Endoscopic Ultrasound (EUS):
Visualizing Lesions under the Surface

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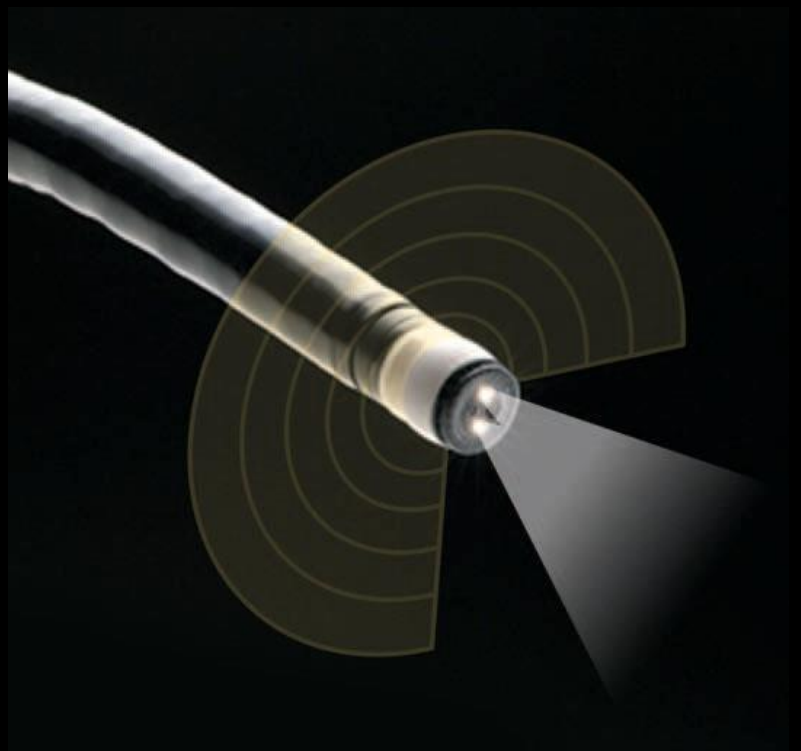
Outline

1. Basic primer in EUS
2. How has EUS changed patient care and community referrals?
3. When do you refer for an EUS? What is appropriate referral?
4. When is EUS useful? / What are limitations / Complications?
5. Applications of EUS at Lutheran General Hospital
6. Future Applications of EUS

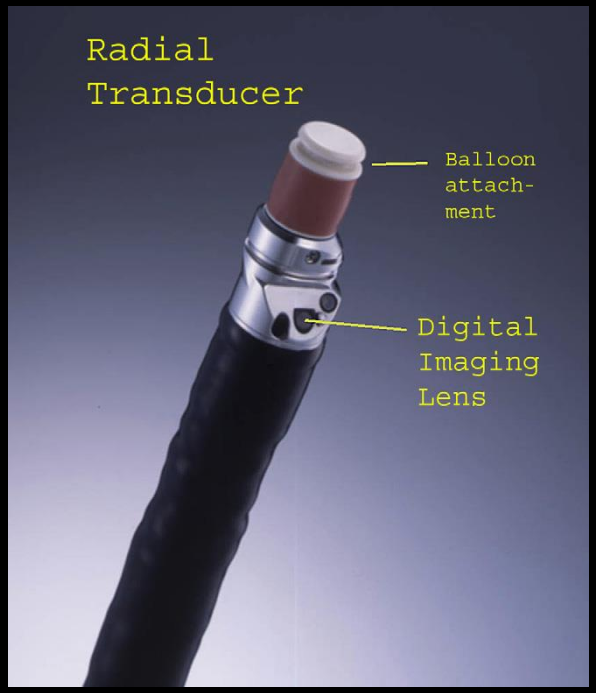
What is EUS?

- Endoscopic Ultrasound has expanded the breadth of GI Endoscopy
  - Introduced in 1980s: Japan / USA / Germany
  - Able to visualize pancreas through the stomach wall
  - Permits detailed imaging of GI wall layers
  - Enables accurate locoregional tumor staging

Endoscopy vs. EUS



The EUS Scopes

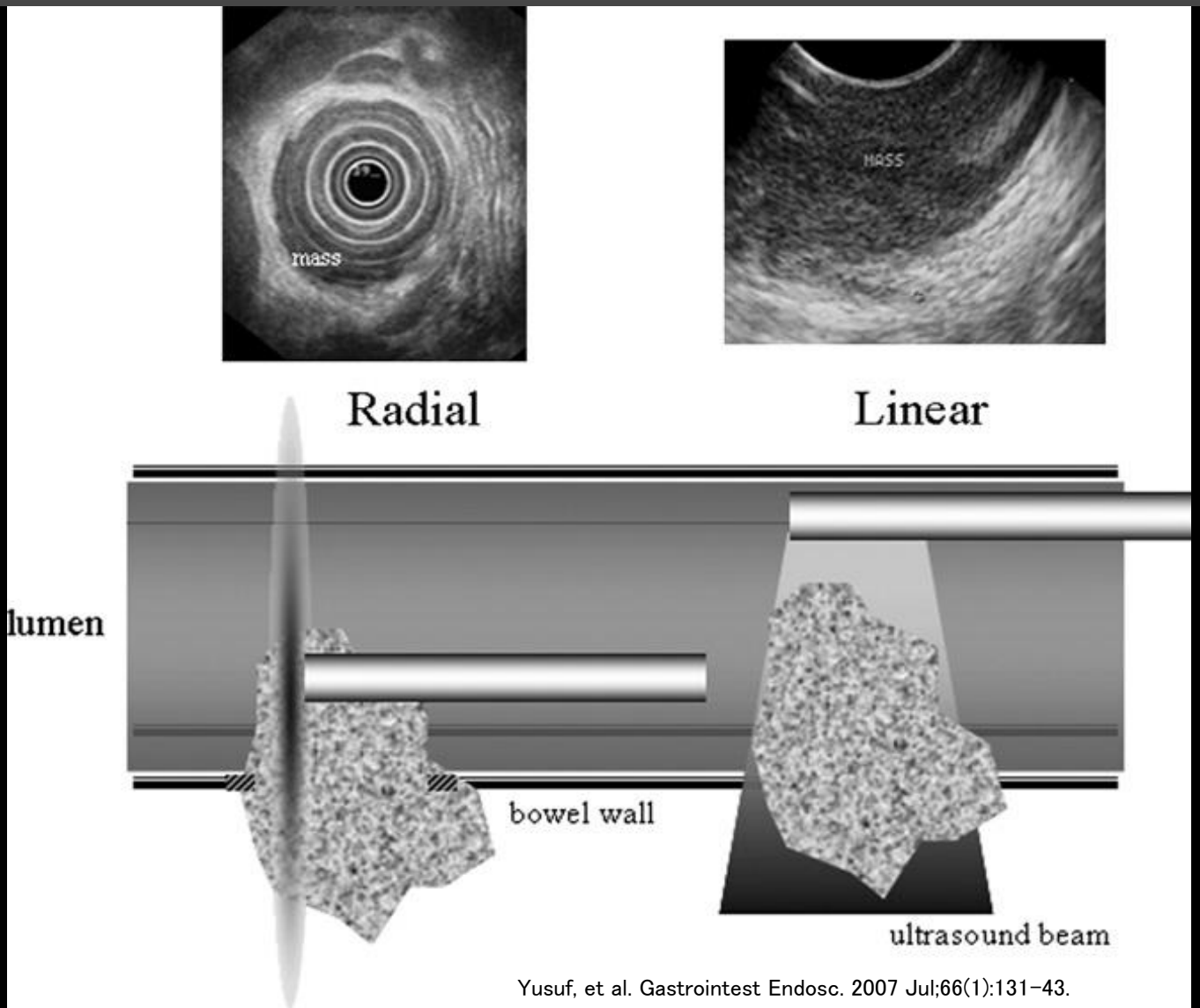


Radial

Linear (FNA)

Miniprobe

Radial vs. Linear



Yusuf, et al. Gastrointest Endosc. 2007 Jul;66(1):131-43.

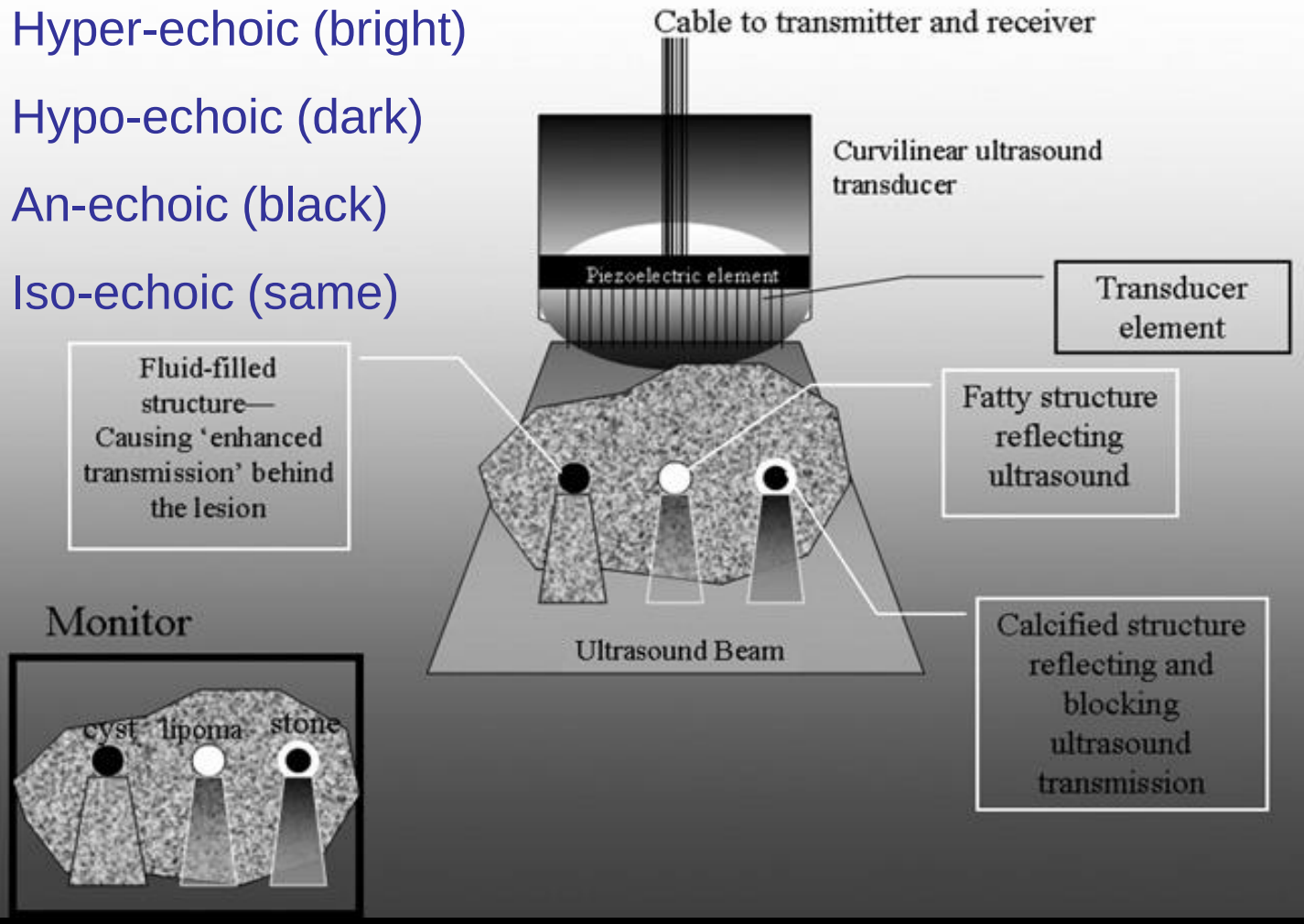
Basic principles of Ultrasound

Hyper-echoic (bright)

Hypo-echoic (dark)

An-echoic (black)

Iso-echoic (same)



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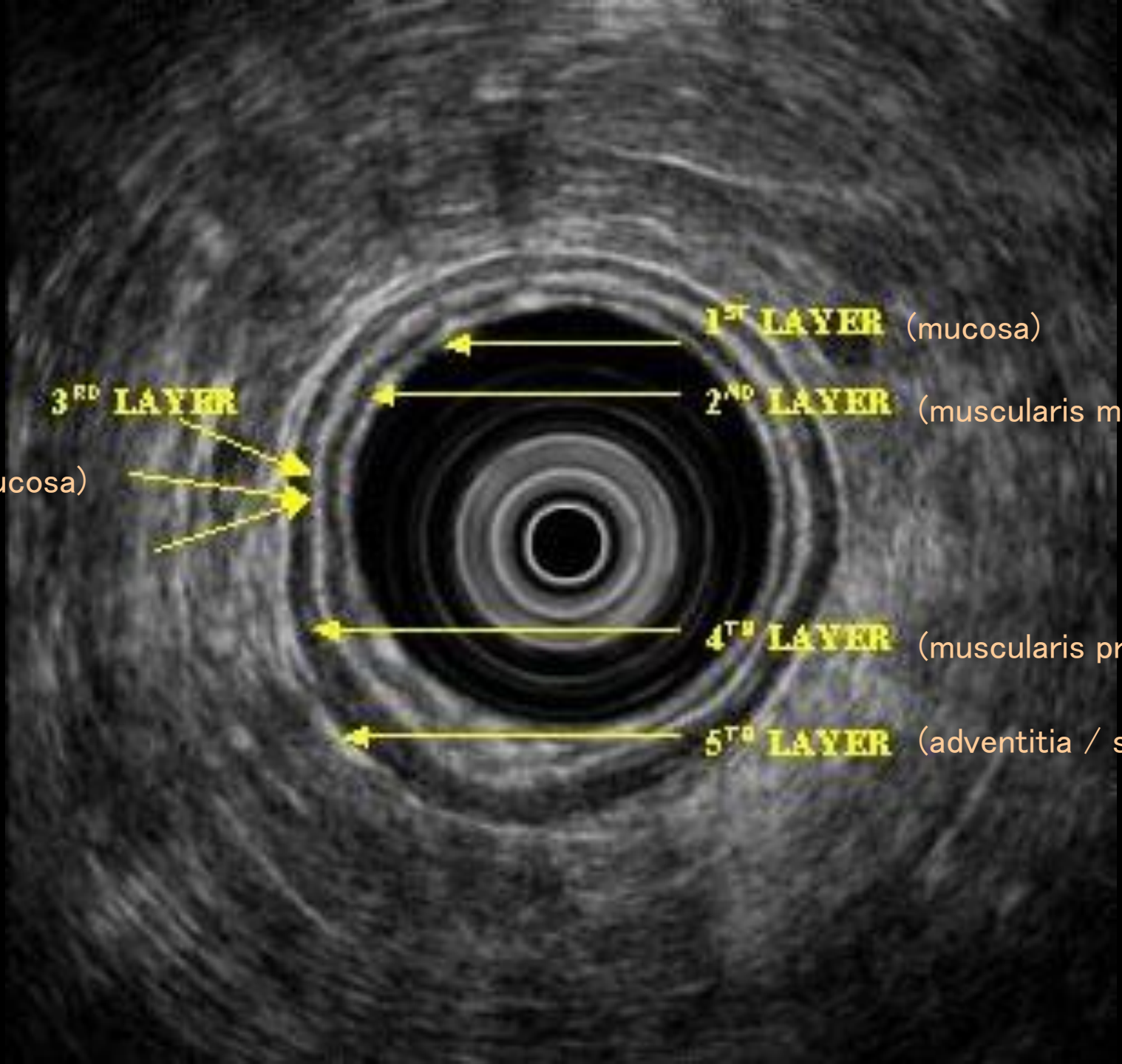
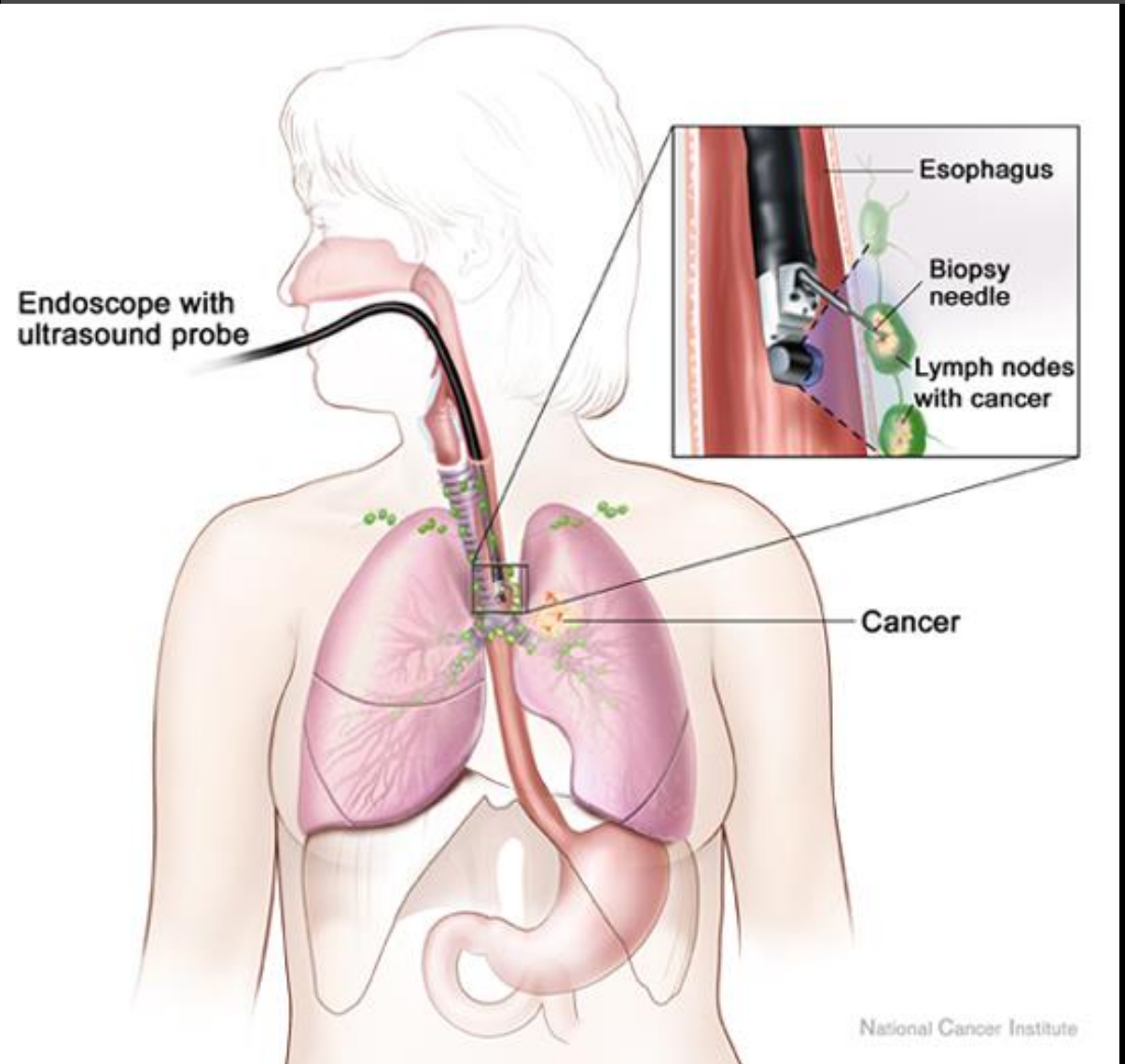
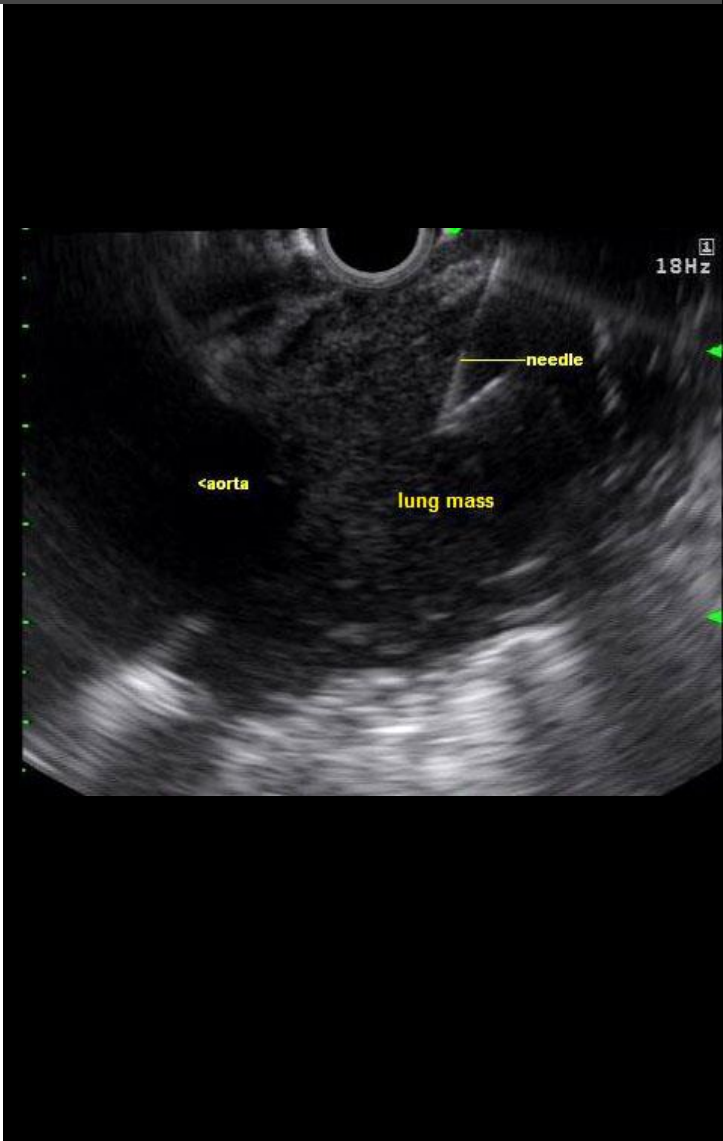

1ST LAYER (mucosa)
2ND LAYER (muscularis mucosa)
3RD LAYER
(submucosa)
4TH LAYER (muscularis propria)
5TH LAYER (adventitia / serosa)

EUS Fine Needle Aspiration



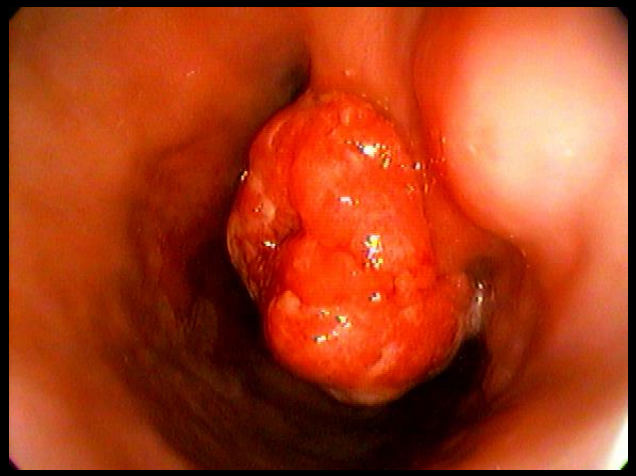


Fine Needle Aspiration (FNA)

How EUS has changed patient care

Esophageal cancer staging:

EUS results could dramatically change the patient's treatment course



Role of EUS in Esophageal Ca

- Central role in initial staging
  as outcome is strongly associated with stage
- Useful in monitoring disease recurrence
- Has complementary role with other imaging:
  - EUS for locoregional staging
  - CT / PET : eval for mets / stage IV dz

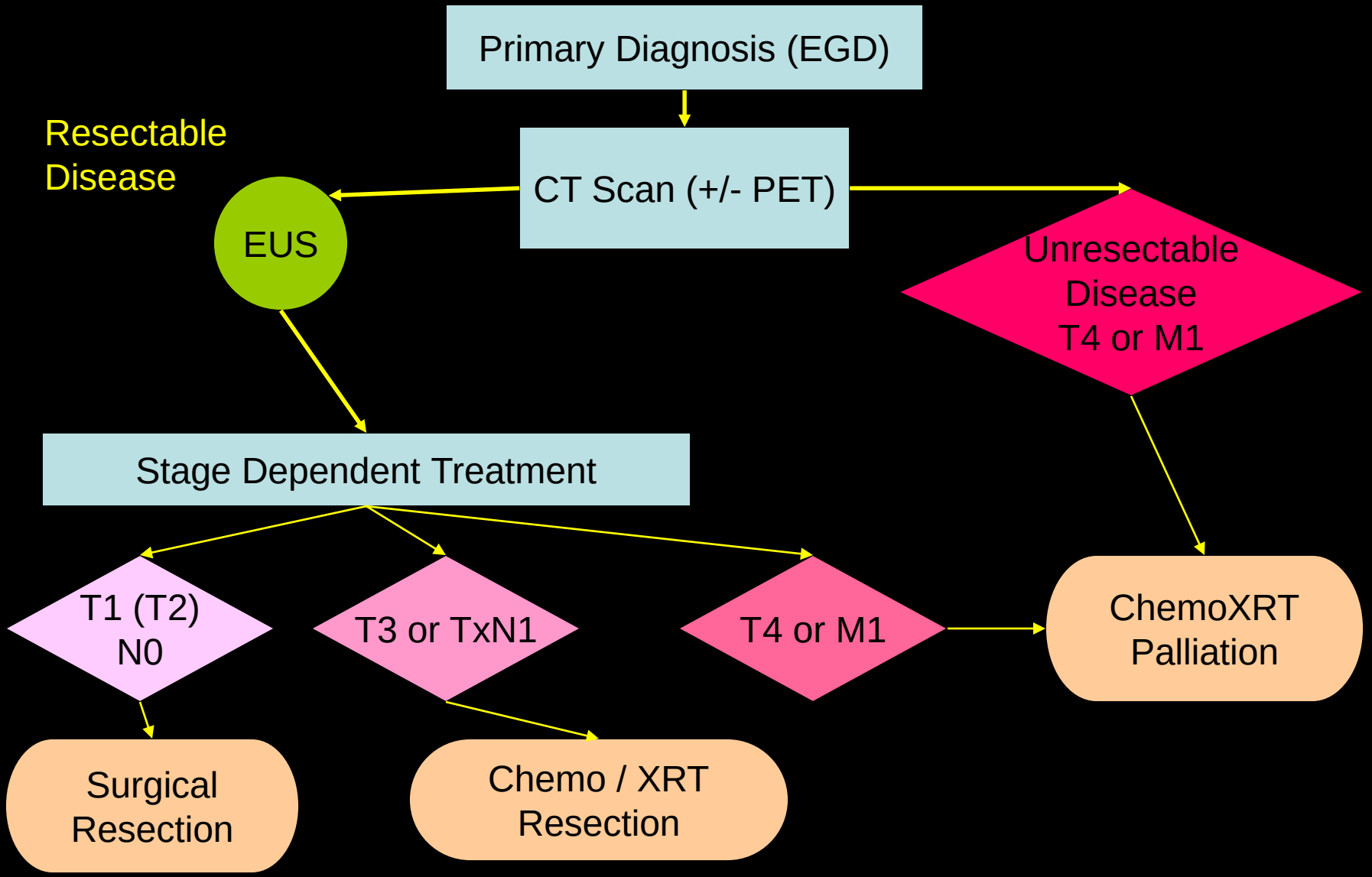
Comparing CT scan vs. EUS in detecting Lymph Nodes

	Sensitivity	Specificity
CT	29% (17-44)	89% (72-98)
EUS	71% (56-83)	79% (59-92)

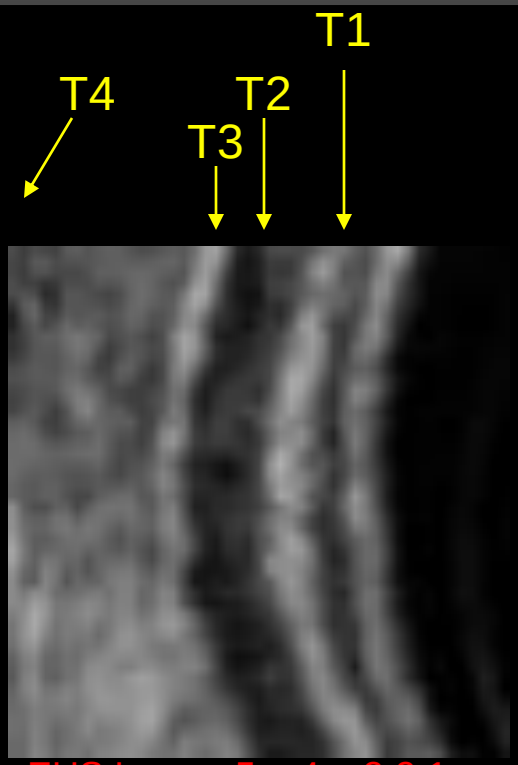
(Lymph node staging in Esophageal Cancer)

Vazquez-Sequeiros, E, Clain, JE, Norton, ID, et al, Gastroenterology 2003; 125:1626.

Esophageal Cancer Staging Algorithm



EUS T + N Staging



EUS T-stage	
T1	Invasion up to Layer 3 (submucosa)
T2	Invasion into (but not thru) Layer 4 (musc. Propria)
T3	Breaks thru musc. propria
T4	Invasion into adjacent structures

Why is T Stage Important?
Risk of LN Mets

Depth of tumor predicts LN involvement

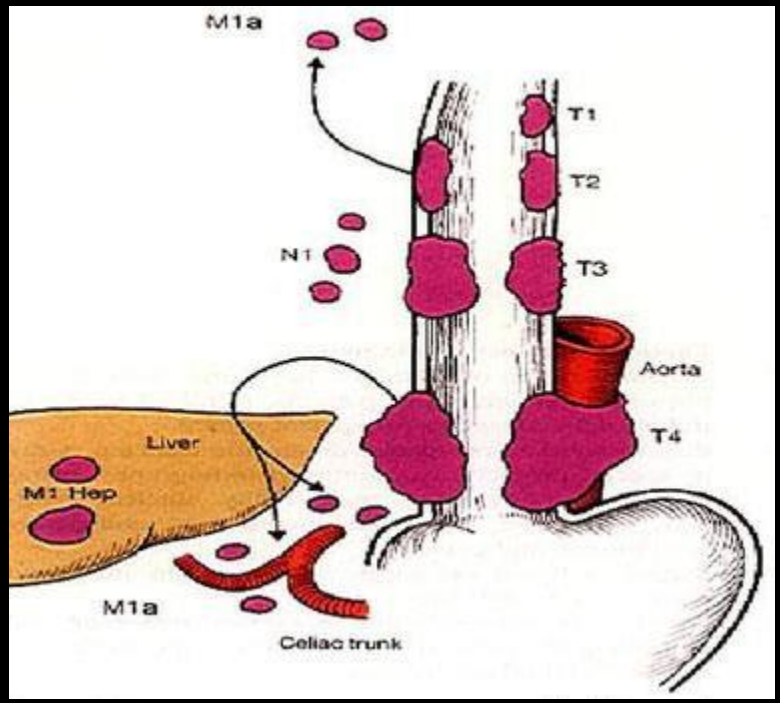
T Stage	N1 Disease
Tis	0%
T1	11%
T2	43%
T3	77%

Compared to T1 patient:

T2 = 6x more likely to have N1

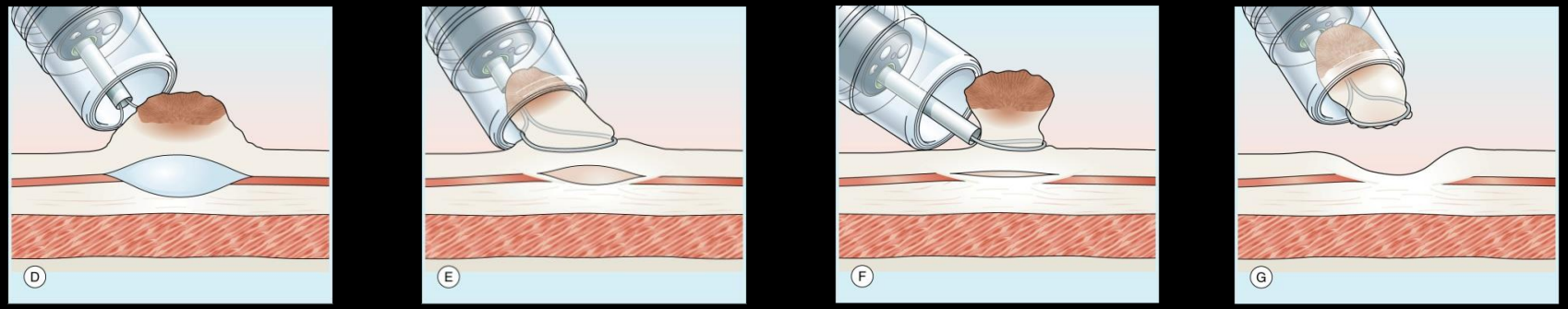
T3 = **23x**

T4 = **35x**

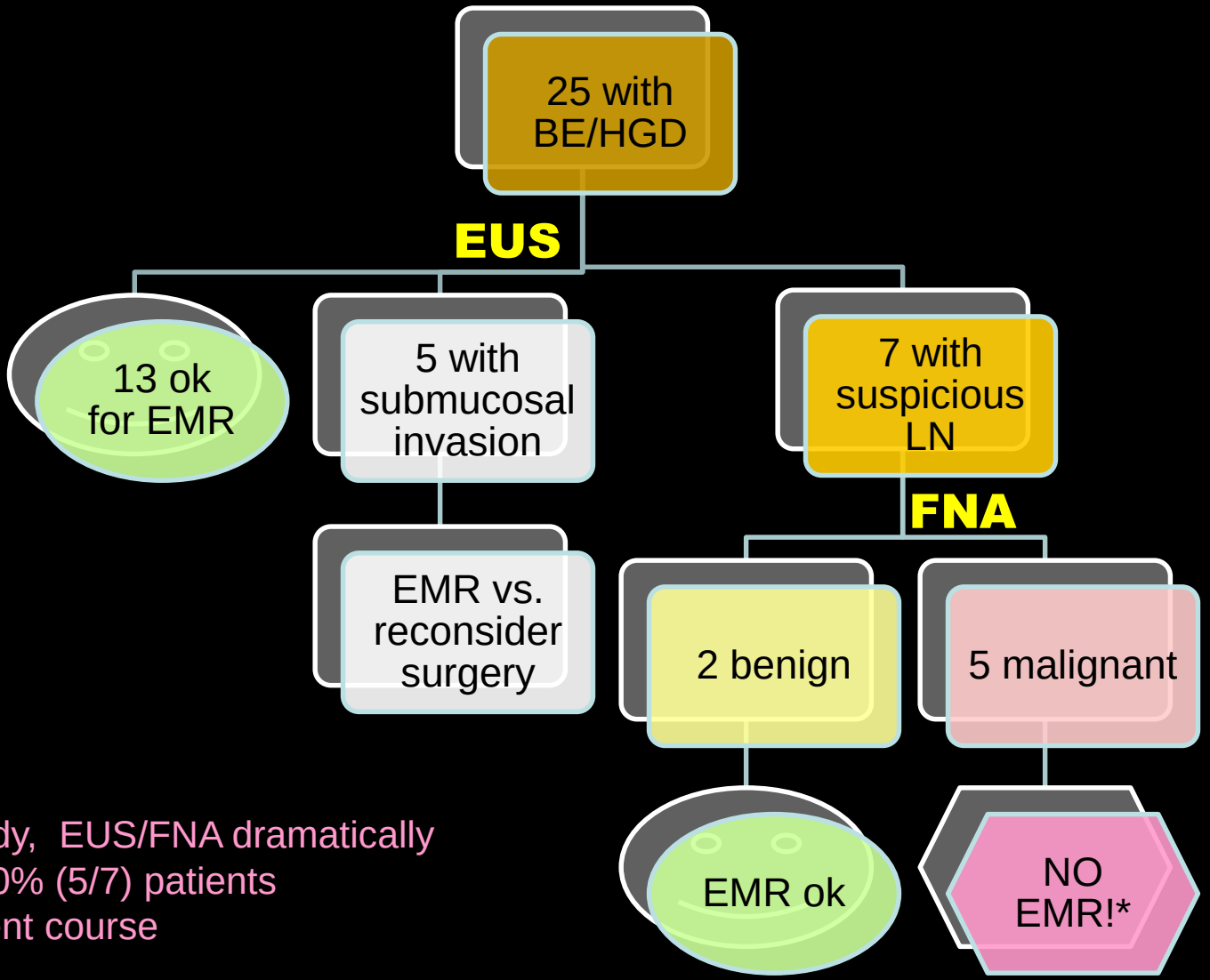


Rice, TW et. al *Ann Thorac Surg*. 1998 Mar;65(3):787–92.

Utility of EUS in EMR



Clinical impact of EUS



*In this study, EUS/FNA dramatically changed 20% (5/7) patients management course

Shami VM, Villaverde A, Stearns L, Chi KD, Kinney TP, Rogers GB, Dye CE, Waxman I. Endoscopy. 2006 Feb;38(2):157-61.

Cost analysis of EUS

Impact of pre-op EUS on Esophageal cancer management and cost

- 26% of patients undergoing pre-op EUS staging would be spared combined modality therapy who were found to be Stage I or IV.

In other words:

- Estimated for every 100 pts undergoing pre-op EUS for Esophageal cancer staging:
  - 14 pts with Stage I would be spared neo-adjuvant CTX (Total Cost savings $122,192)
  - 12 pts with Stage IV would be spared surgery (saving a total of $285,600)
  - Average cost savings $3443 per patient

(Shumaker, et. al *Gastrointest Endosc*. 2002 Sep;56(3):391-6.)

EUS Indications

Question:

Are community physicians aware of the indications of EUS?

EUS Indications

ASGE Recommended Indications for EUS

1. Staging of tumors of GI tract, pancreas, bile ducts, mediastinum
2. Evaluating abnormalities of the GI-tract wall or adjacent structures
3. Tissue sampling of lesions within, or adjacent to the wall of the GI tract
4. Evaluation of abnormalities of pancreas (masses, PC, chronic pancreatitis)
5. Evaluation of abnormalities of the biliary tree
6. Providing endoscopic therapy under US guidance

EUS Indications / Limitations

- 1st study to assess knowledge of referring indications of EUS among physicians

- Setting: Mayo Clinic, Rochester

- 25 question survey
  - Surveyed: 121 GI
    259 Internists
    129 non-GI subspecialties
    150 Surgeons

Yusuf TE et. al, GIE 2004;60:575–9.

Average Score per Specialty

Organ system	GI	IM	Non-GI	Surgery
Esophagus	81%	68%	69%	68%
Liver Pancreas Biliary	84%	63%	58%	50%
Colon/rectum	80%	62%	56%	58%
Total	84.3%	68.9%	65.4%	65.3%

Yusuf TE et. al, Gastrointest Endosc 2004;60:575–9.

What does this mean?

- Gastroenterologists still responded incorrectly to 15% of questions
- Liver, Pancreas, and Lower intestine EUS were the least understood among referrers
- More education is needed regarding EUS use and it’s limitations

Use of EUS at LGH

Utilization of EUS for locoregional staging for Esophageal Cancer & GEJ CA

Year		# Diagnoses Made	# EUS Performed for staging by site
2005	Total EsophCA + GEJ CA Diagnosis = 20	Esoph = 13	6/13 (46.2%)
	EUS cases performed: 12/20 (60%)	GEJ = 7	6/7 (85.7%)
2006	Total EsophCA + GEJ CA Diagnosis = 16	Esoph = 12	5/12 (41.7%)
	EUS cases performed: 9/16 (56.3%)	GEJ = 4	4/4 (100%)
2007	Total EsophCA + GEJ CA Diagnosis = 14	Esoph = 7	5/7 (71%)
	EUS cases performed: 8/14 (57%)	GEJ = 7	3/7 (42.9%)
3 Year Total	Total EsophCA + GEJ CA Diagnosis = 50	Esoph = 32	16/32 (50%)
	EUS cases performed: 29/50 (58%)	GEJ = 18	13/18 (72.2%)

•LGH Data 2005-2007. EUS Available at LGH 1/2005.

Limitations of EUS

- Ultrasound can only “see so far”
- Tim
  - D for a r
- Tec
  - A
  - s
  - N

NA

Complications of EUS

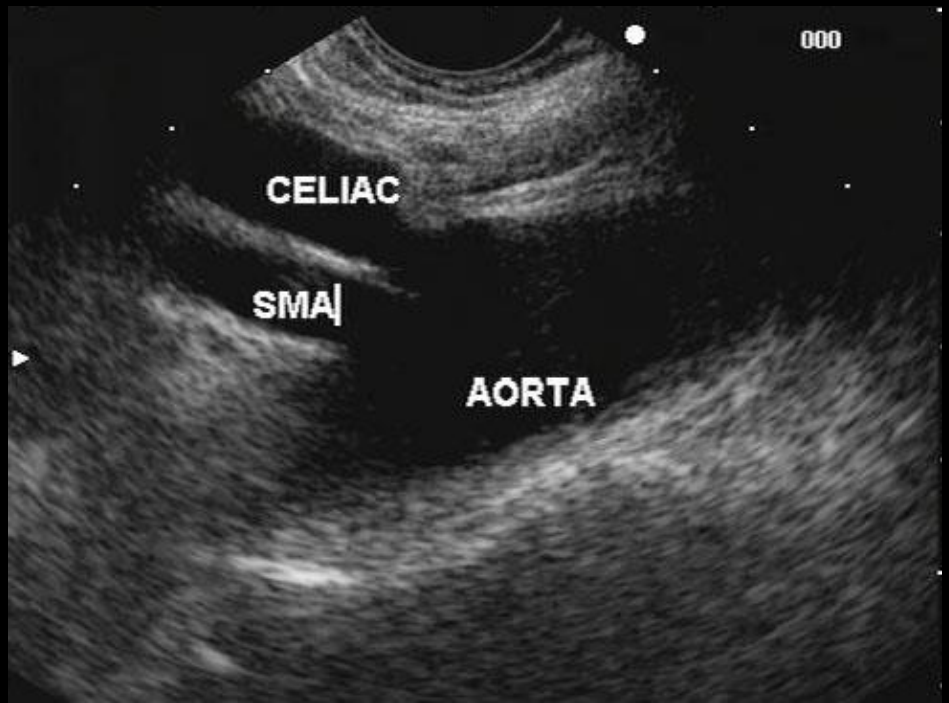
- Infection risk after FNA
  - Primarily in pancreatic cyst aspiration
    - Studies show bacteremia incidence of 0.4% - 1% (Voss et al. Gut 2000:46:244-9)
    - IV antibiotic pre/post procedure
- Bleeding
  - Mild intraluminal bleeding: 4% (Voss et al. Gut 2000:46:244-9)
  - Extraluminal bleeding: 1.3% (Affi et al. GIE 2001; 53:221-5)
- Perforation
  - Standard EGD risk: 0.03% (Eisen et al. GIE 2002; 55:784-93)
  - Diagnostic EUS risk: 0.07% (Rahod & Maydeo GIE 2002; 56:AB169)
- Pancreatitis after EUS/FNA: 1%-2% (Gress et al. GIE 2002;56:864-7)
- EUS is very safe; Similar risks to diagnostic EGD

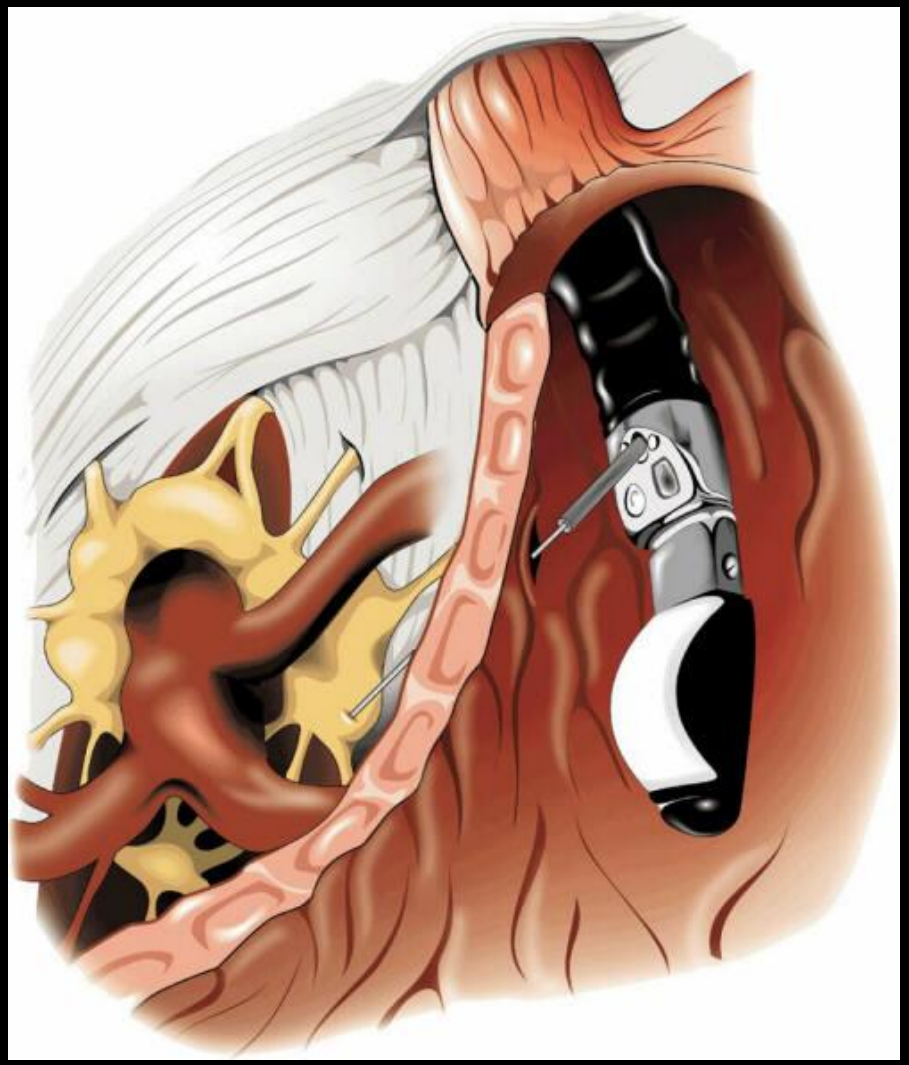
Applications of EUS at LGH

- Esophageal cancer locoregional staging
- "Abnormal CT scan" – pancreatic lesion
  - Solid & cystic pancreatic lesions
    - Pancreatic cyst fluid analysis
- Mediastinal lymphadenopathy (with EBUS)
- Evaluation of submucosal lesions
- Difficult polypectomy cases
  - Evaluation prior to EMR
- Celiac plexus neurolysis
- EUS-guided Pancreatic pseudocyst drainage
- EUS-guided "Rendez-vous" ERCP
- Rectal EUS

EUS guided Celiac Plexus Neurolysis

- Pancreatic cancer:
  - Pain score reduction in 78% of pts at 2 wks, and sustained for 24 wks
- Chronic Pancreatitis:
  - Pain score reduction in 50% of pts and sustained for 24 wks.

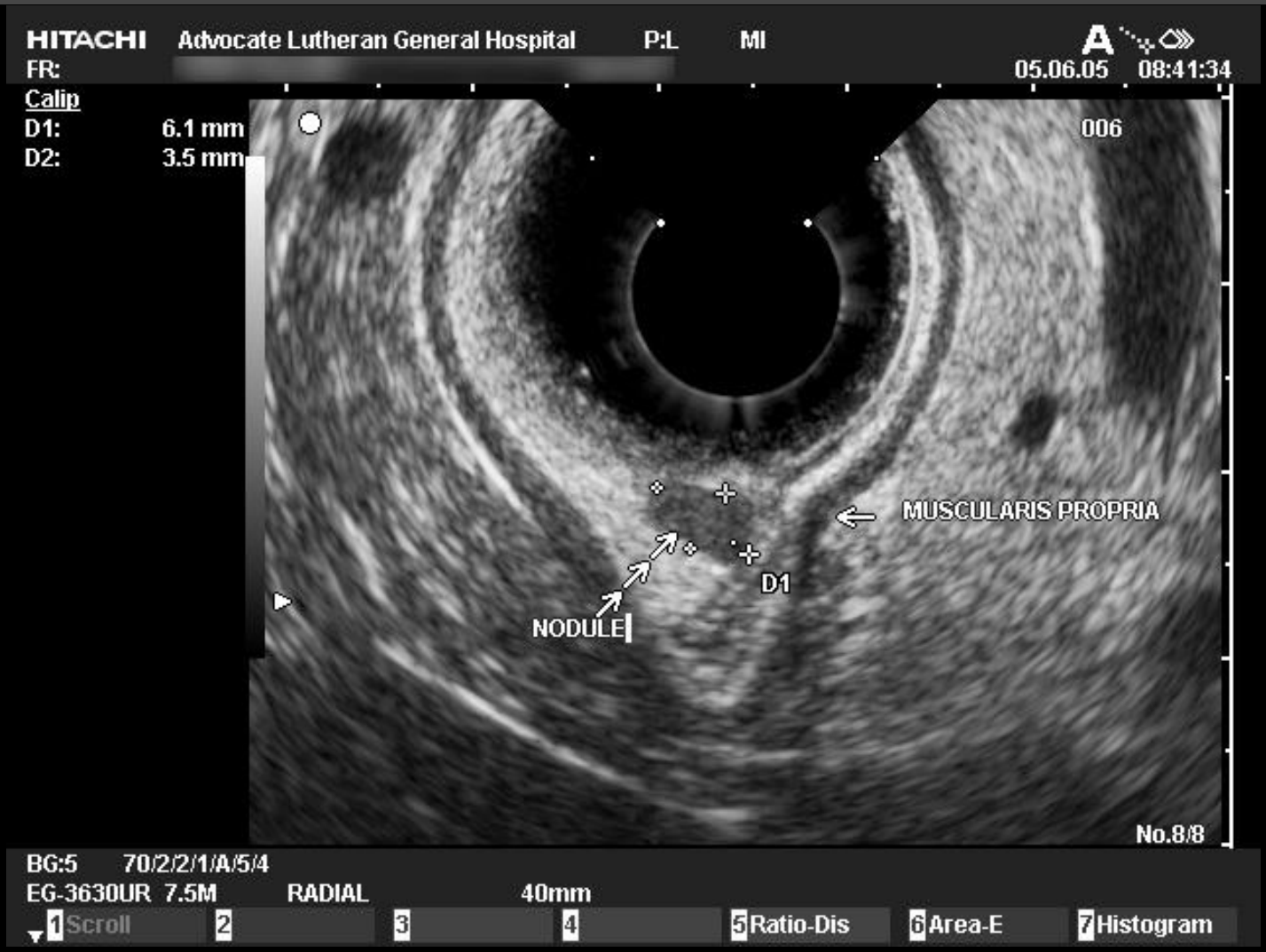




Utilizing EUS in Polypectomy

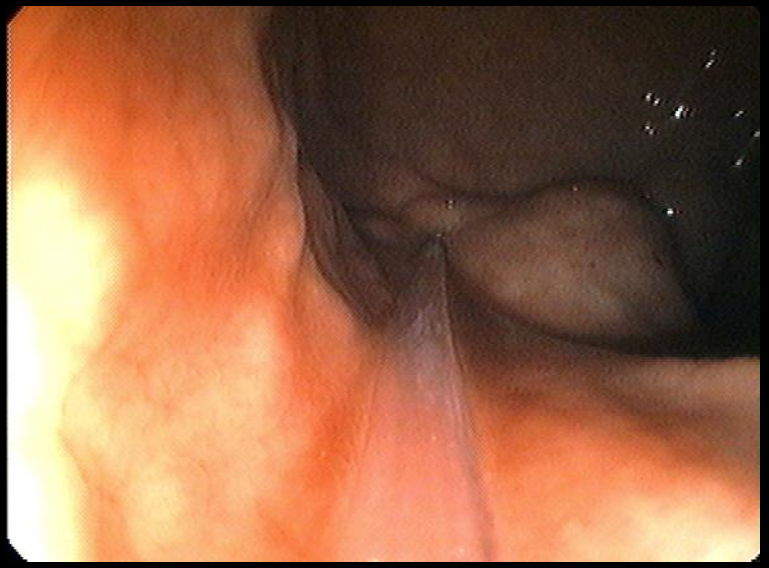
- 43 y.o. athlete referred to evaluate incidental antral nodule found on EGD during workup of abdominal pain.

Utilizing EUS in Polypectomy



Utilizing EUS in Polypectomy

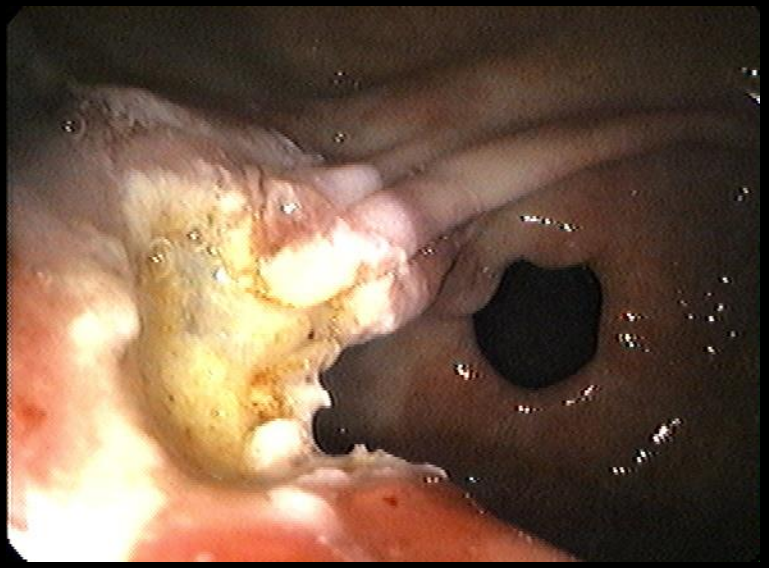
Marking Borders



Saline Lift

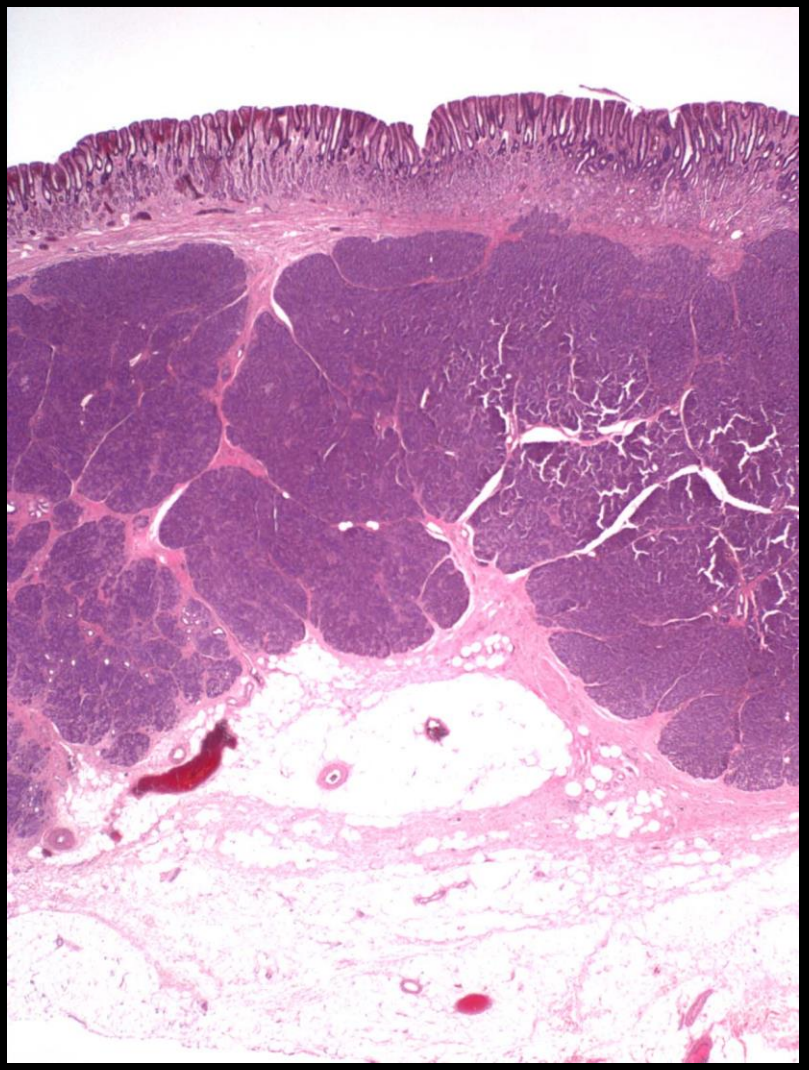
Utilizing EUS in Polypectomy

Snare within Cap



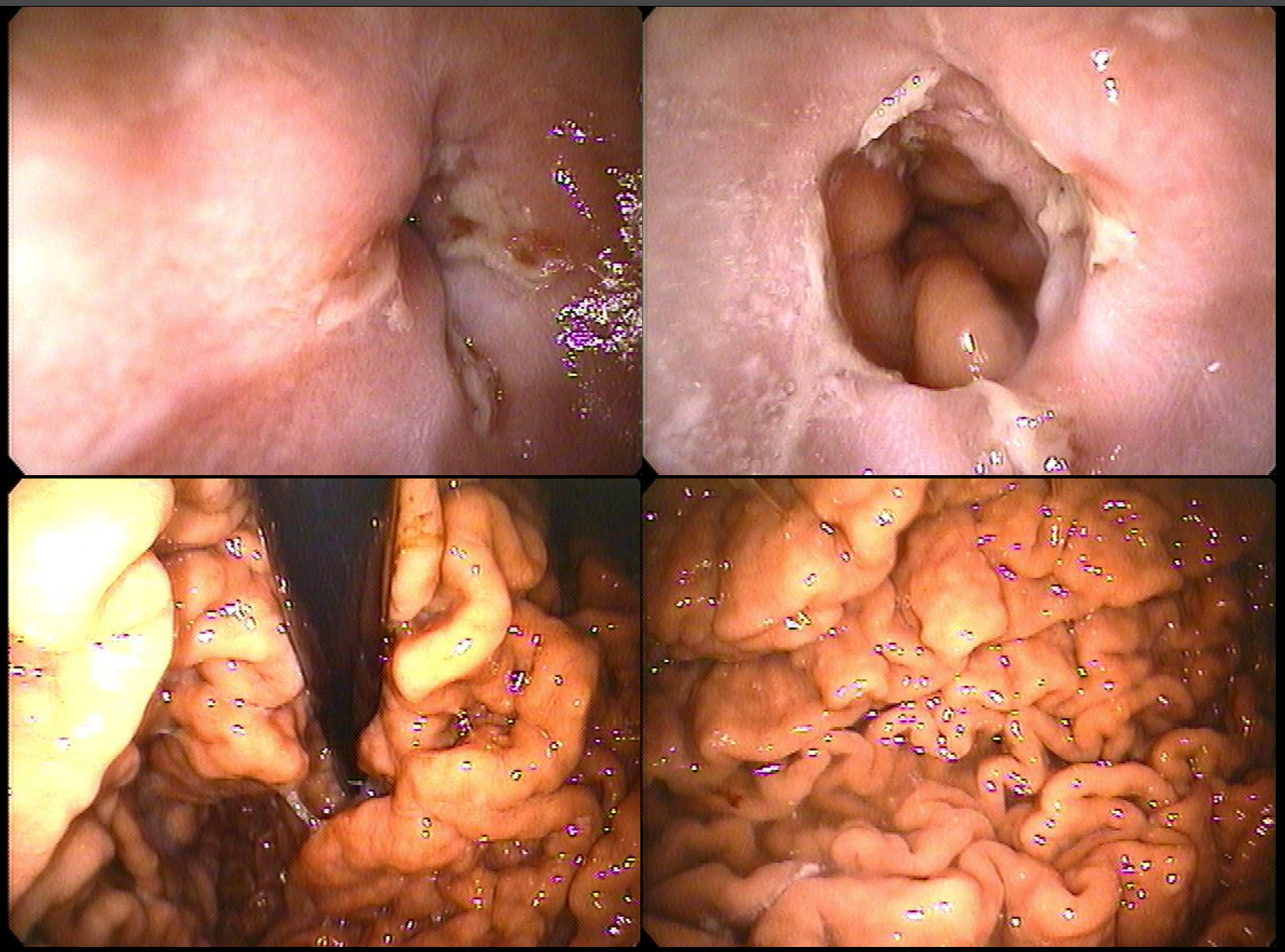
Resection Site

Utilizing EUS in Polypectomy



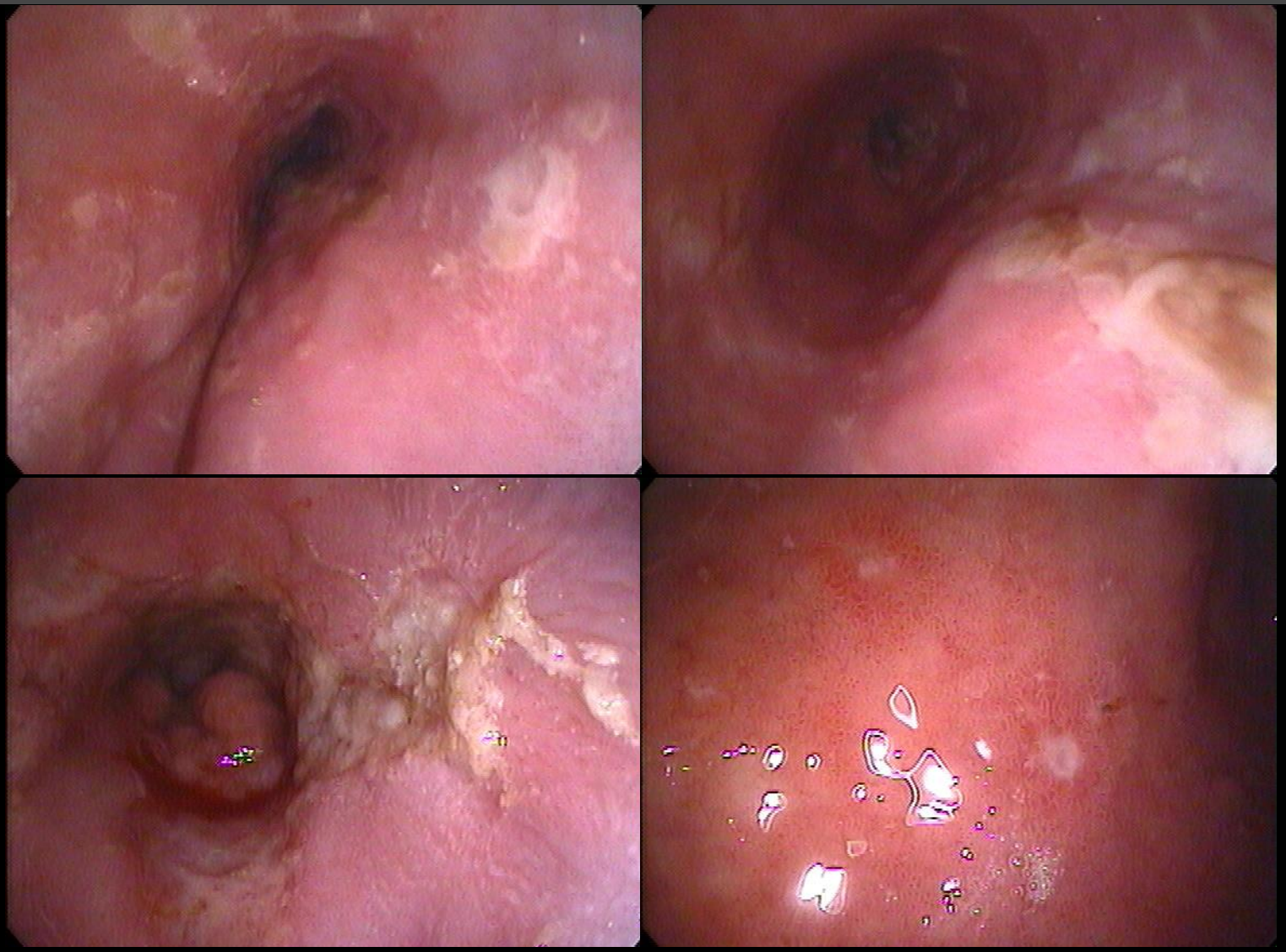
Localization of Neuroendocrine Tumor

2006 - EGD



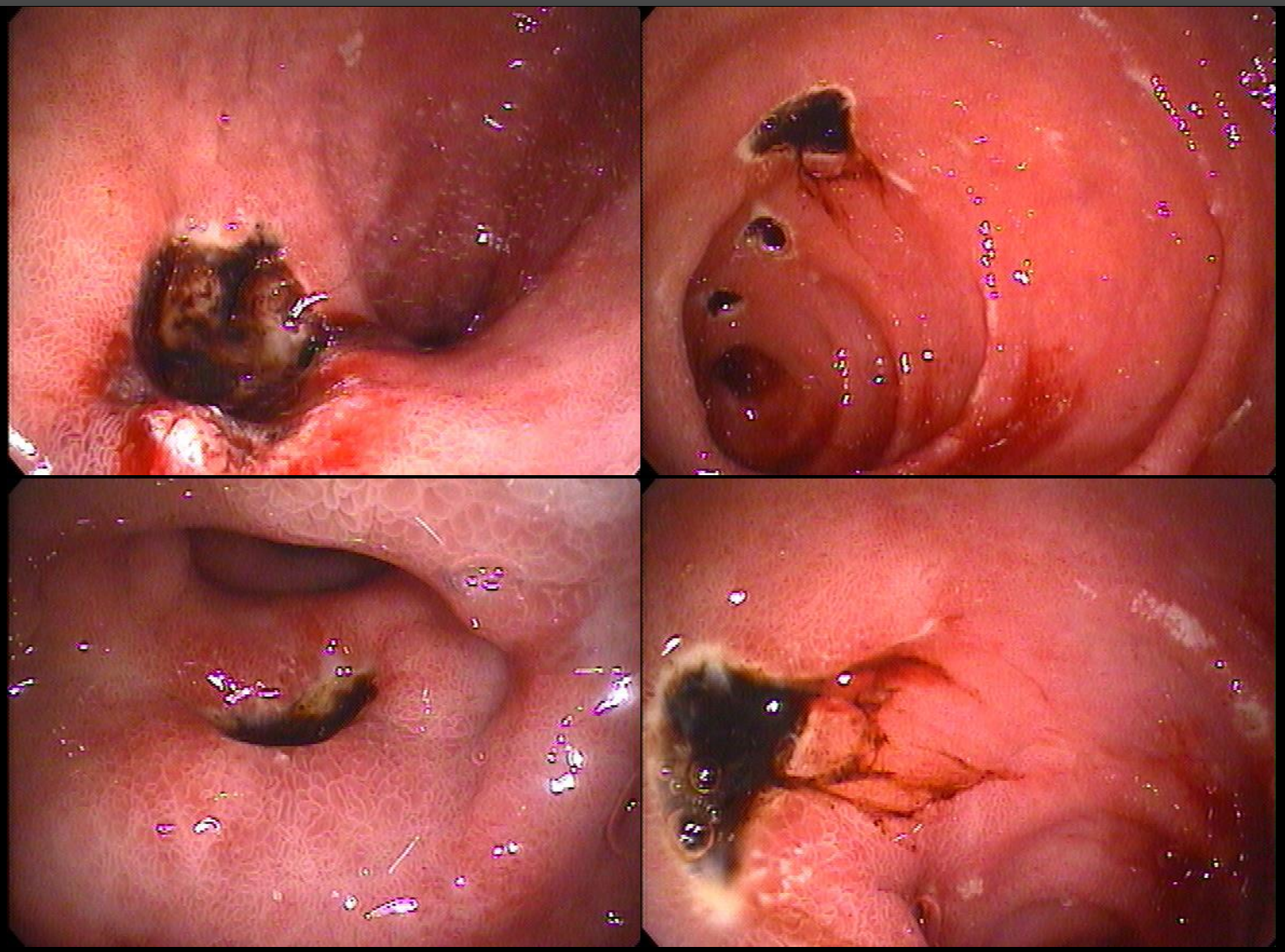
Localization of Neuroendocrine Tumor

2008 - EGD

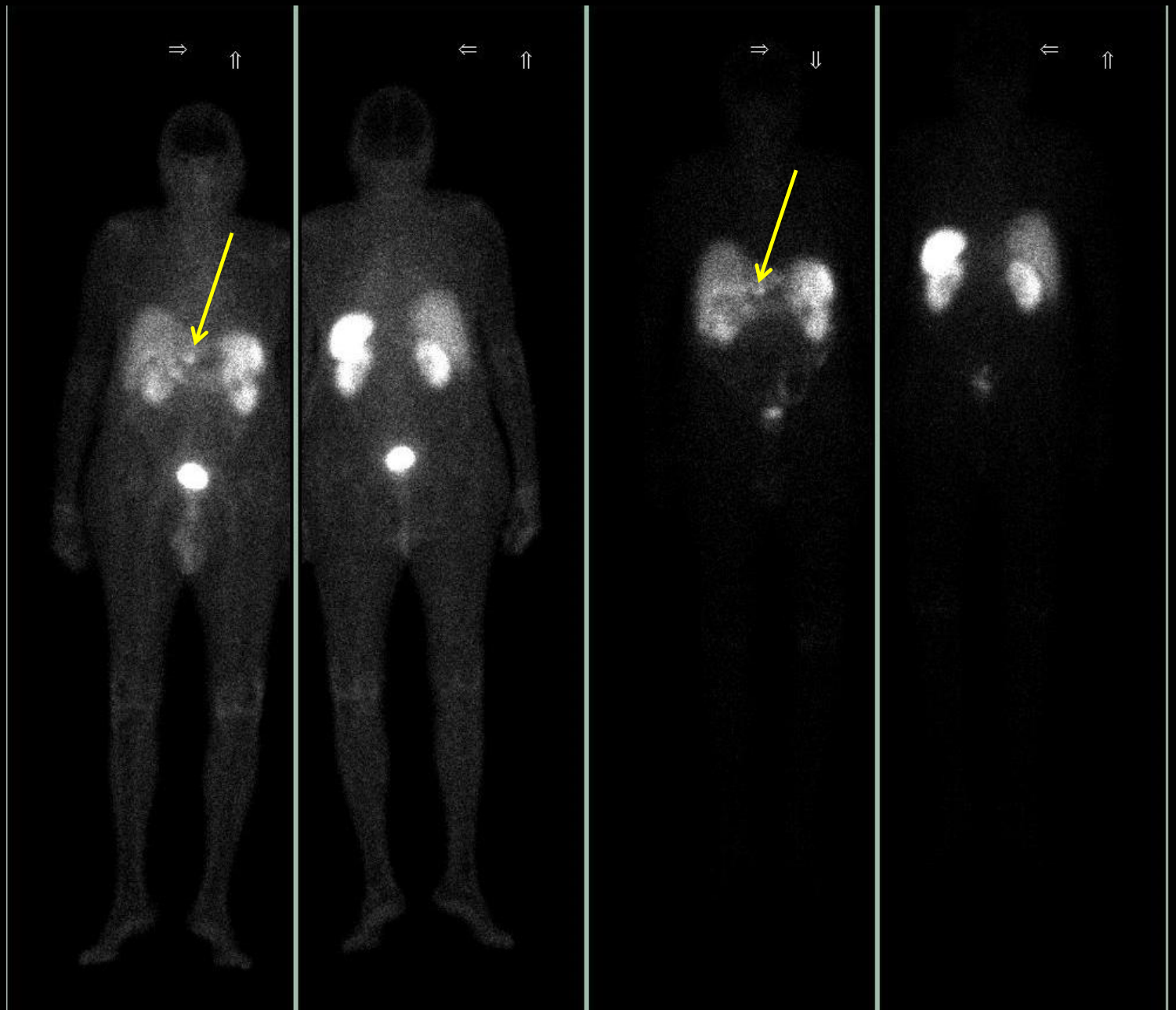


Localization of Neuroendocrine Tumor

2008 - EGD



3/25/2008 – Octreotide scan



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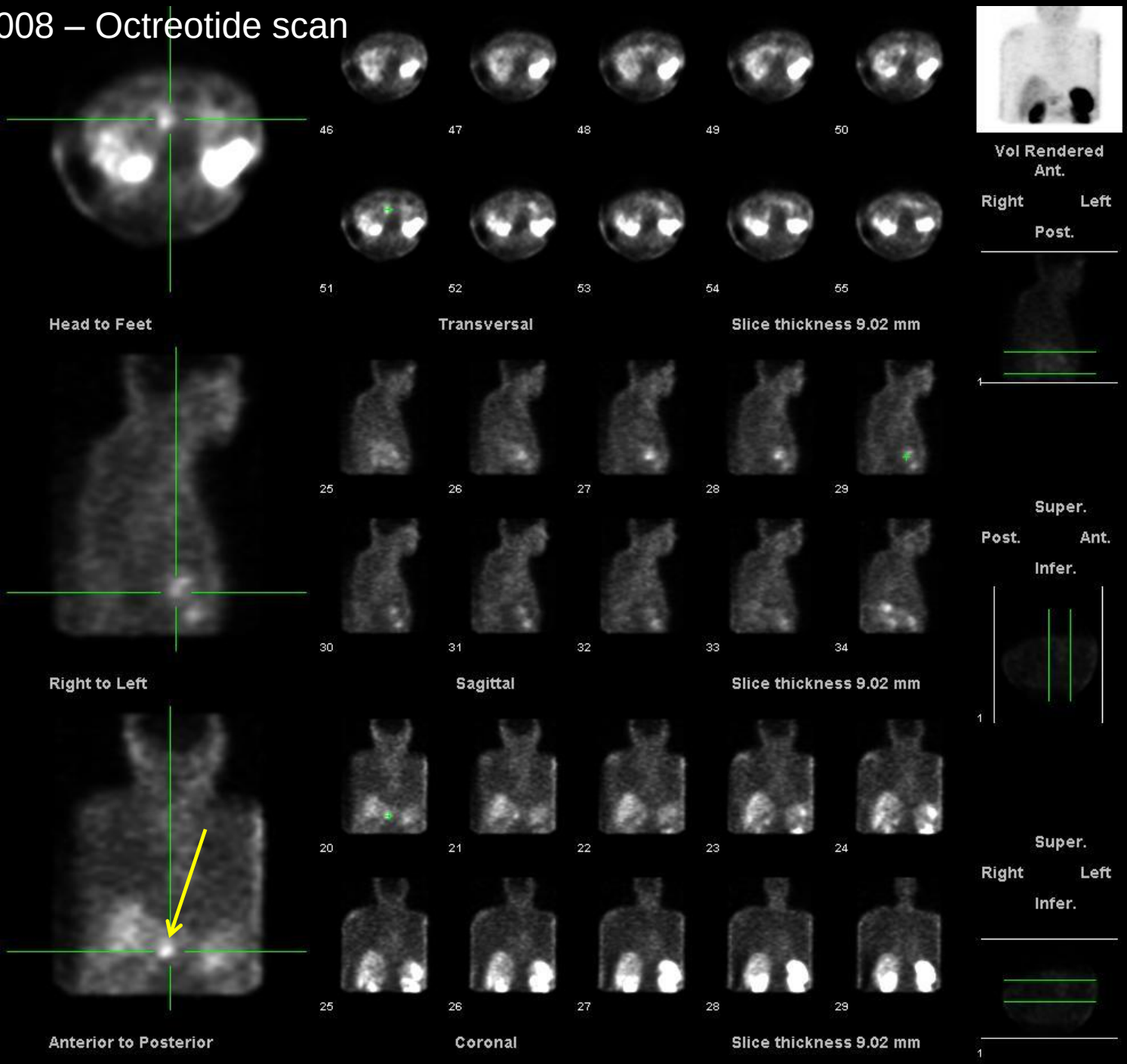
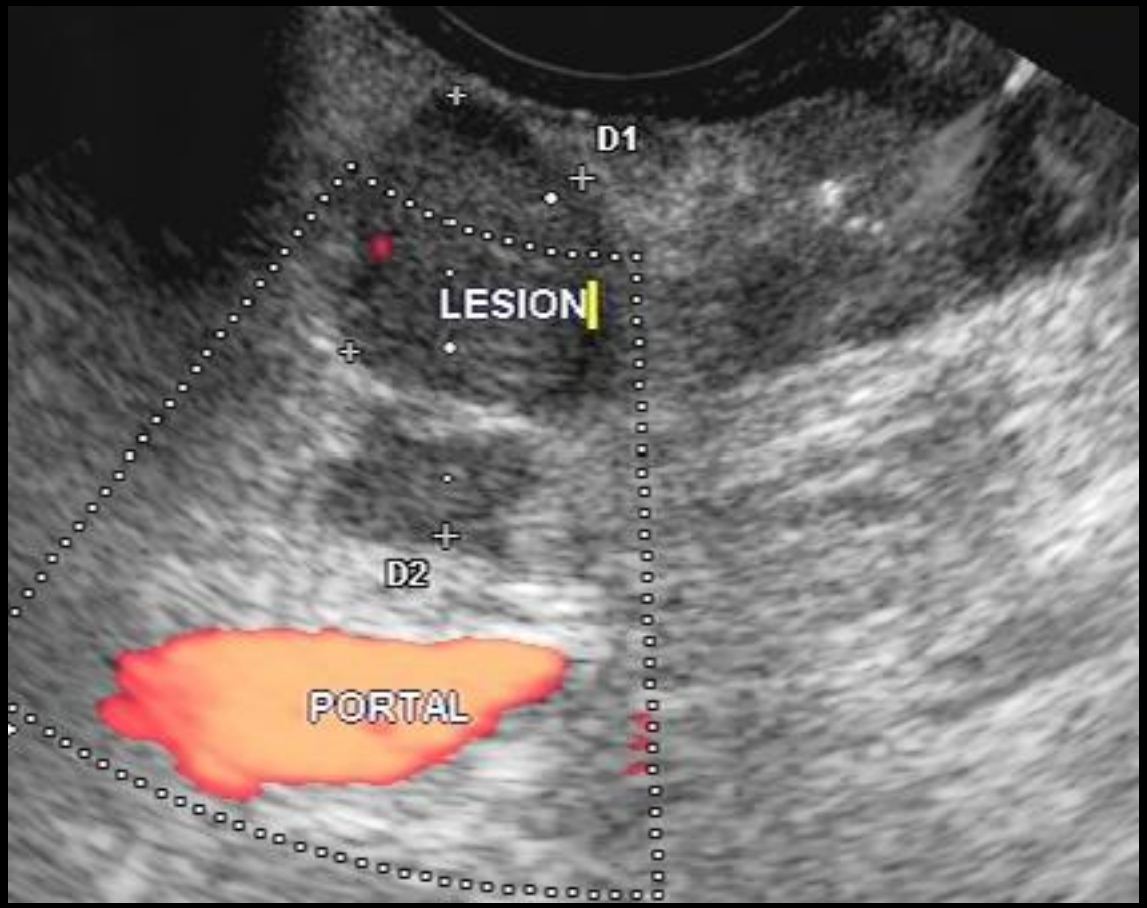


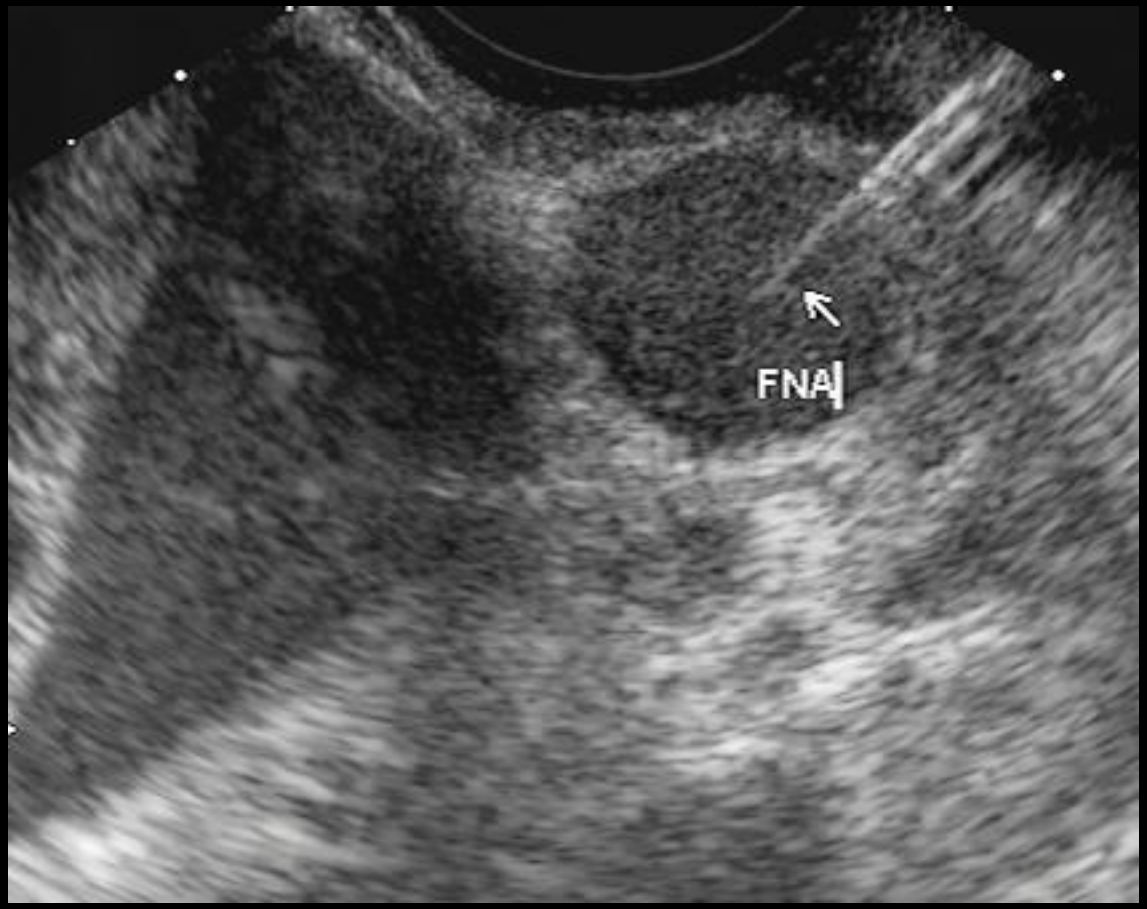
Localization of Neuroendocrine Tumor

5/29/2008 - EUS



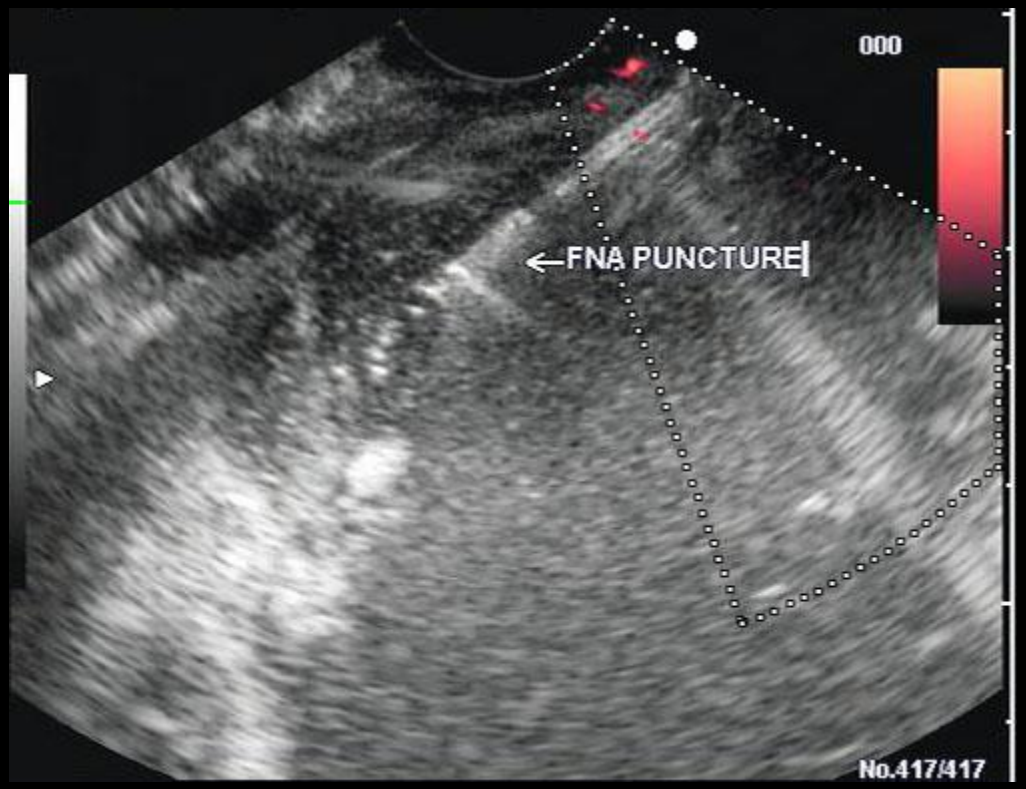
Localization of Neuroendocrine Tumor

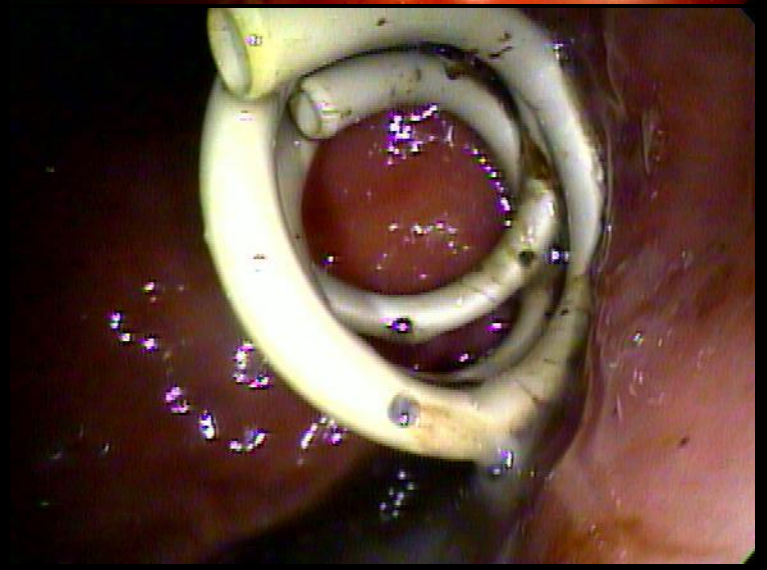
5/29/2008 - EUS



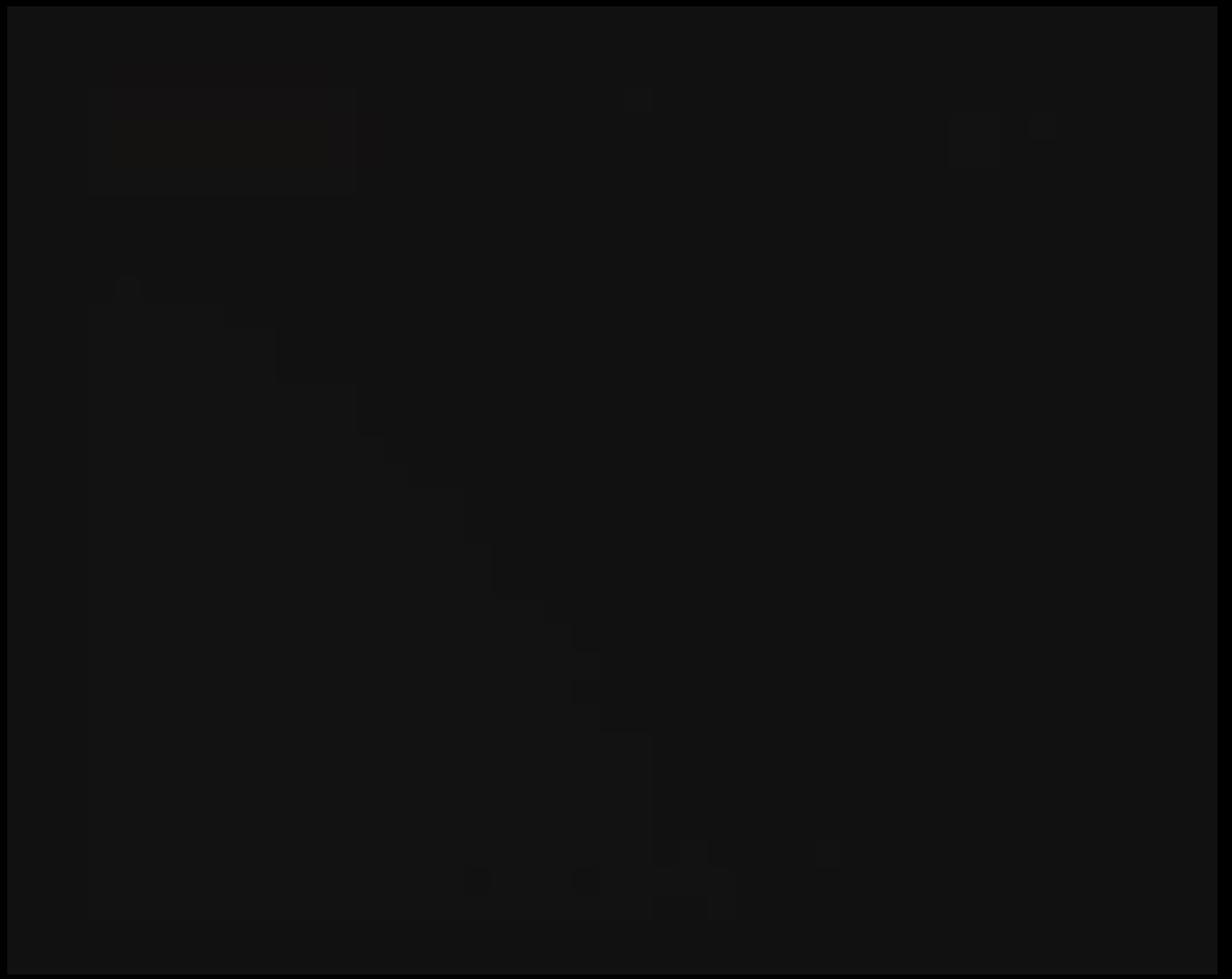
FNA revealed neuroendocrine cells consistent with Gastrinoma

Pancreatic Pseudocyst Drainage



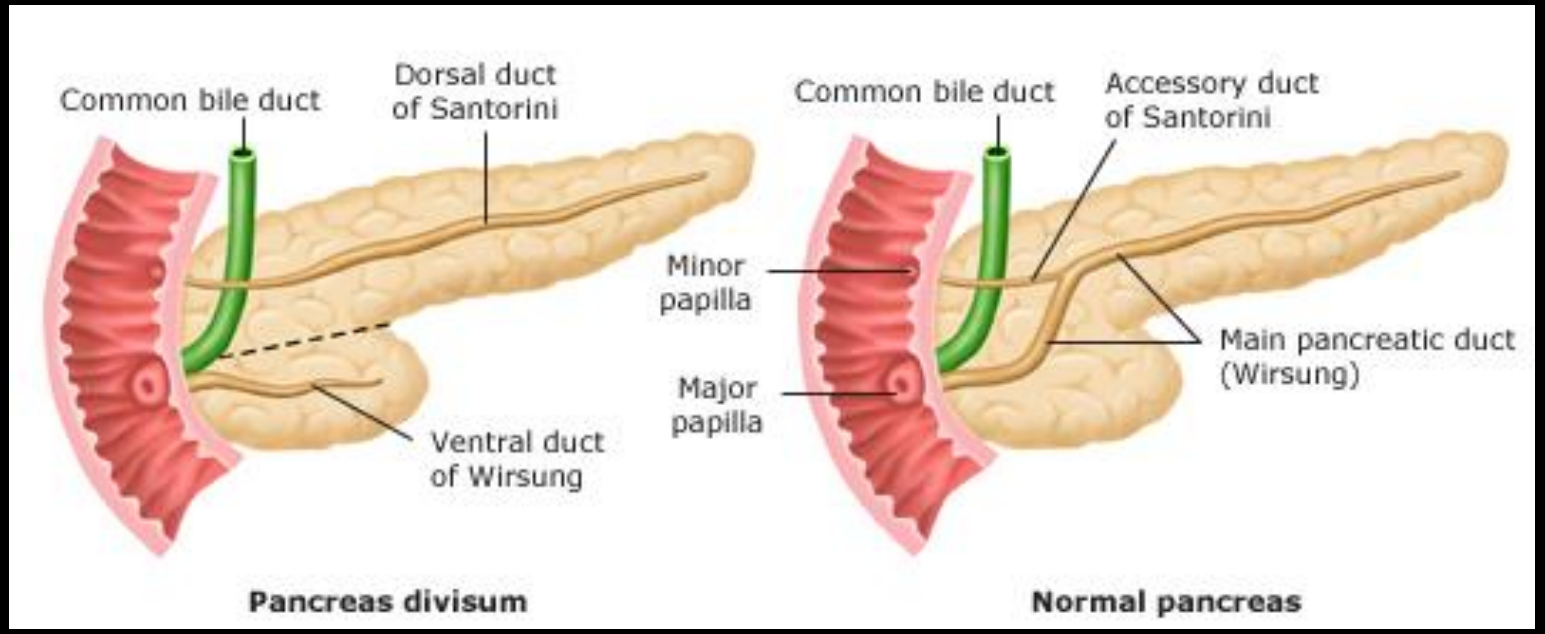


EUS-guided cystgastrostomy in Pancreatic pseudocyst drainage

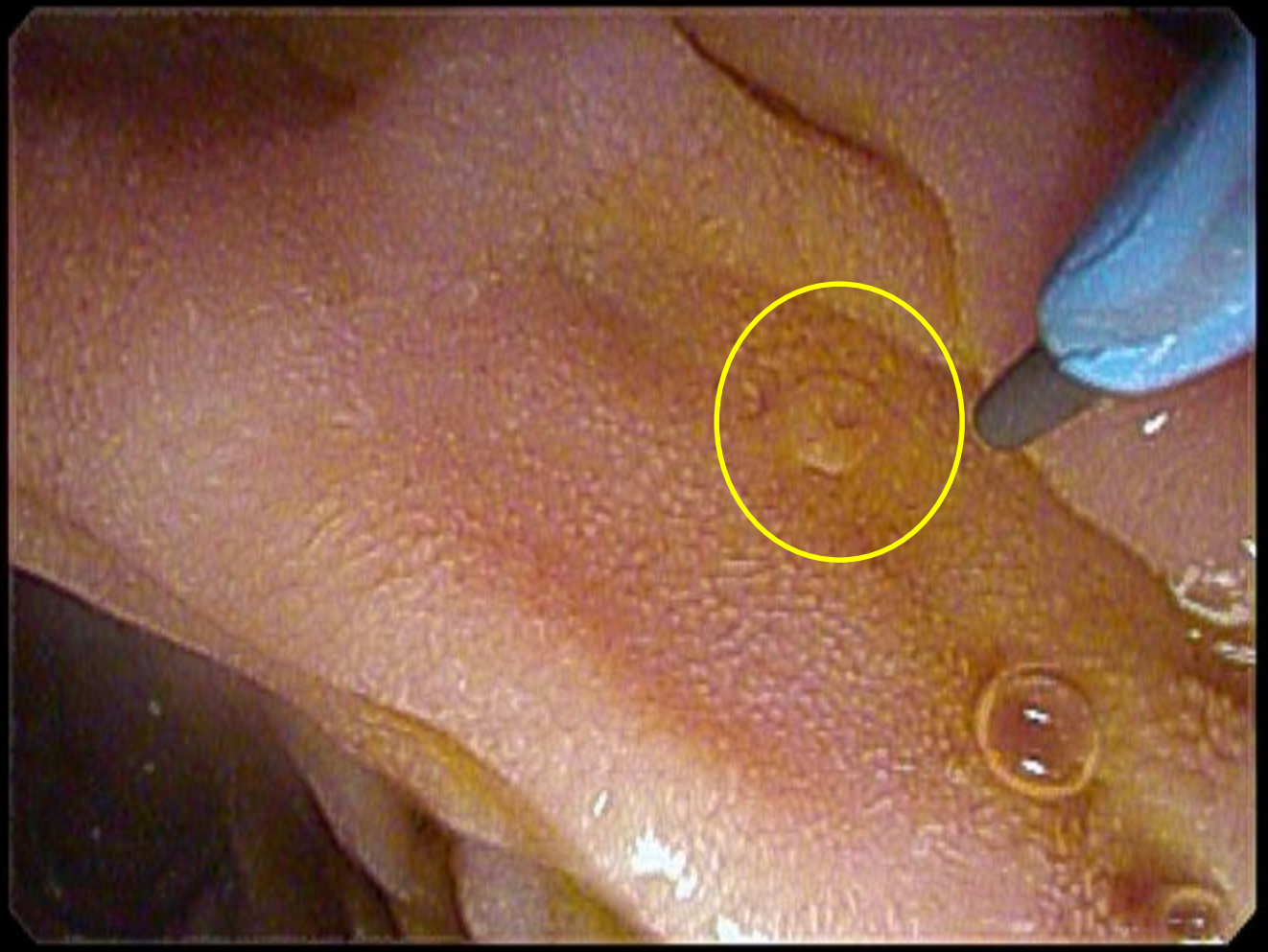


EUS-guided Rendezvous

- 47 y.o. woman with symptomatic pancreas divisum for minor papilla



EUS-guided Rendezvous



Failed ERCP attempt of minor papilla

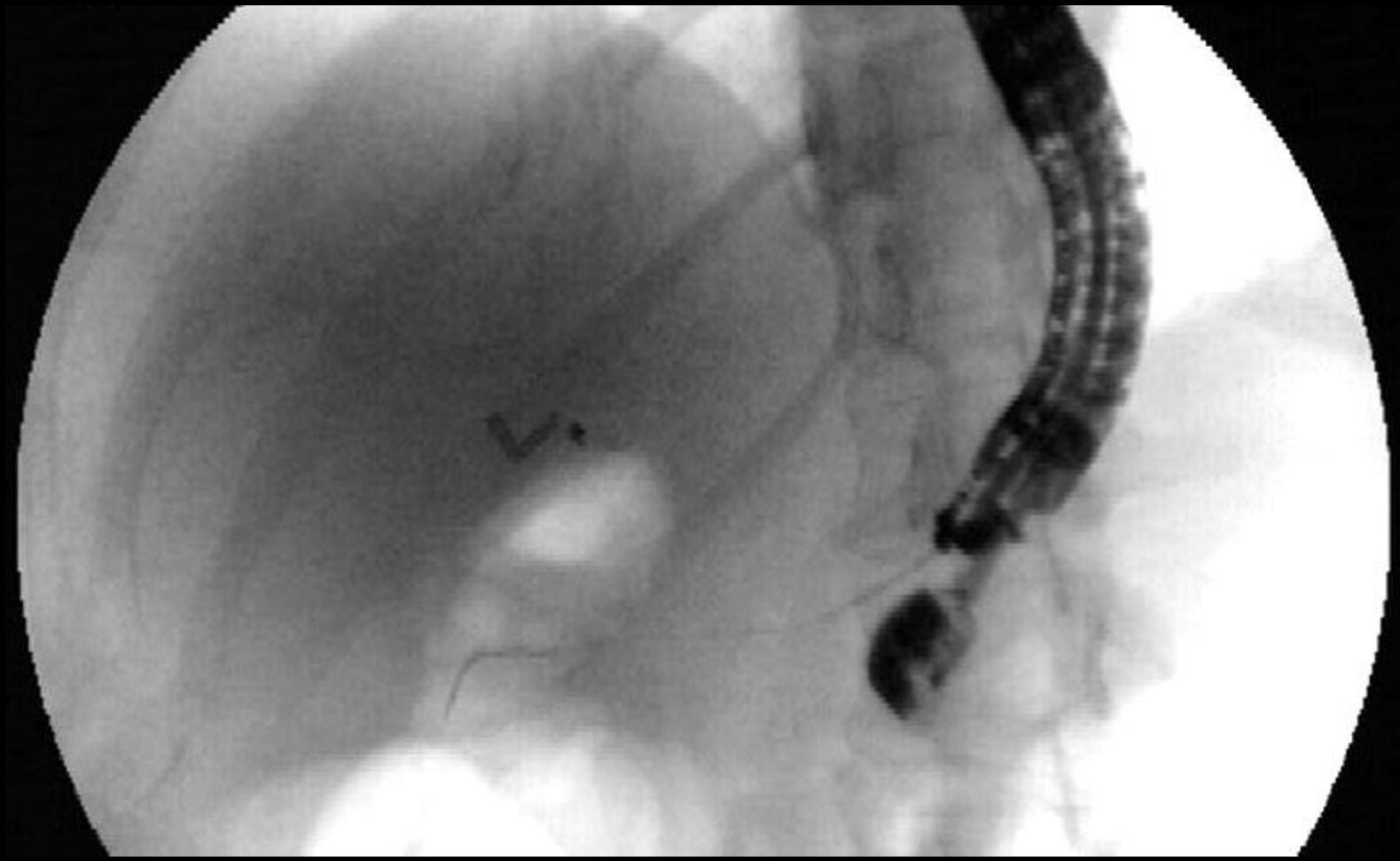
EUS-guided Rendezvous

Dilated main pancreatic duct

EUS-guided Rendezvous

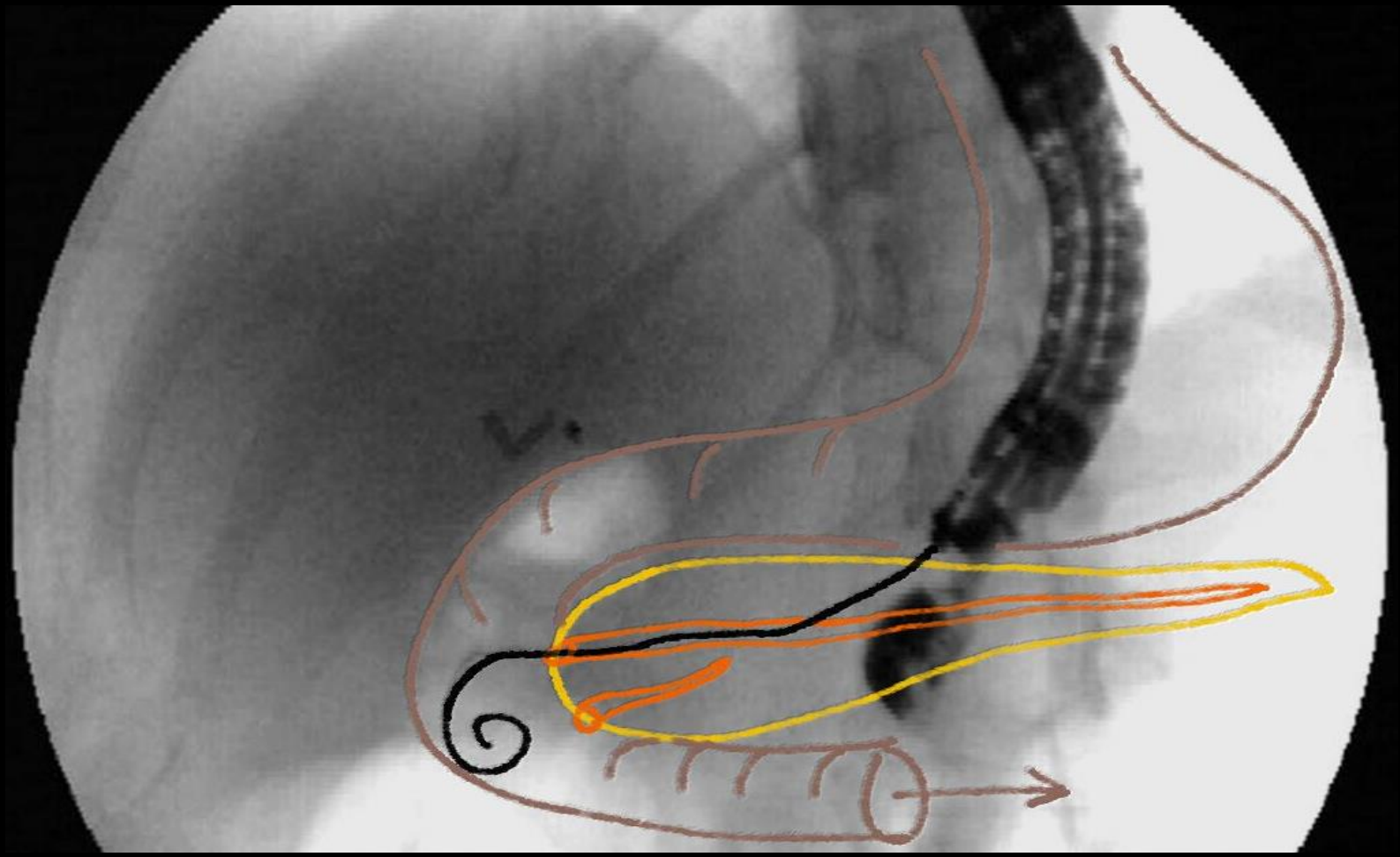
Transgastric access of main pancreatic duct

EUS-guided Rendezvous



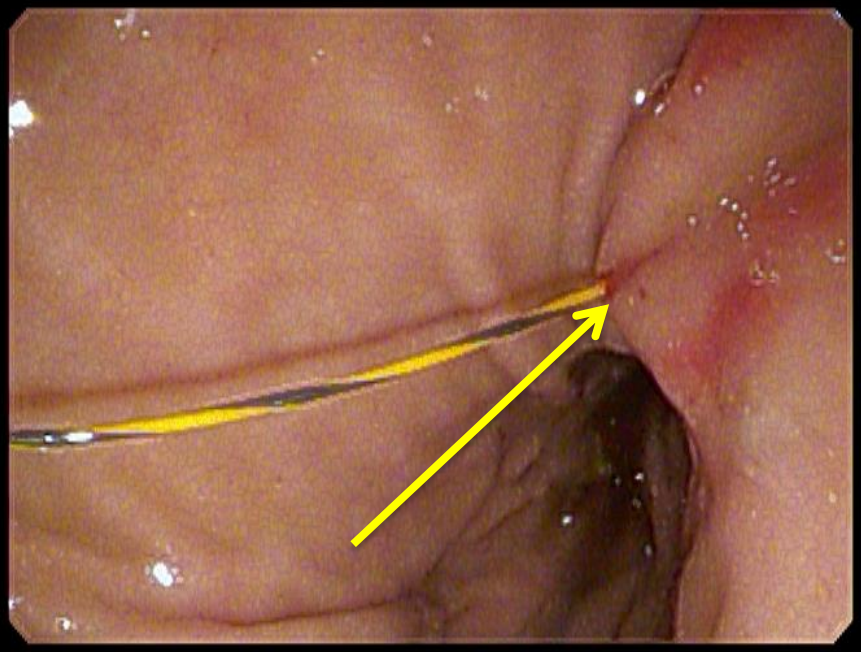
Trans-gastric puncture into PD

EUS-guided Rendezvous

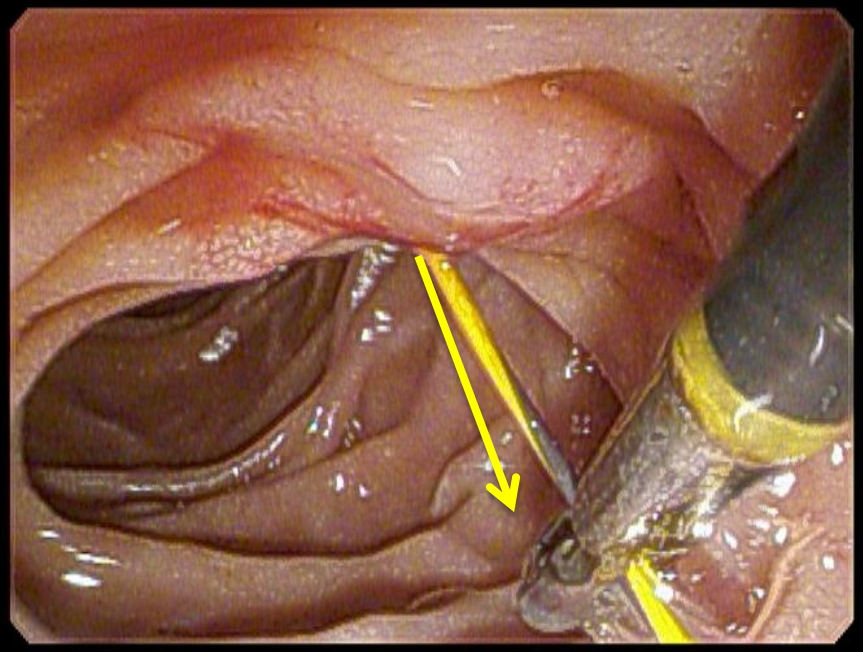


Trans-gastric puncture into PD

EUS-guided Rendezvous

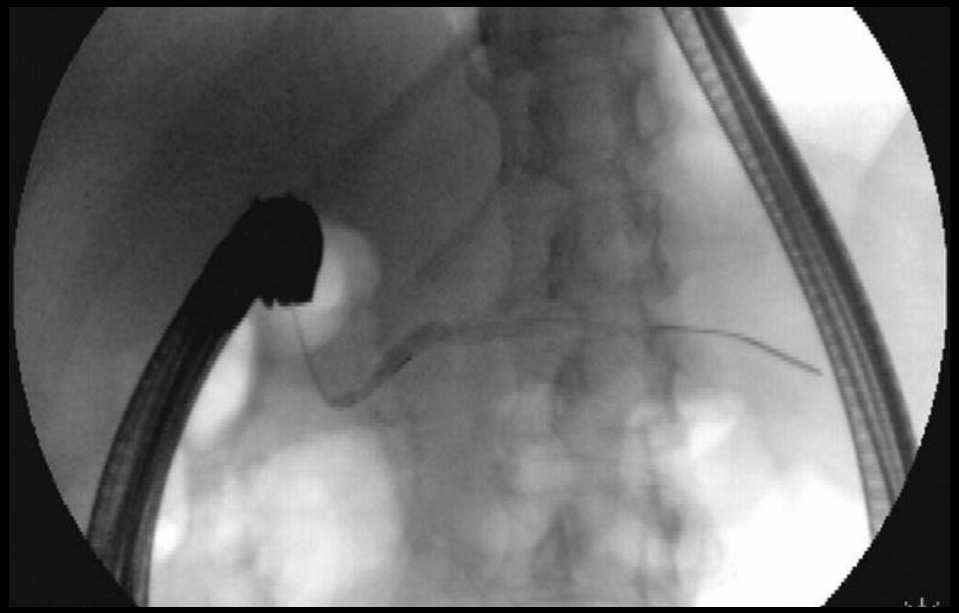


Guidewire puncture into stomach

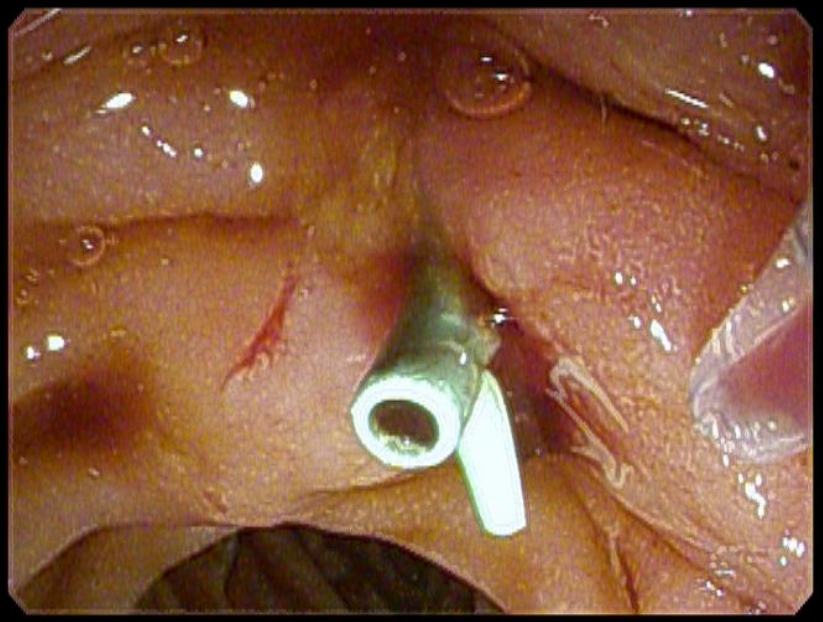


Wire exiting minor papilla

EUS-guided Rendezvous



Minor pancreatogram

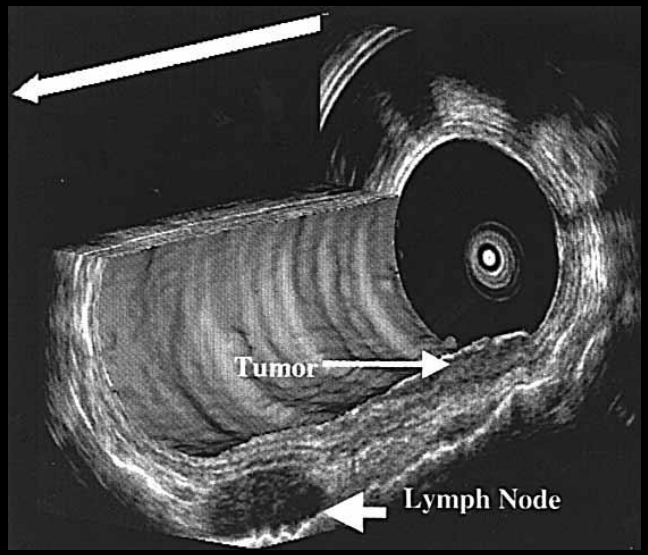


Stent in minor papilla

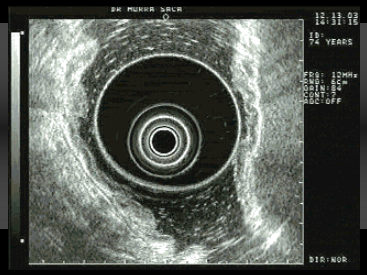
Future Applications of EUS

- Moving from Diagnostic → Therapeutic
  - Direct delivery of chemotherapeutic agents to target lesion
  - EUS-guided placement of Brachytherapy radiation seeds
  - EUS guided Angiography

- Advances in EUS Imaging
  - 3D “Spiral” EUS



Summary



- EUS is the most accurate staging modality for locoregional staging of esophageal and pancreatic cancers
- EUS is cost effective and very safe
- More education to referring physicians is needed for appropriate EUS indications
- EUS has allowed us to add a whole new dimension of innovation in GI procedures by allowing us to move beyond the lumen.