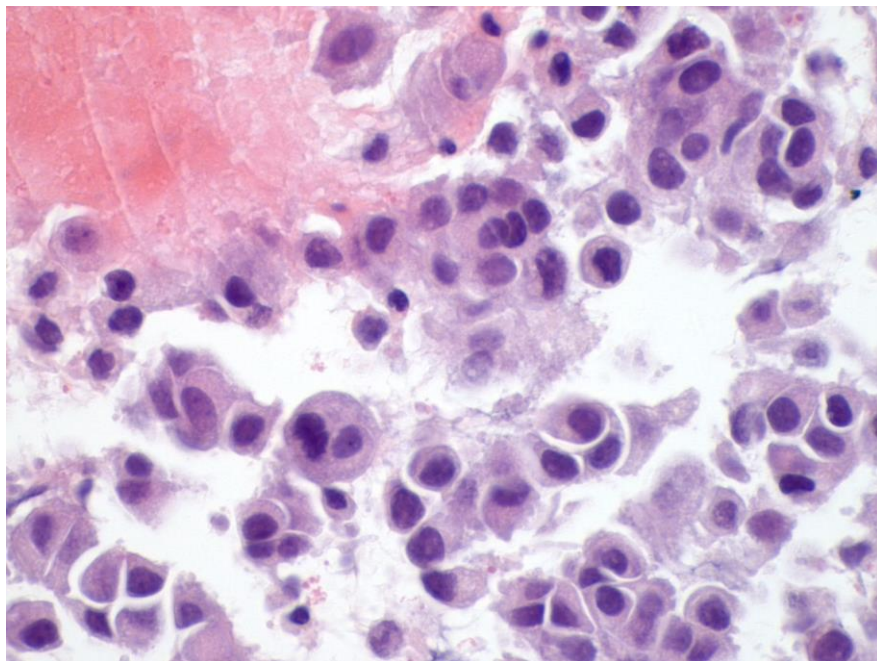
Cystic Pancreatic Neuroendocrine Tumors: The Value of Cytology in Pre-Operative Diagnosis

Vicente Morales-Oyarvide MD¹, Won Jae Yoon, MD², Thun Ingkakul MD¹, David G Forcione MD³, Brenna Casey, MD³, William R Brugge MD³, Carlos Fernández-del Castillo MD¹, Martha B Pitman MD⁴

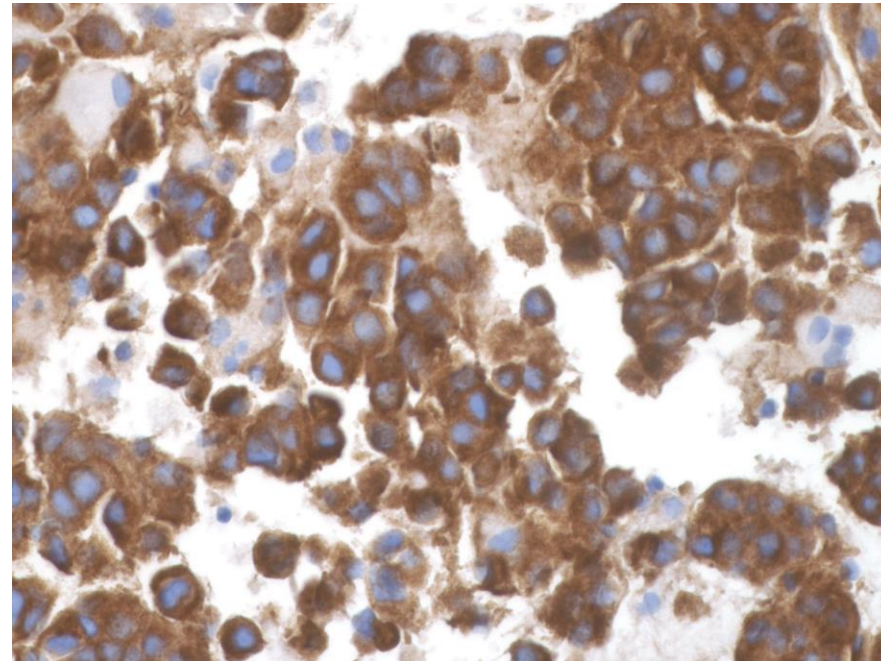
Cancer Cytopathology, 2014; 122:435-444.



PanNET Cytohistology: Cell Block

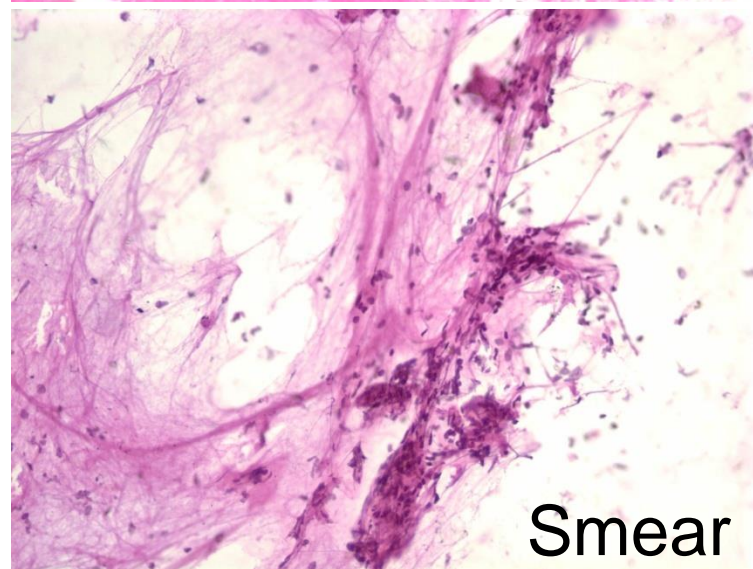
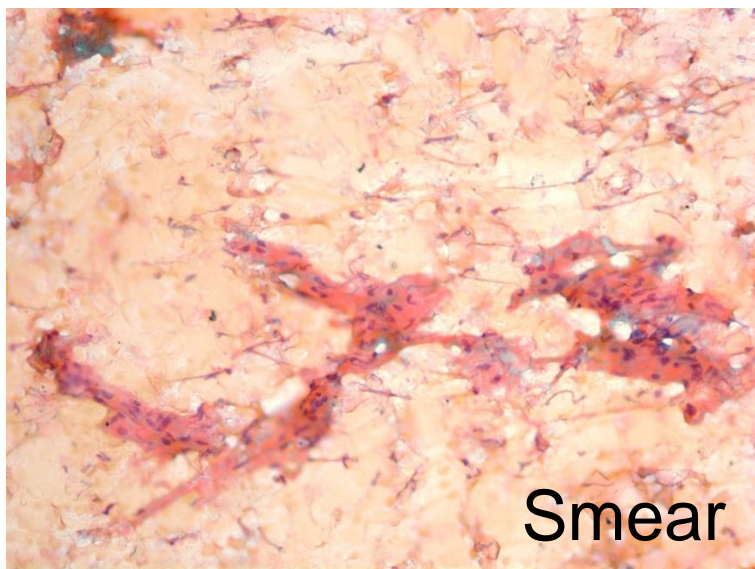
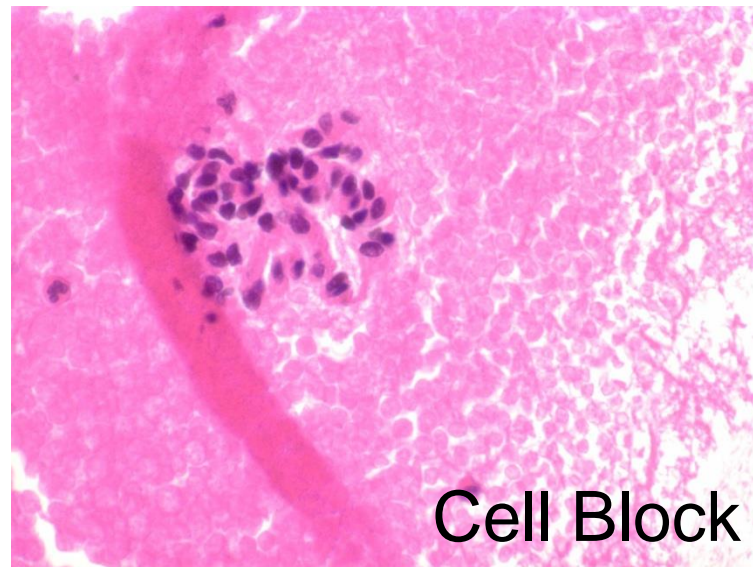
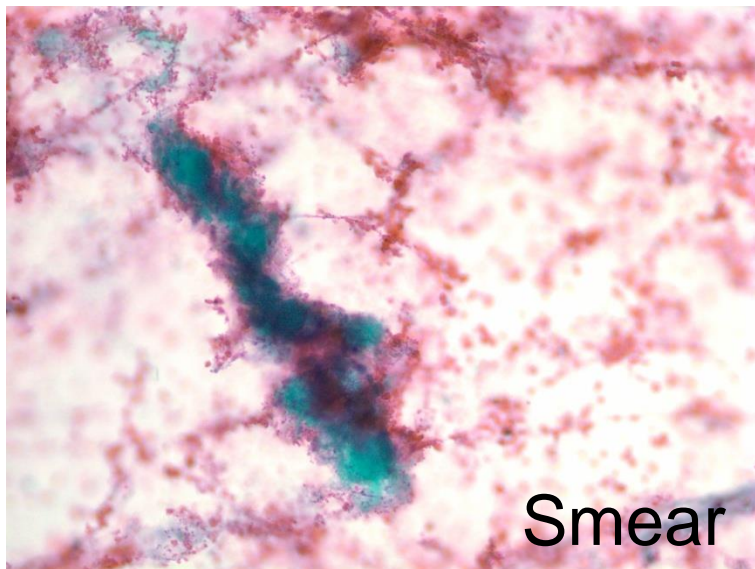


cPanNET



Synaptophysin

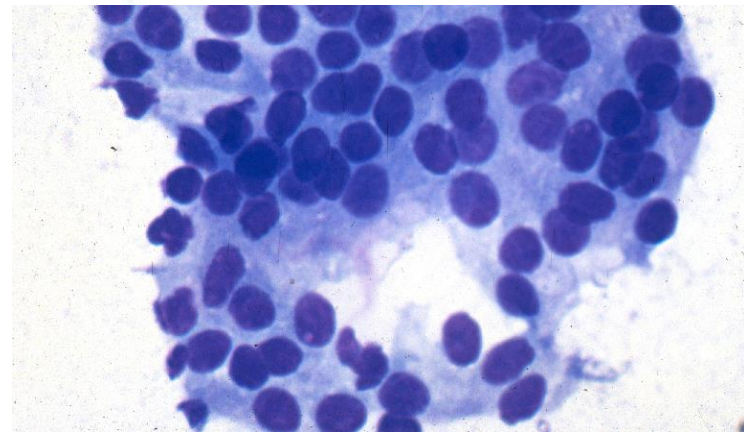
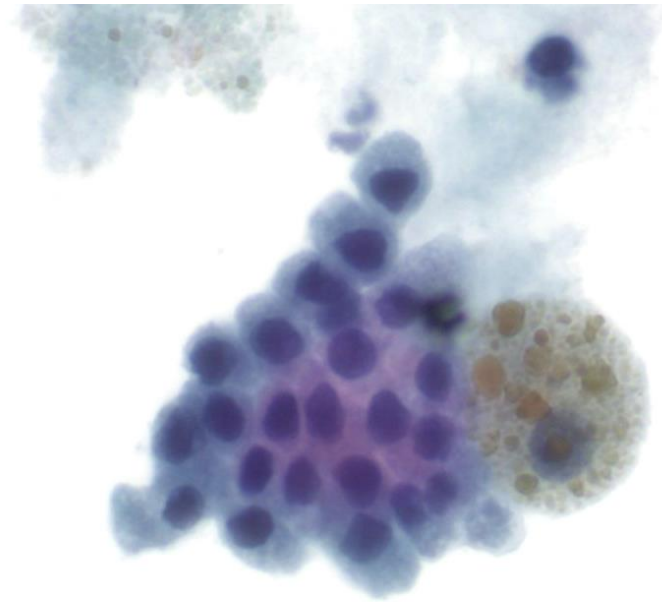
Serous Cystadenoma





Serous Cystadenoma

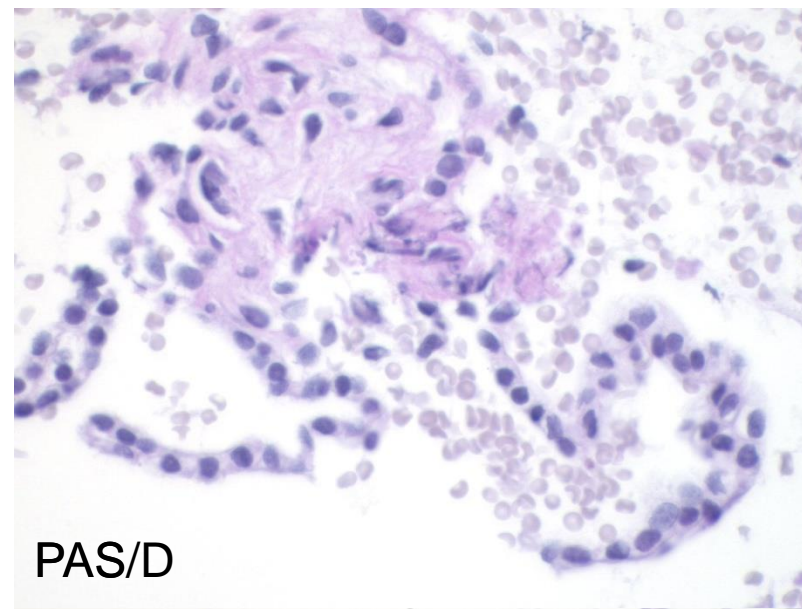
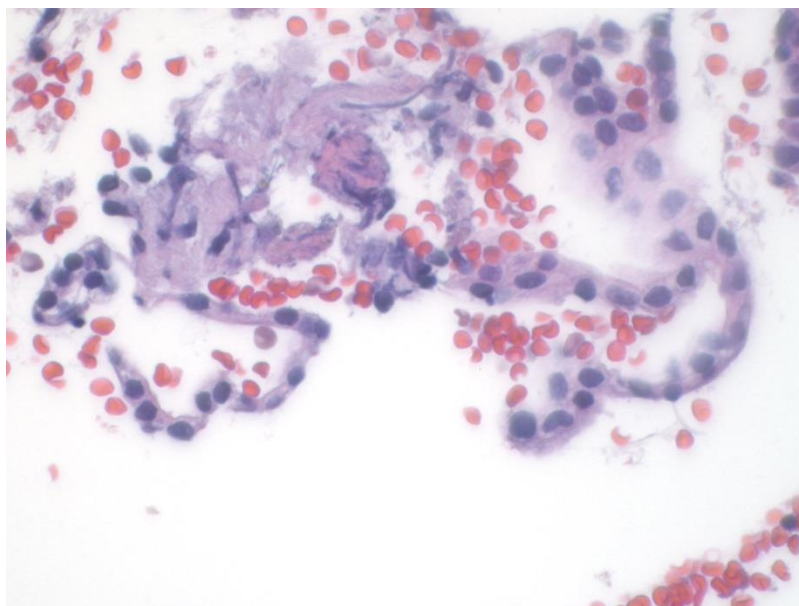
- Cuboidal non-mucinous epithelial cells
- Hemosiderin-laden macrophages in a clean or bloody, non-pseudocyst like background
- CEA and amylase low
- NO *KRAS/GNAS*
- 3p deletions support diagnosis





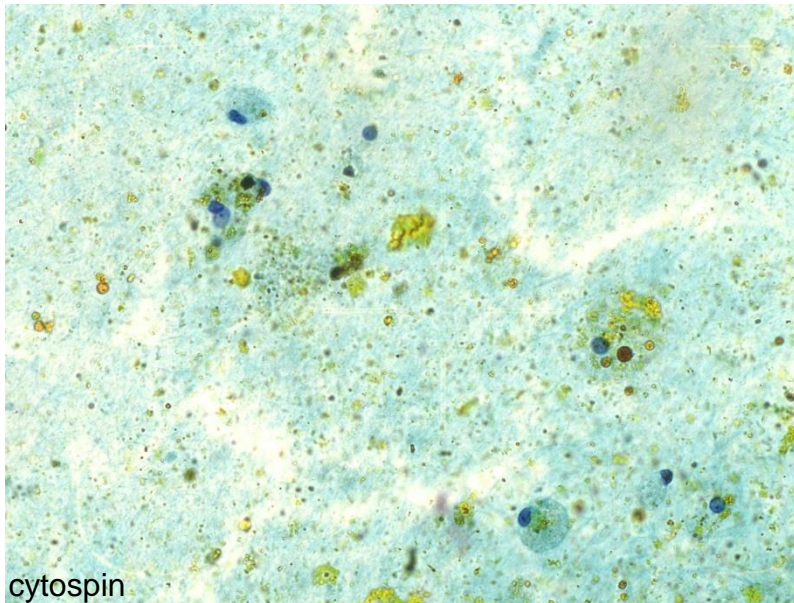
Cytohistology: Cell Block

Serous Cystadenoma

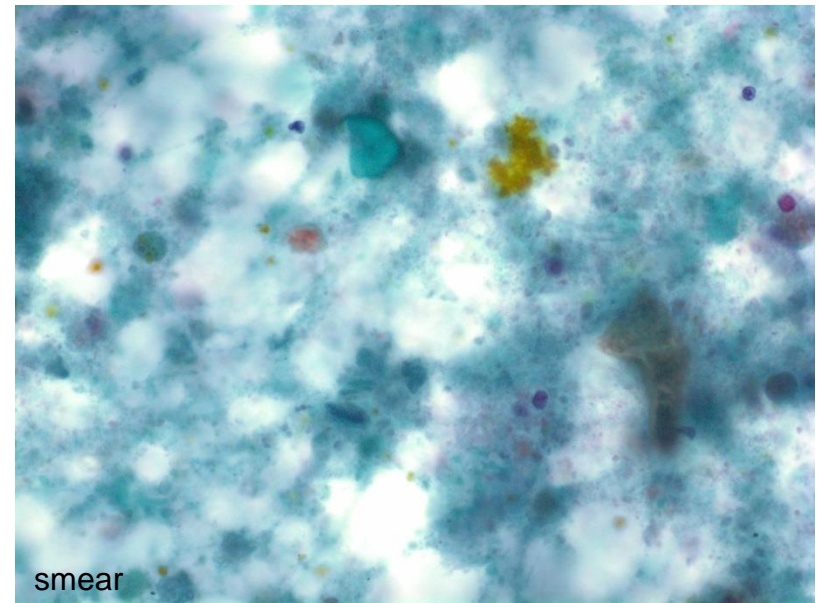




Pancreatic Pseudocyst cytology



cytospin



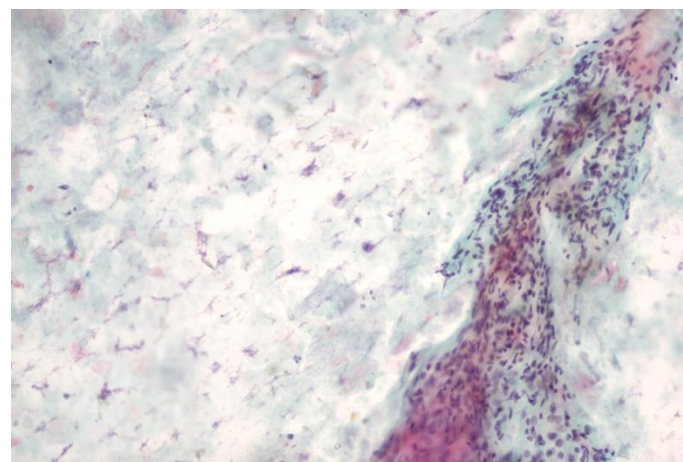
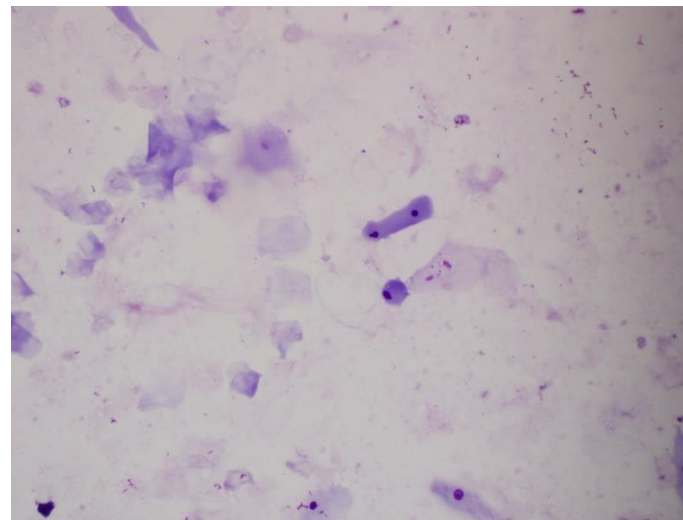
smear

- cyst debris, blood, proteinaceous material and yellow hematoidin-like pigment
 - variable inflammation
 - NO cyst lining epithelium
- CEA low; amylase usually in the 1000's; no *KRAS* or *GNAS*



Lymphoepithelial cyst

- Anucleate squames and abundant keratinous debris
- Mature superficial squamous cells
- Lymphocytes are usually present but amount is variable and may be quite scant
- +/-Cholesterol clefts



Cytology Smears for NGS

Cytology smears as excellent starting material
 for NGS-based molecular testing of patients
 w/adenocarcinoma of lung
onlinelibrary.wiley.com/doi/10.1002/cn...

