

Progress in the application of EUS in gastrointestinal diseases

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Application of EUS in digestive tract diseases

Esophagus

The stomach

Duodenum

Jejunum, ileum

Colon, rectum

Progress in the application of EUS in diseases of the digestive tract

Esophagus

The stomach

Duodenum

Jejunum, ileum

Colon, rectum

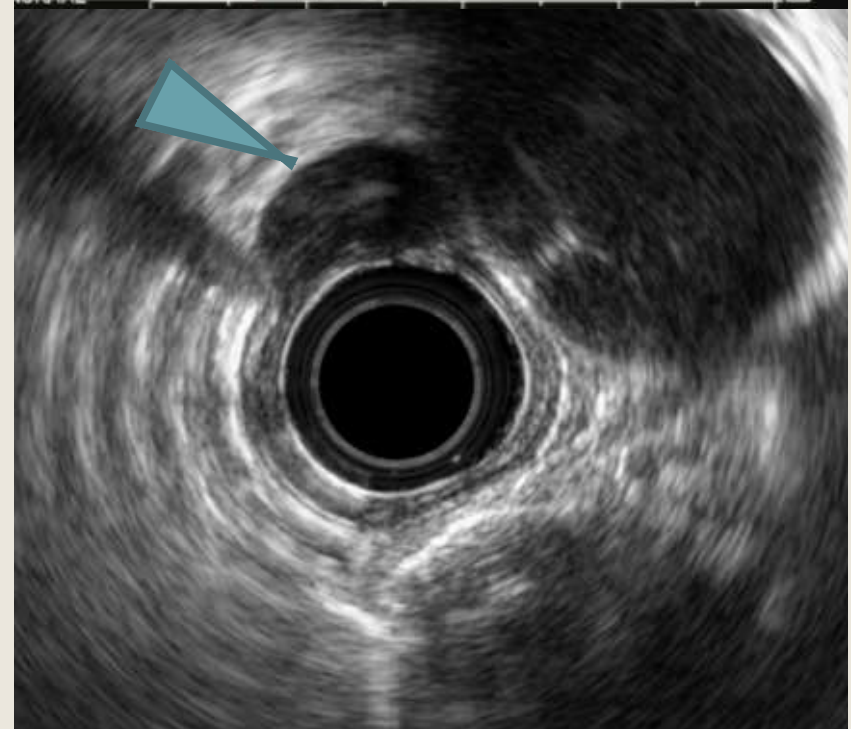
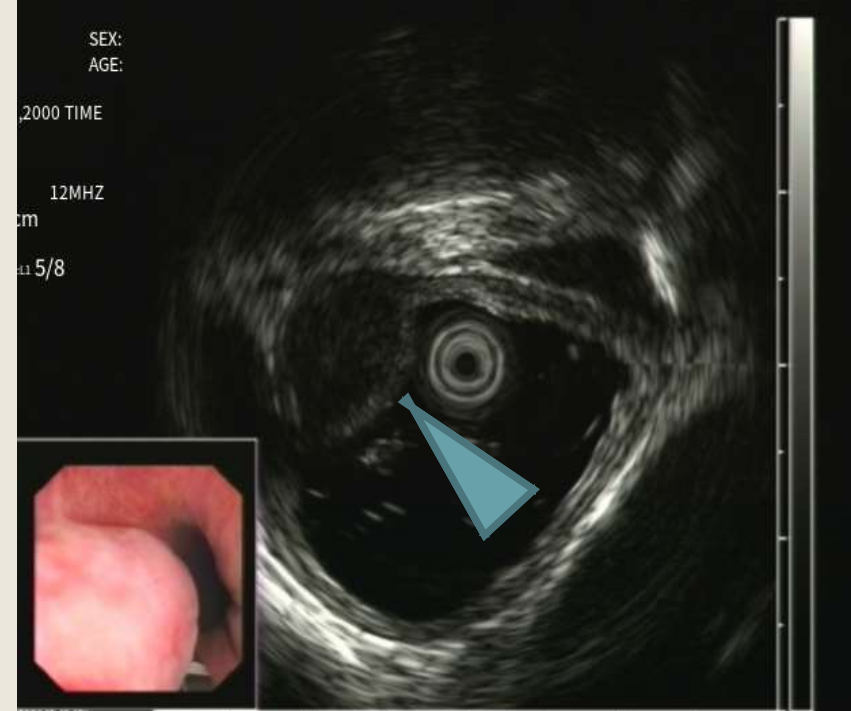
EUS in esophageal diseases

Indications: All esophageal eminence, depression, or thickening and narrowing are indications for endoscopic ultrasonography, but they are of particular diagnostic value in the following aspects:

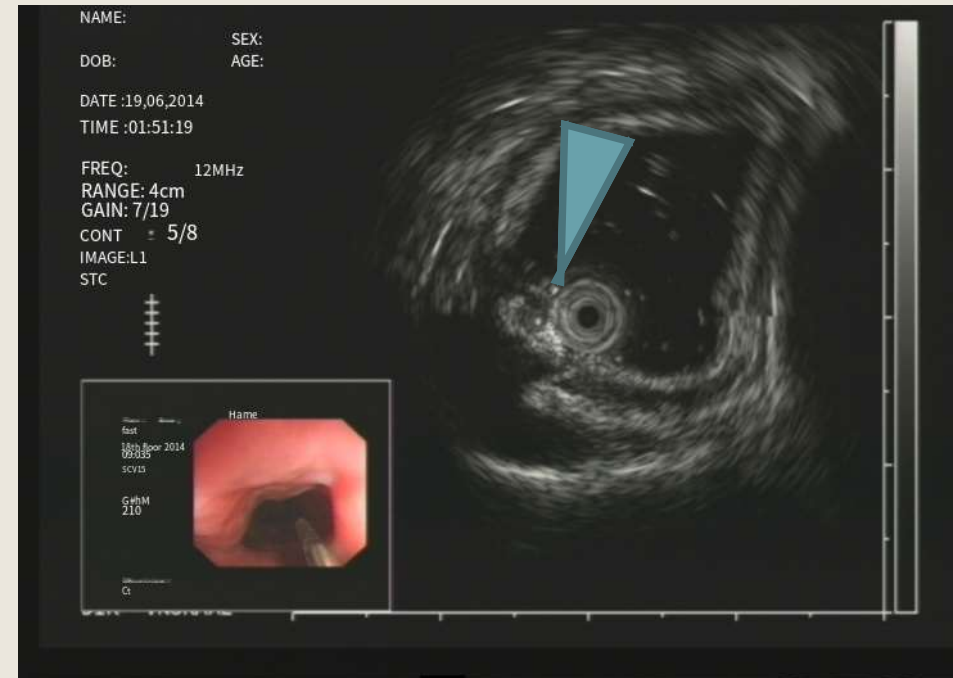
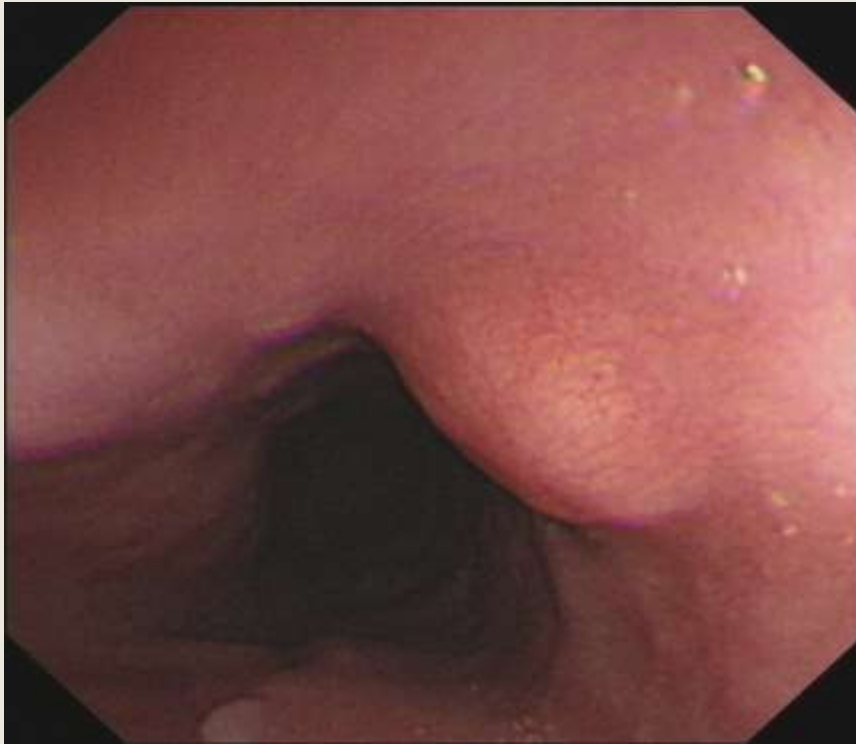
- 1. Diagnosis and differential diagnosis of esophageal submucosal lesions, such as esophageal leiomyoma, vasculoma, granulosa cell tumor, hamartoma, cyst, lipoma, etc.
- 2. Diagnosis and differential diagnosis of esophageal external pressure eminence, such as changes caused by physiological external pressure such as aorta, (branch) trachea and spine, or external pressure eminence caused by extramural lesions such as enlarged lymph nodes beside the esophagus.
- 3. Auxiliary diagnosis of esophageal thickening and stenosis, such as achalasia of cardia, eosinophilic esophagitis and other thickening diseases, and differential diagnosis of benign and malignant esophageal stenosis.
- 4. Preoperative TN staging of esophageal cancer, evaluation of curative effect of radiotherapy and chemotherapy, etc.
- 5. Evaluation before and after endoscopic treatment of esophageal varices.

Esophageal leiomyoma

- Originating in the musculi propria or mucosal musculi
- Round or oval
- May be lobed or ringed
- Low echo predominates and is evenly distributed
- May be accompanied by calcification, single or multiple



Esophageal leiomyoma (with calcification, followed by sound shadows)



Esophageal vasculoma

- Originating in the submucosa
- Moderate-hyperechoic
- Internal honeycomb without echo



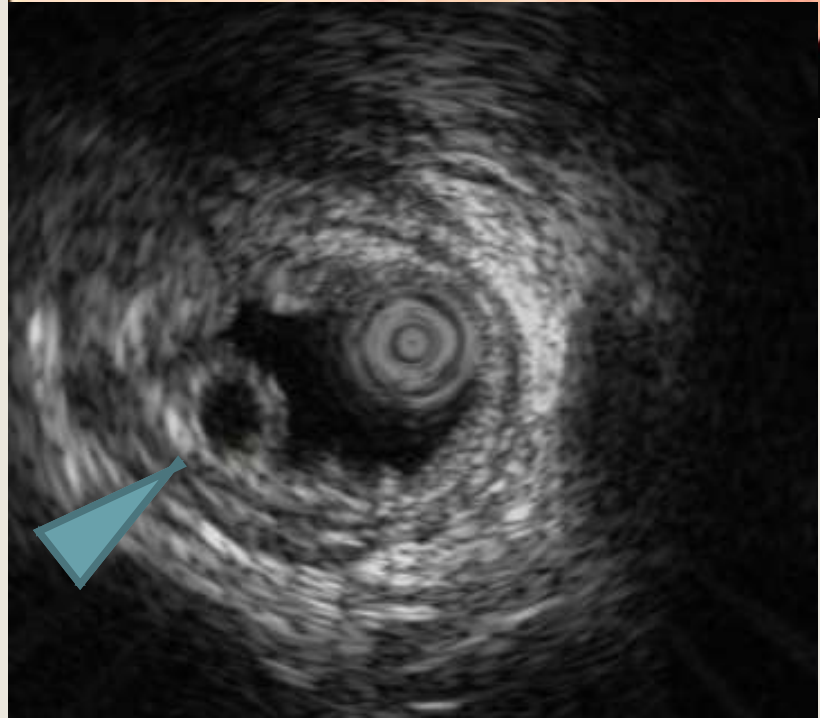
Granulosa cell tumor of the esophagus

- Originating in the deep mucosa
- Round or oval
- Medium echo (higher than leiomyoma)
- Evenly distributed



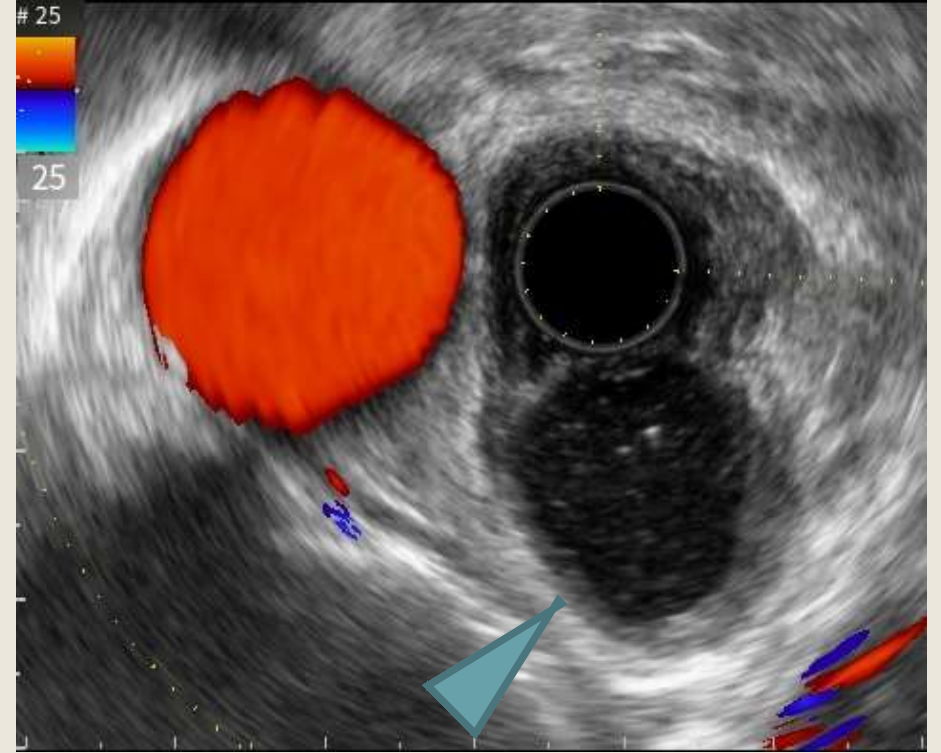
Esophageal cysts

- Located in the submucosa
- Cystic echoless dark area
- Internal sonorhea is good
- Accompanied by enhancement effect



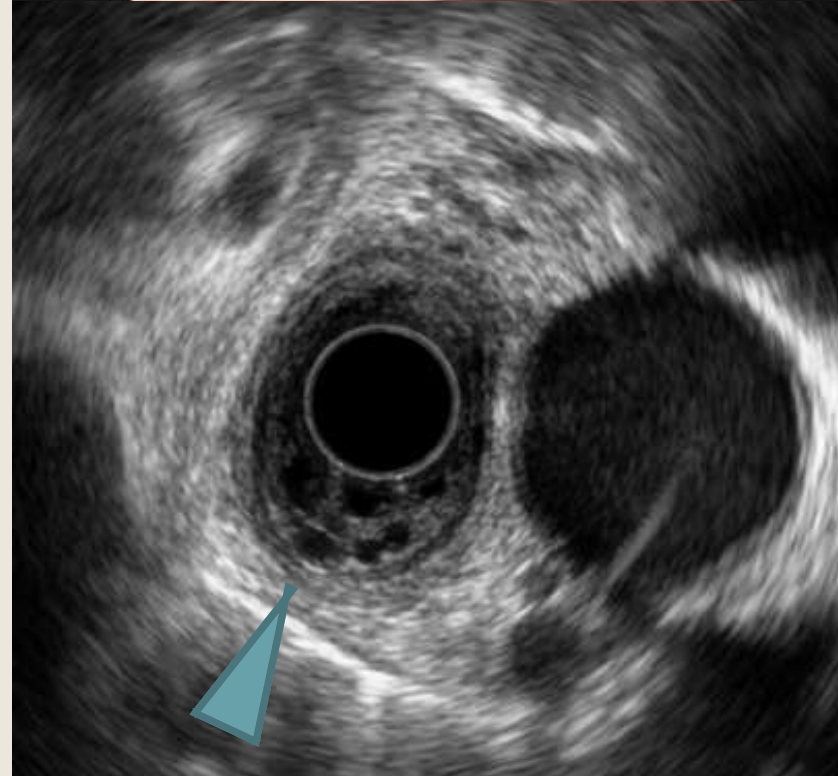
Bronchogenic cyst of the esophagus

- Originating from the musculi propria
- Cystic hypoechoic dark area with punctate hyperechoic floating
- Posterior with enhancement effect



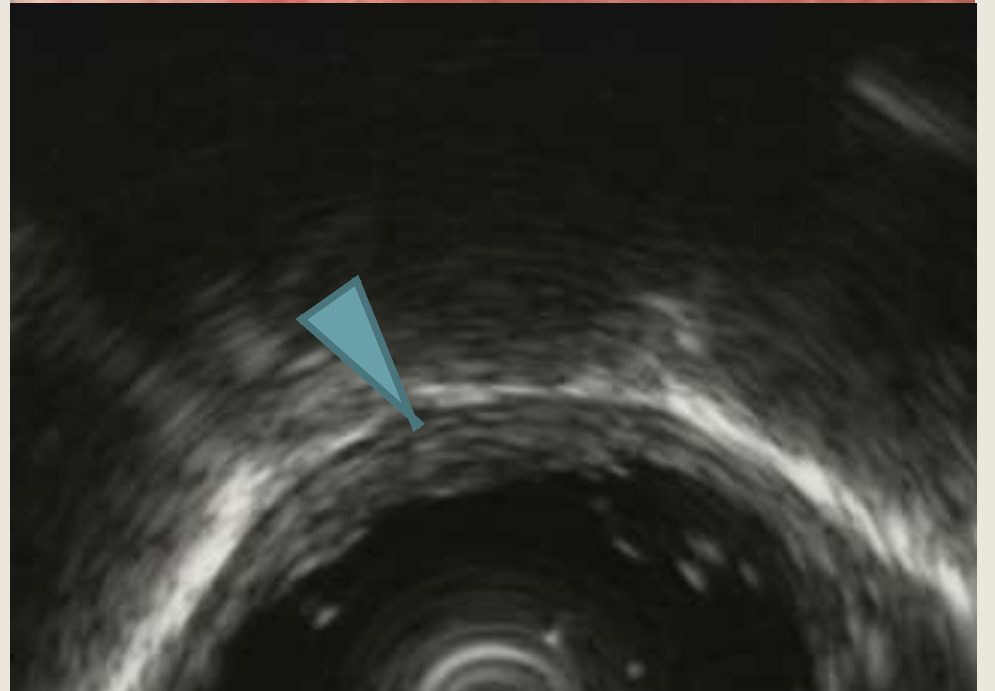
Esophageal varices

- Located inside the wall of the esophagus
- A cellular or tubular echoless dark area
- Blood flow signals are visible inside
- Complete/incomplete occlusive changes occurred in the lumen after lauromacrol/glue treatment



Early esophageal cancer

- The mucosal layer is hypoechoic thickening
- A 20MHz microprobe is recommended
- Extramural lymph nodes are also observed



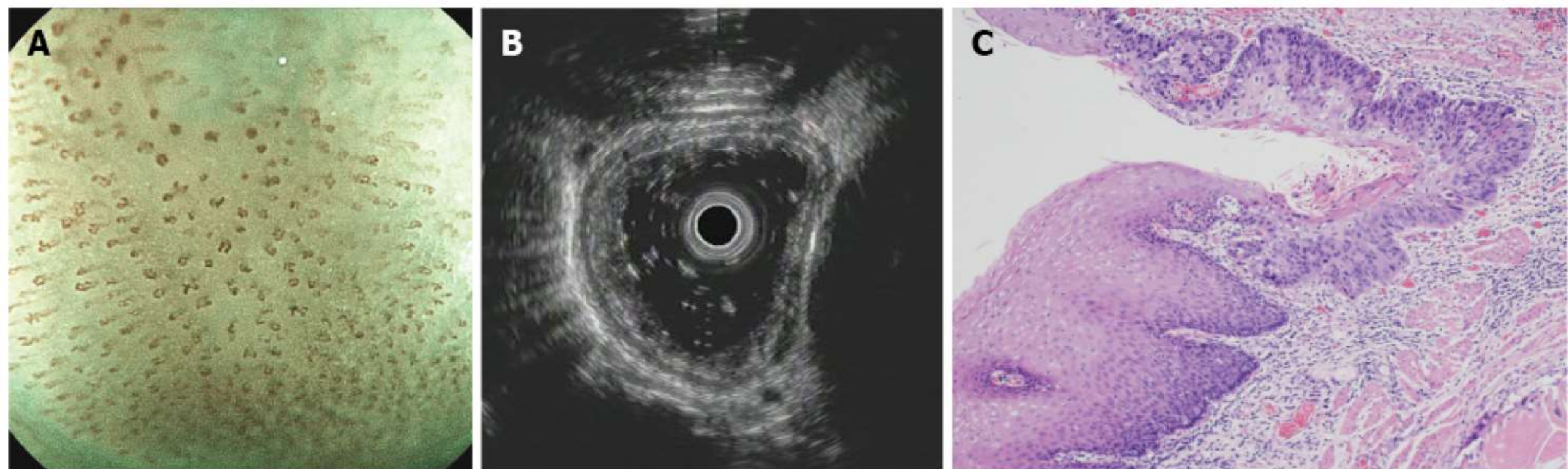
Retrospective Study

Study of preoperative diagnostic modalities in Chinese patients with superficial esophageal squamous cell carcinoma

Ya-Ting Zeng, Yu-Ying Sun, Wen-Cheng Tan, Shu-Ai Luo, Bi-Hui Zou, Guang-Yu Luo, Chun-Yu Huang

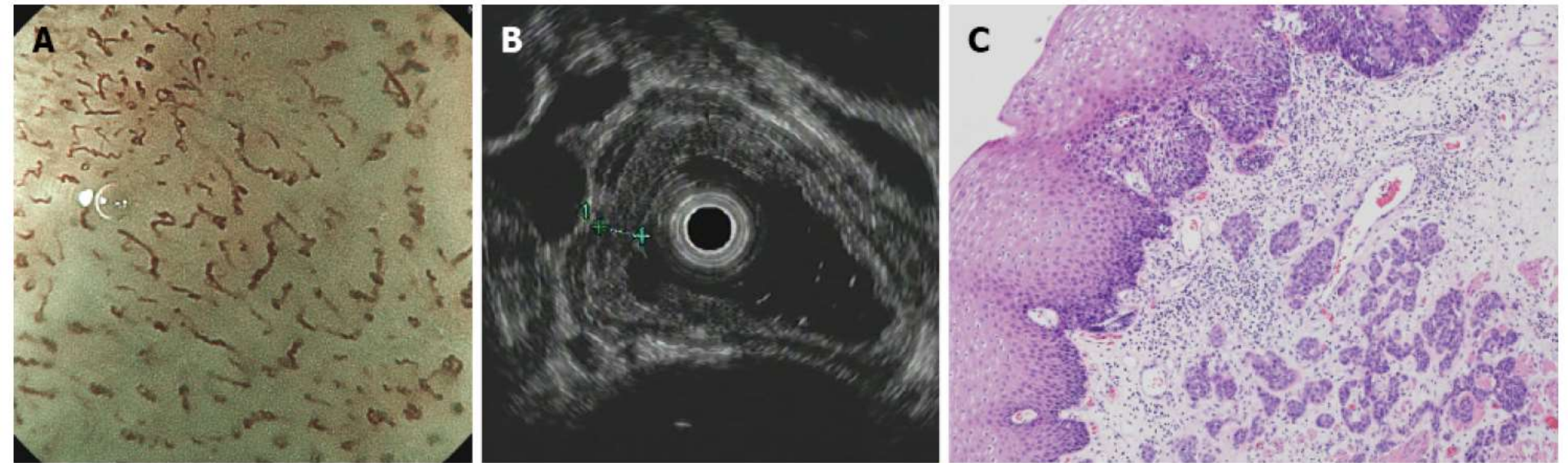
CONCLUSION

We recommend that preoperative diagnosis of SESCC be conducted based on the finding of WLI and ME-NBI/BLI. EUS can be added after patient consent in China, preferably utilizing a high-frequency miniature probe or miniature probe combined with conventional radical EUS.



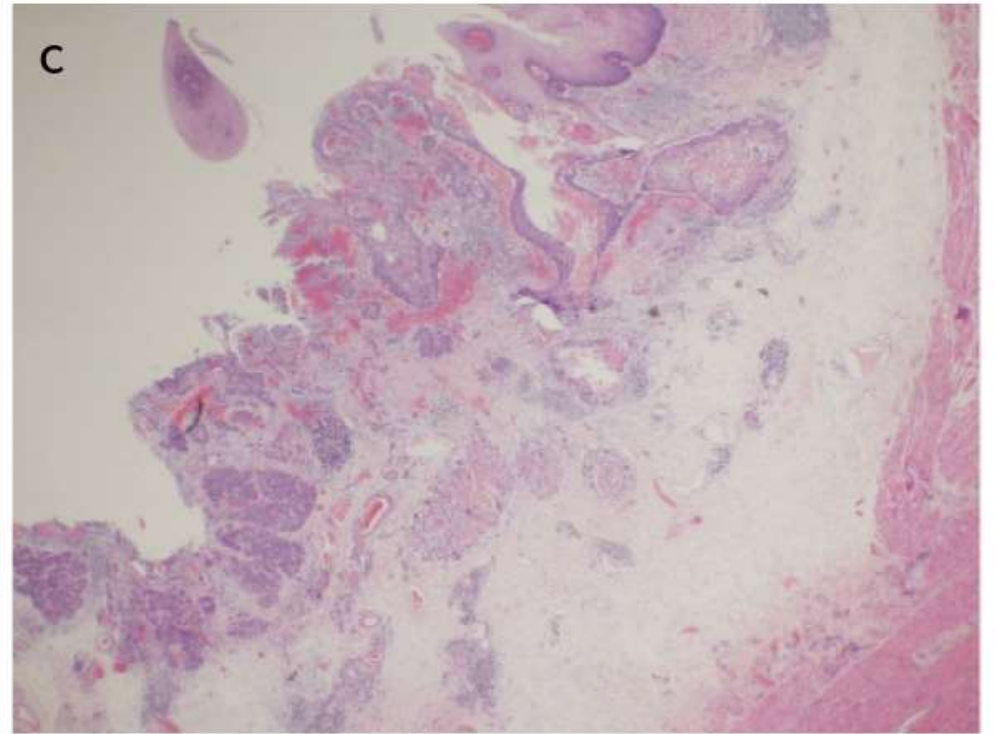
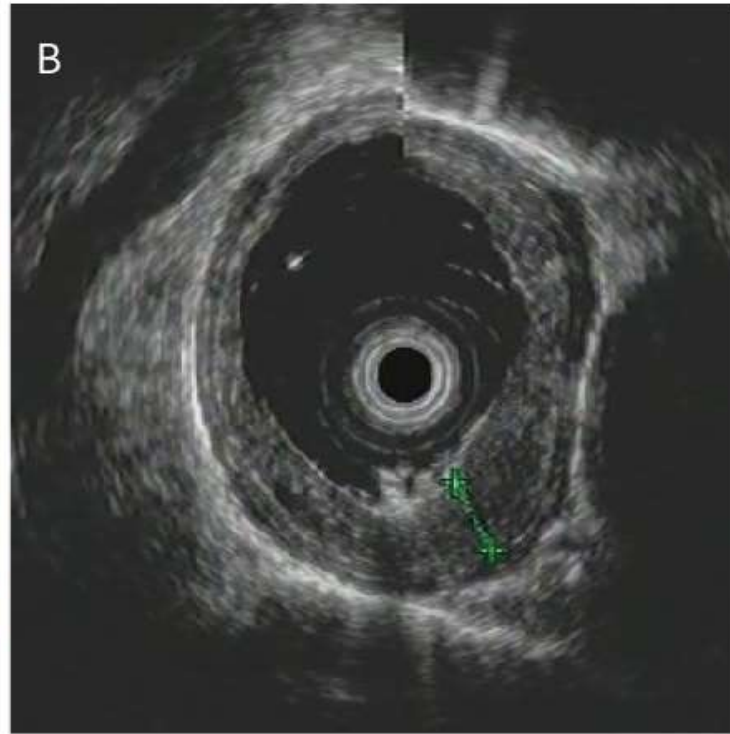
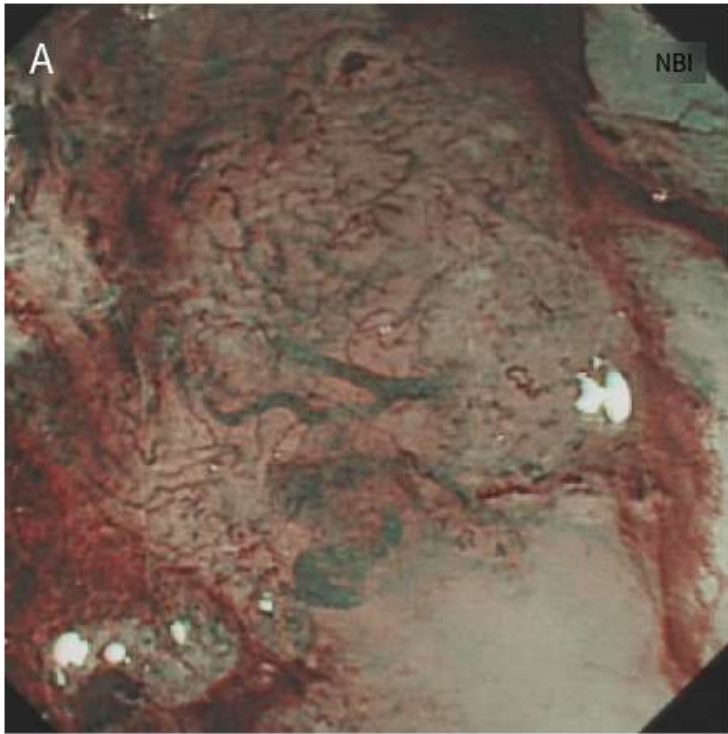
DOI: 10.4240/wjgs.v14.i9.986 Copyright ©The Author(s) 2022.

Figure 1 A typical case of carcinoma *in situ*. A: ME-BLI image shows micro-vessels with a loop-like formation (type B1); B: Ultrasonography image shows hypoechoic thickening confined to the first two layers; C: Hematoxylin-eosin staining ($\times 40$) of an endoscopic resection specimen shows that the squamous cell carcinoma is limited to the epithelium, without invasion.



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Figure 2 A typical muscularis mucosal lesion. A: ME-BLI image shows type B2 vessels without loop-like formations but with a stretched and markedly elongated transformation; B: Ultrasonography image shows a hypoechoic lesion invading the third layer with continuous submucosa; C: Hematoxylin-eosin staining ($\times 40$) of a surgical specimen shows a moderately differentiated squamous cell carcinoma invading the muscularis mucosa.

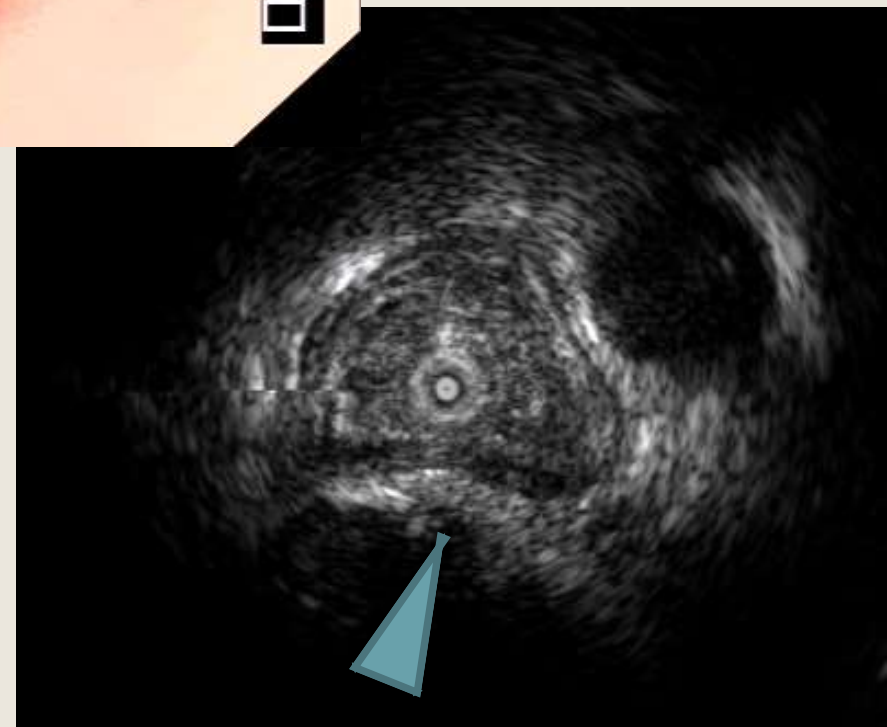
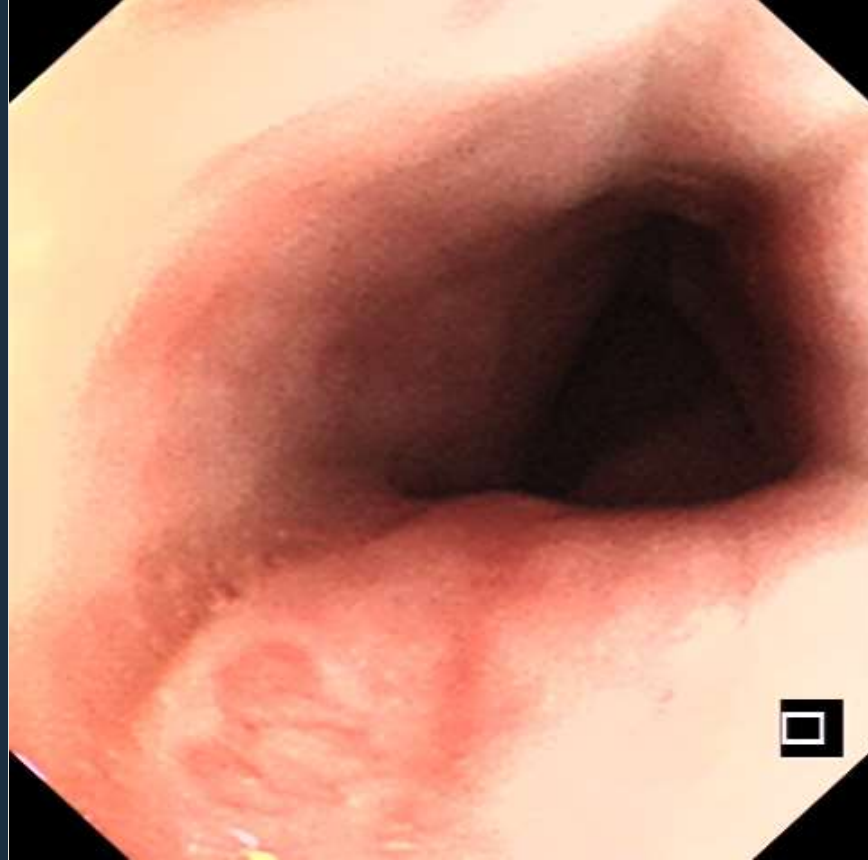


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Figure 3 A typical submucosal lesion. A: ME-NBI image shows micro-vessels dilated more than three times that of B2 vessels (type B3); B: Ultrasonography image shows a hypoechoic lesion invading the fourth layer; C: Hematoxylin-eosin staining (× 20) of a surgical specimen shows a moderately differentiated squamous cell carcinoma infiltrated to the middle third of the submucosa without muscularis propria involvement.

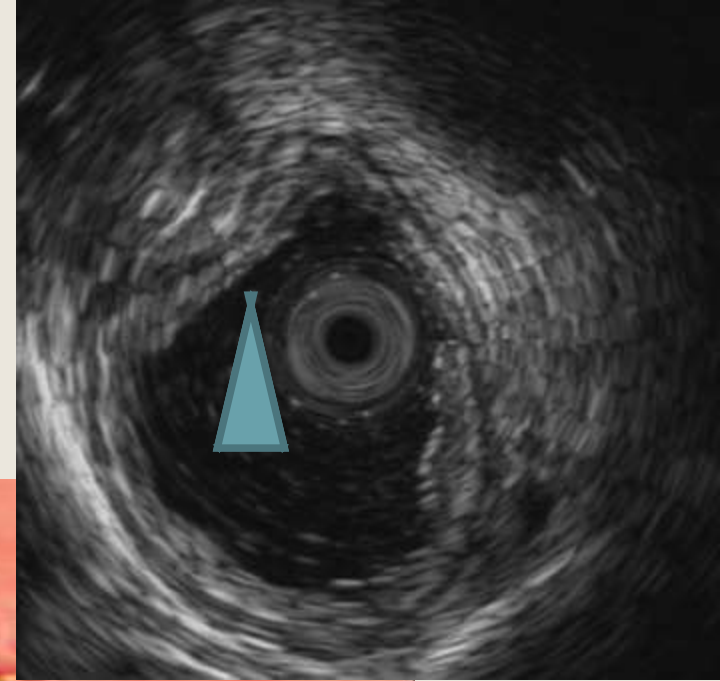
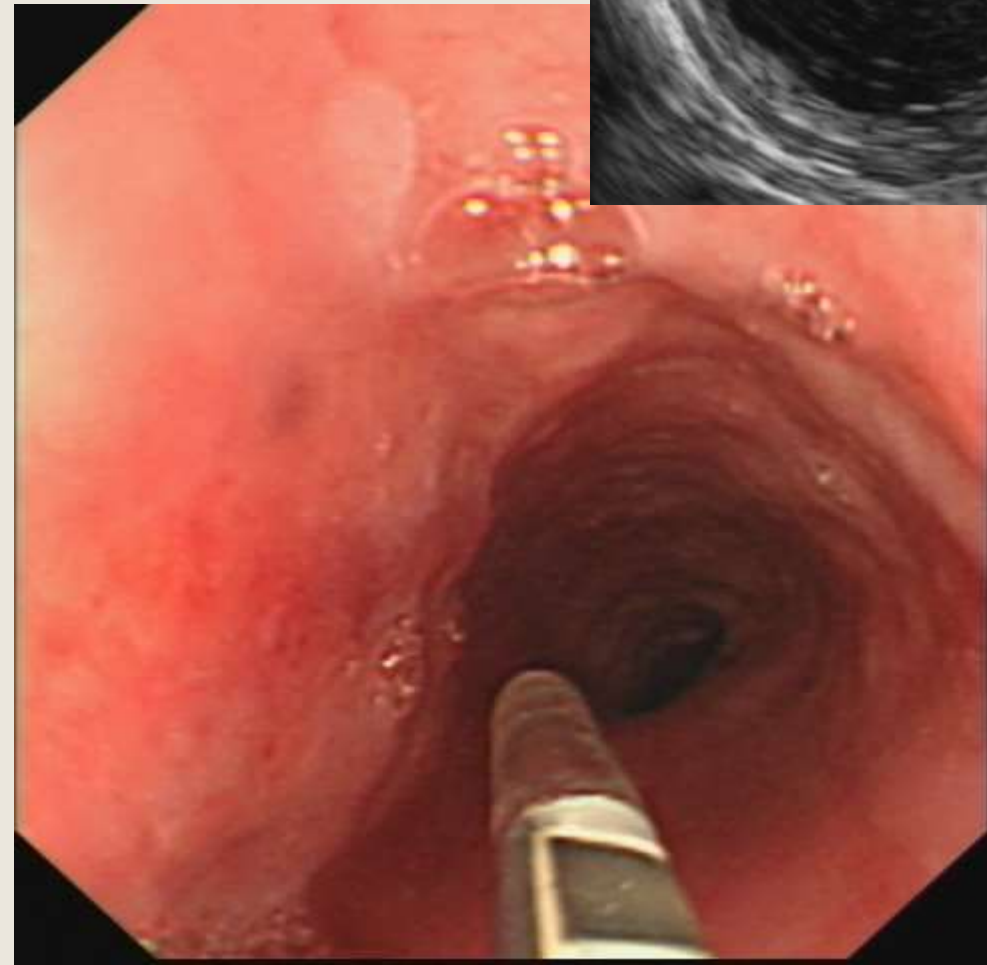
Esophageal external pressure eminence (thoracic vertebra)

- The thickness and hierarchy of the esophageal wall at the eminence are normal
- Strong arc-shaped echo sticking can be seen outside the wall of the bulge
- Arc strong echo followed by sound shadow



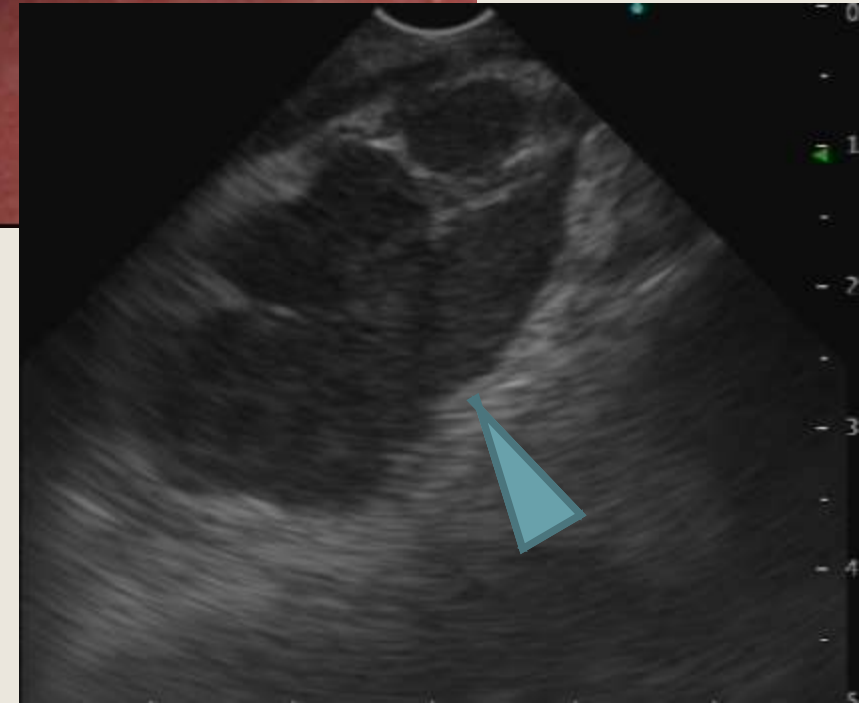
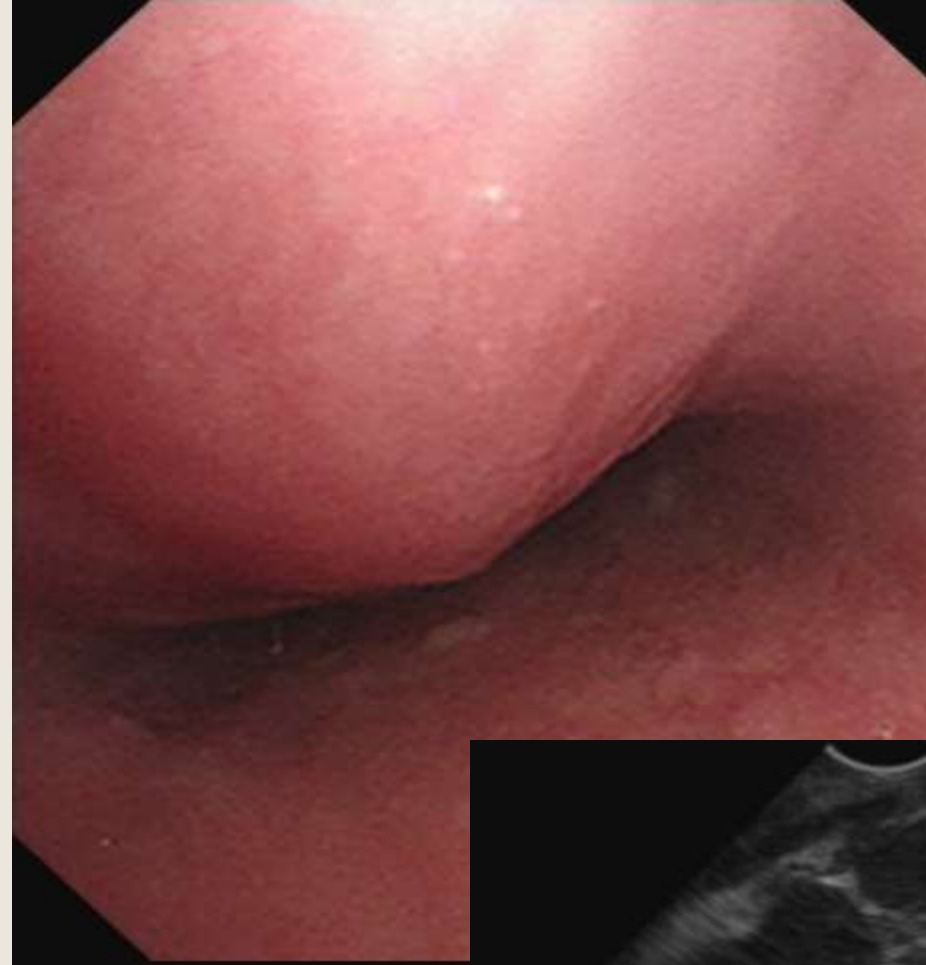
External pressure eminence of the esophagus (bronchus)

- The thickness and hierarchy of the esophageal wall at the eminence are normal
- Strong arc-shaped echo sticking can be seen outside the wall of the bulge
- Arc-shaped strong echo followed by multiple reflections (gas artifacts)



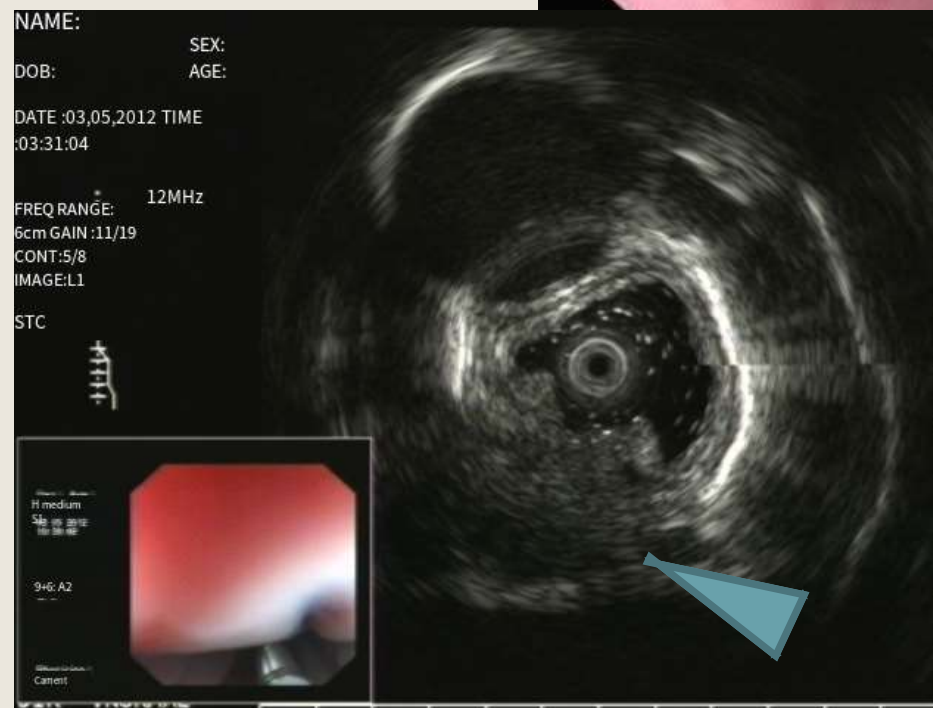
External esophageal pressure bulge (enlarged lymph nodes)

- The thickness and hierarchy of the esophageal wall at the eminence are normal
- Hypoechoic focal adhesion was visible outside the ridges
- The hypoechoic lesions are lymph nodes fused with each other



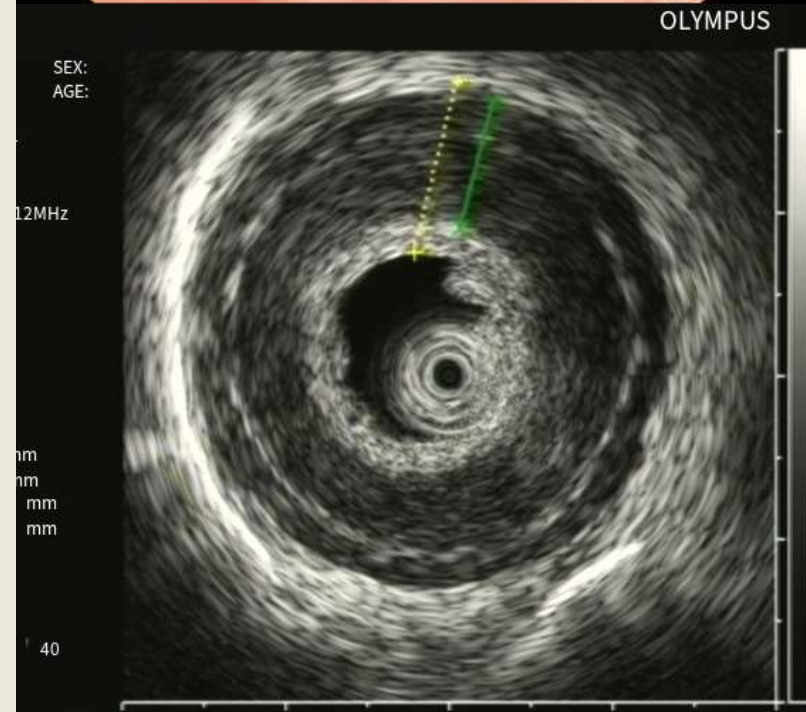
Esophageal lymph node tuberculosis

- The hierarchical structure of the esophageal wall at the uplift was destroyed
- A hypoechoic lesion was seen outside the wall of the protuberant and broke into the esophagus
- The hypoechoic lesion was integrated into the esophageal wall



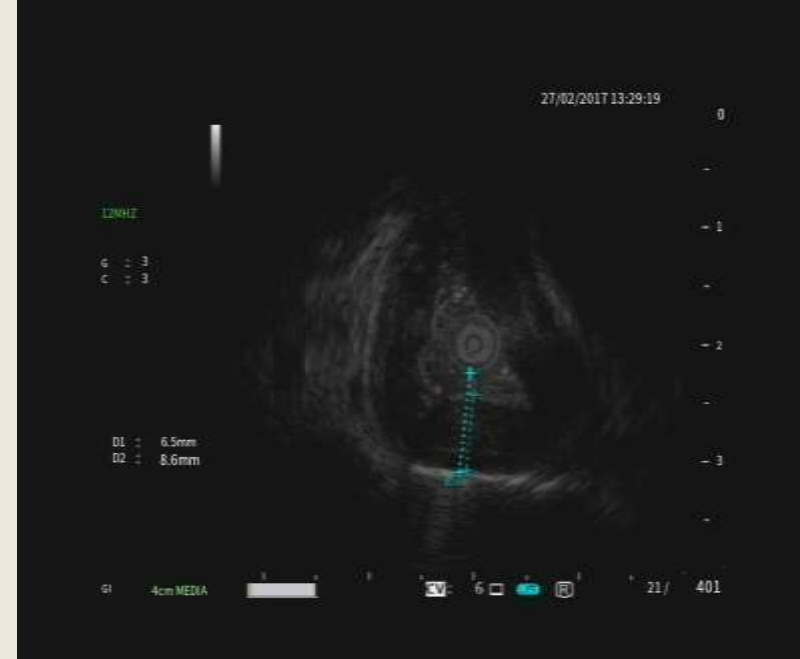
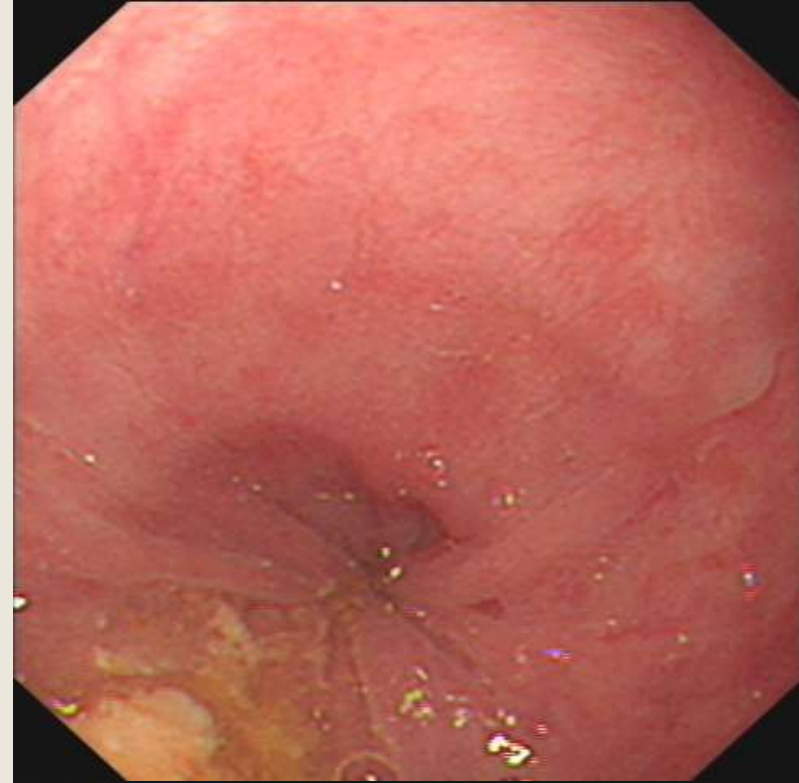
Eosinophilic esophagitis

- Diffuse, uniform thickening of the esophageal wall
- The layers of the esophageal wall were clearly distinguishable
- The thickening of muscularis propria was predominant
- The echo of the muscularis propria layer was increased and showed moderate echo



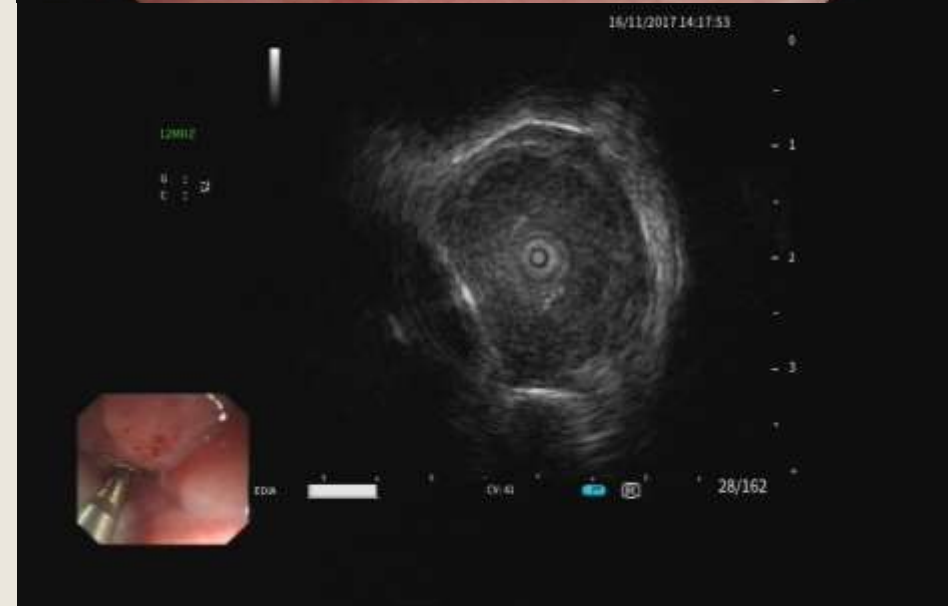
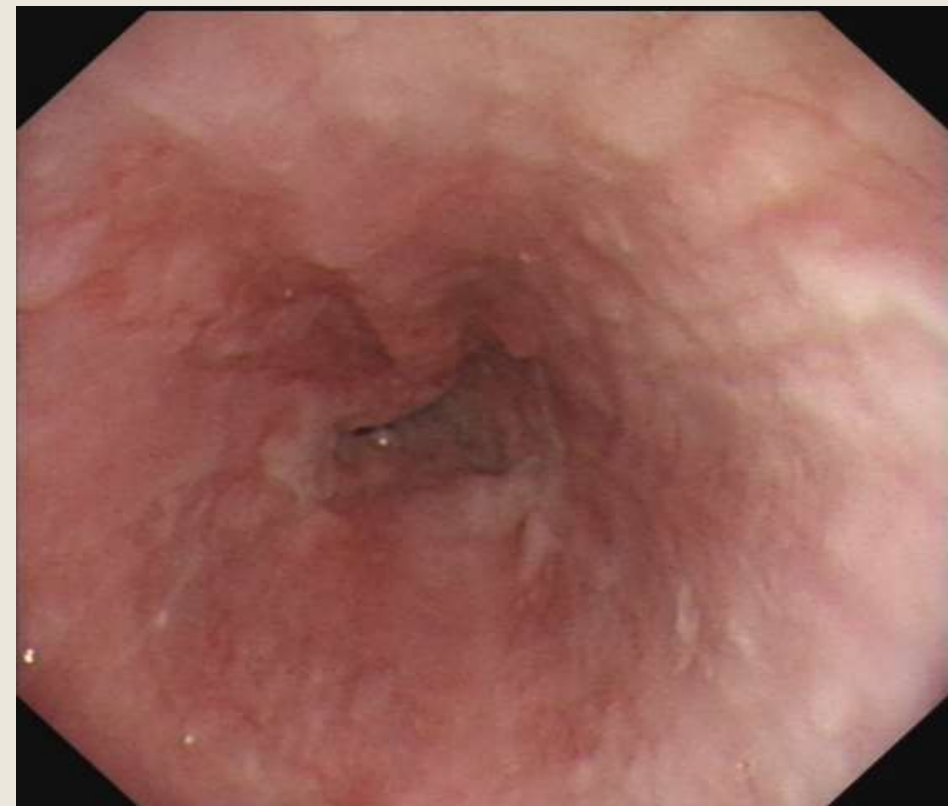
Achalasia of the cardia

- Diffuse, uniform thickening of the esophageal wall
- A hierarchical structure of the esophageal wall was present
- The muscularis propria is mainly thickened
- The muscularis propria was hypoechoic and uneven



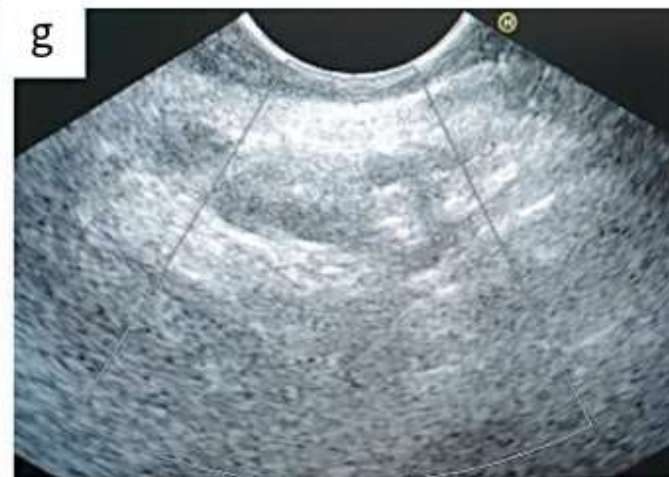
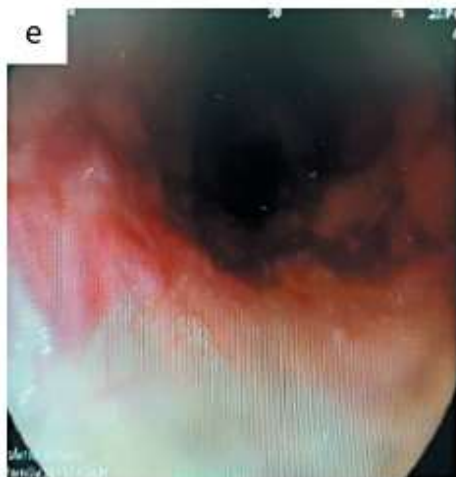
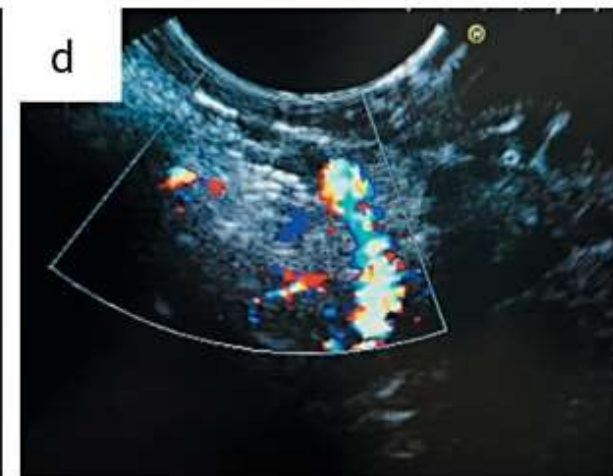
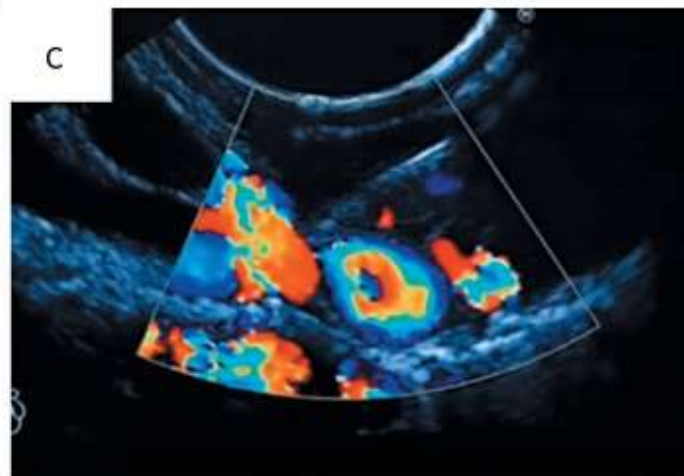
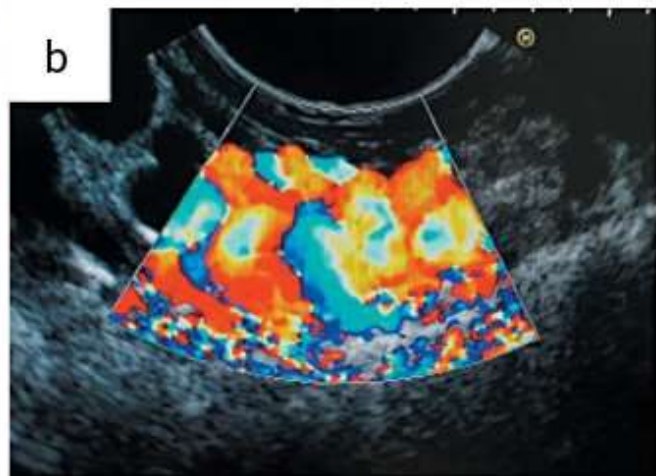
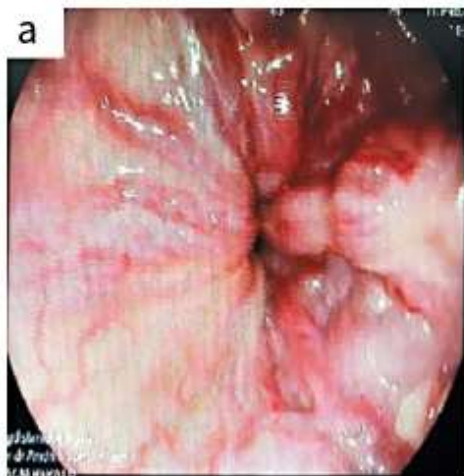
Circumferential constrictive esophageal carcinoma

- The wall of the esophagus was diffusely and uniformly thickened
- The layers of the esophageal wall were unclear and the structure disappeared
- The esophageal wall showed moderate-hypoechoic changes



The Clinical Role of Endoscopic Ultrasound for Management of Bleeding Esophageal Varices in Liver Cirrhosis

Case Rep Gastroenterol 2022;16:295-300



EUS in gastric diseases

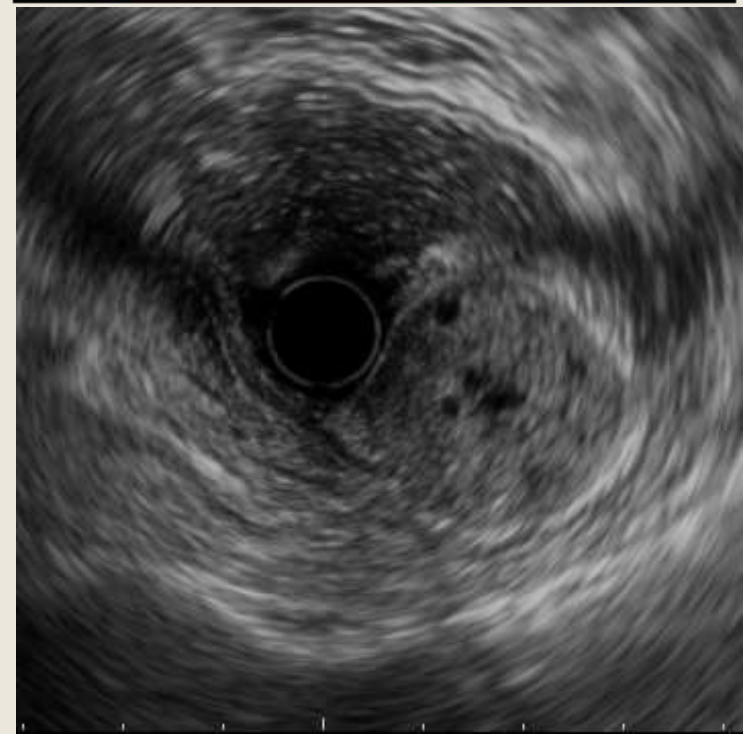
Gastric submucosal lesions

- A wide variety
- The sonograms were similar
- Different diseases are the same picture
- Difficulty in identification
- Different in nature
- Different prognosis

- GIST
- Leiomyoma
- Neurilemmoma
- Neuroendocrine tumors
- Ectopic pancreas
- Lipoma
- Calcifying fibroma
- Inflammatory fibroid polyp
- Foreign body granuloma
- Gastritis cystica profunda
- Glomus tumor
- Hemangioma
- Metastatic tumors
- Cysts
- Isolated varicose veins
- ...

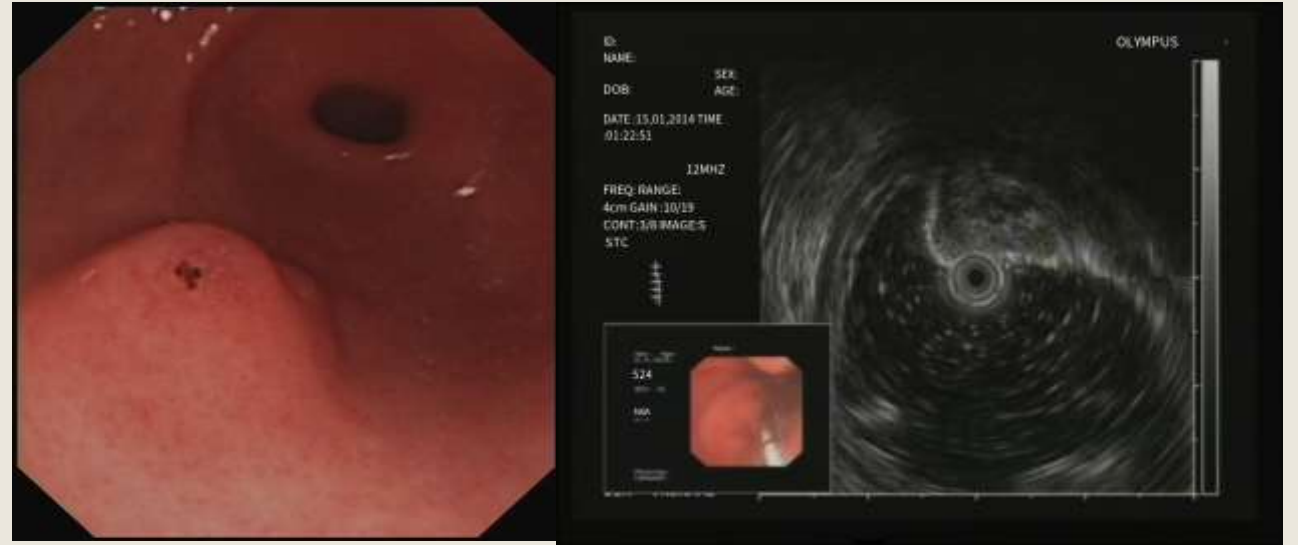
Gastric GIST

- Derived from the muscularis propria or submucosa
- Round or oval hypoechoic
- The internal echo is homogeneous or heterogeneous



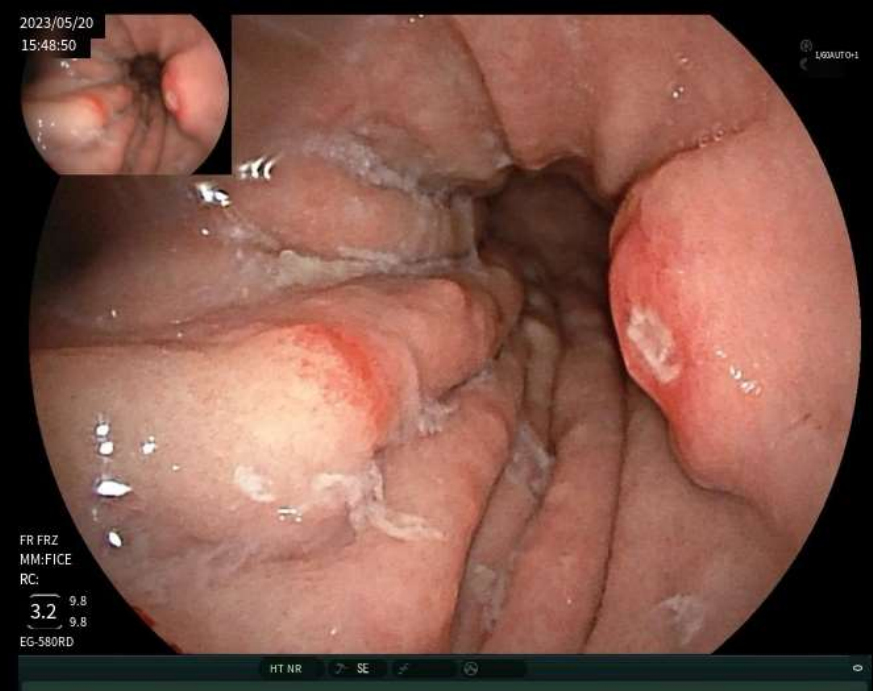
Ectopic pancreas in the stomach

- Multi-level involvement (mainly submucosa, can invade both mucosa and muscularis propria)
- Hypoechoic, homogeneous or heterogeneous
- There may be lumen-like structures inside



Gastric neuroendocrine tumors

- Solitary or multiple
- Originating from deep mucosa (can accumulate submucosa, muscularis propria)
- Moderately to hypoechoic, generally homogeneous
- Rich internal blood supply



EUS-FNA of gastric submucosal lesions

- The success rate of biopsy and pathological diagnosis of submucosal lesions by EUS-FNA are not ideal.
- In a prospective multicenter clinical study, 46 cases of gastric submucosal lesions were treated with EUS-FNA using a crude 19G tube. Based on the combined cytological, histological and immunohistochemical results, only 24 cases (52.2%) obtained definite pathological diagnosis, and 3 cases (6.5%) had inconclusive pathological results. Nineteen cases (41.3%) had no diagnostic results.



A combined radiomic model distinguishing GISTs from leiomyomas and schwannomas in the stomach based on endoscopic ultrasonography images



FIGURE 2 ROI segmentation for radiomic analysis: (a) original EUS image; (b) segmentation of tumor region; and (c) segmentation of tumor region and muscularis propria region (arrow). EUS, endoscopic ultrasonography; ROI, region of interest.

A combined radiomic model distinguishing GISTs from leiomyomas and schwannomas in the stomach based on endoscopic ultrasonography images


Xian-Da Zhang¹Ling Zhang¹ Ting-Ting Gong¹
 Zhuo-Ran Wang² Jin Ding⁵ |
 Kang-Li Guo³ | Jun Li⁴ | Yuan Chen⁵ | Jian-Tao Zhang⁶ | Ben-Gong Ye⁶ |
 | Jian-Wei Zhu³ Feng Liu⁴ | Duan-Min Hu³ | JianGang Chen² |
 Chun-Hua Zhou¹  | Duo-Wu Zou¹⁰

TABLE 2 Selected radiomic features for the conventional radiomic model and combined radiomic model.

Model	Selected radiomic features	Numbers
Conventional radiomic model	Gray-level emphasis, gray-level run emphasis, contrast, skewness, kurtosis, mean	6
Combined radiomic model	GLCM_IMC1, gray-level emphasis, GLCM_MCC, energy, skewness, strength, kurtosis, busyness	8

Abbreviations: GLCM, gray-level co-occurrence matrix; IMC, informational measure of correlation; MCC, maximal correlation coefficient

TABLE 3 Diagnostic performance of the conventional radiomic model and combined radiomic model in the testing dataset.

Model	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	AUC (95% CI)
Conventional radiomic model	74.4	81.0	87.5	63.9	76.8	0.830 (0.801-0.862)
Combined radiomic model	91.0 ***	90.6 ***	94.6	84.9	90.9	0.953 (0.933-0.976)

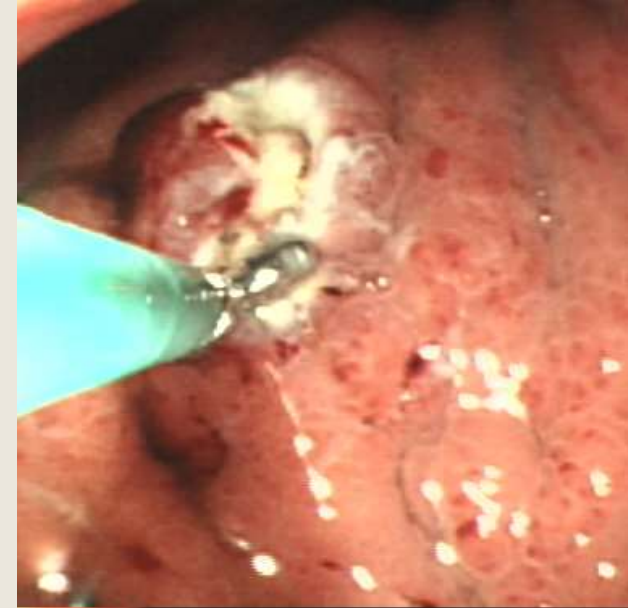
Sensitivity and specificity of the conventional radiomic model and combined radiomic model were compared.

Abbreviations: AUC, area under the curve; NPV, negative predictive value; PPV, positive predictive value.

***p< 0.001.

Diffuse thickening of the gastric wall (leather stomach/lymphoma)

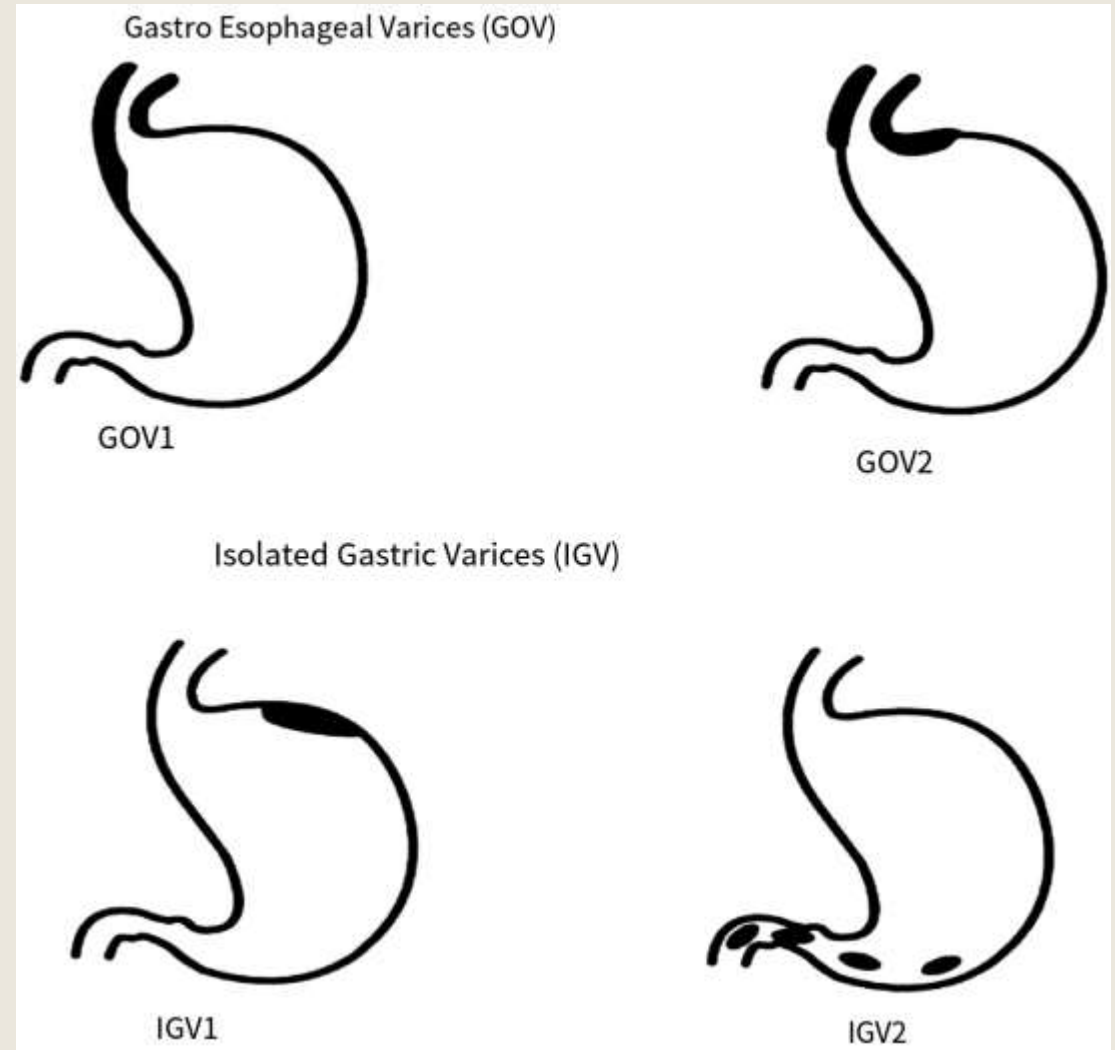
- The diagnostic accuracy of EUS-FNA was 60%
- Deep biopsy is recommended when conventional biopsy fails



Gastric Varices

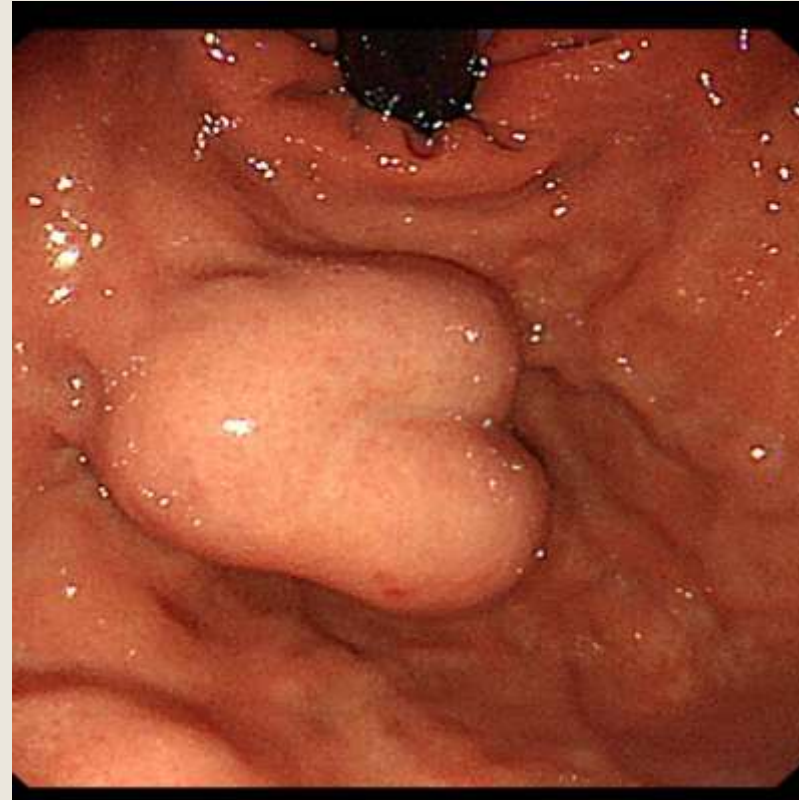
Sarin Classification

- GVs are categorized into 4 types based on the relationship with EV, as well as by their location in the stomach
- Gastroesophageal Varices (GOV) type 1, and GOV type 2;
- isolated gastric varix (IGV) type 1 , and IGV type 2 .



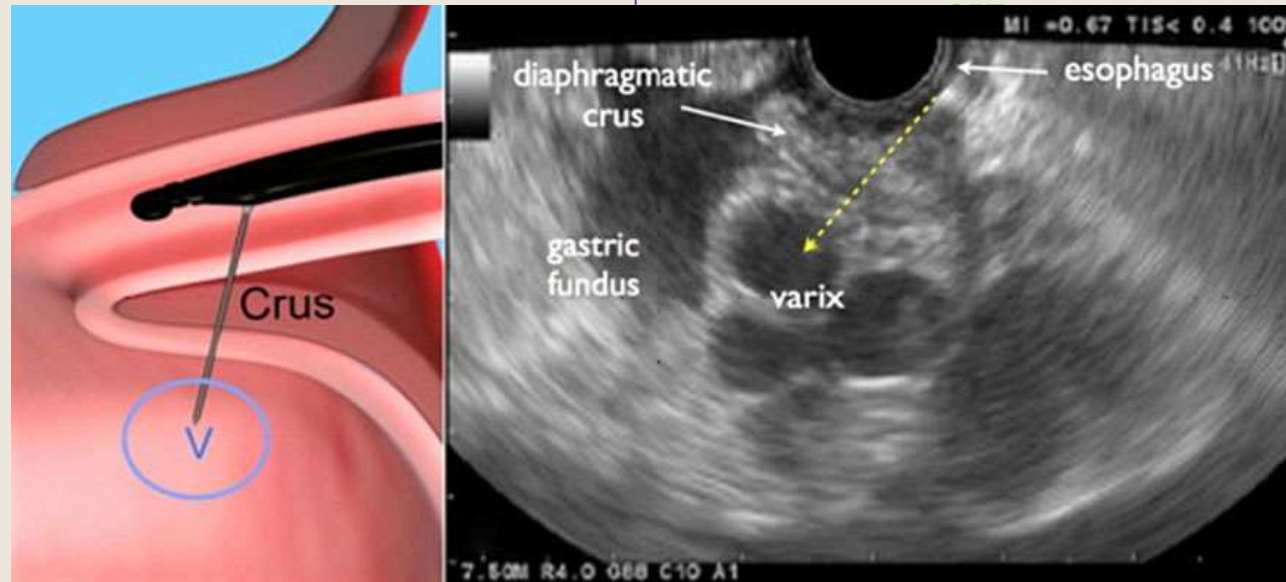
IGV1

- GOV type 1 is the most common type. But, **the incidence of bleeding is highest with IGV type 1** followed by GOV type 2.
- And **the venous drainage of IGV1 is different** from GOV type1 and GOV type 2.



EUS-guided Access for IGV1

Gastrointest. Endosc. 2013; 77: 846–



The coils can be placed into varices via EUS guided approach. IGV1 is usually in the gastric fundus, so the puncture needle would traverse the angle of His in order to reach the target from the lower esophagus.

Structure of Coil

Glue *immediately* adheres to the coil fibers when a coil is immersed into blood of varix.



[Surgical Endoscopy](#), 2016,
Volume 30, 1396–1404

Treatment of giant gastric varices with gastrorenal shunt by EUS coil placement combined with glue injection (Case 1)

Huge varicose veins in the gastric fundus



Six months after EUS interventional therapy



Treatment of giant gastric varices with gastrorenal shunt by EUS coil placement combined with glue injection (Case 2)

Large varicose veins in the gastric fundus

Postoperative discharge of glue ulcer formation

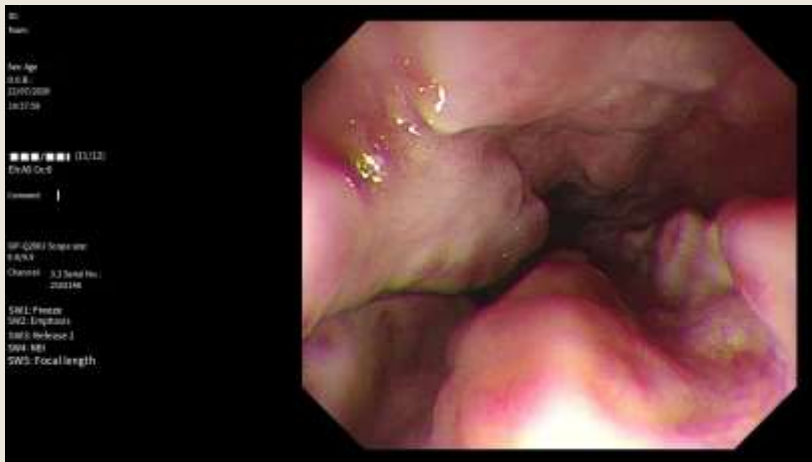
The coil-glue block was discharged



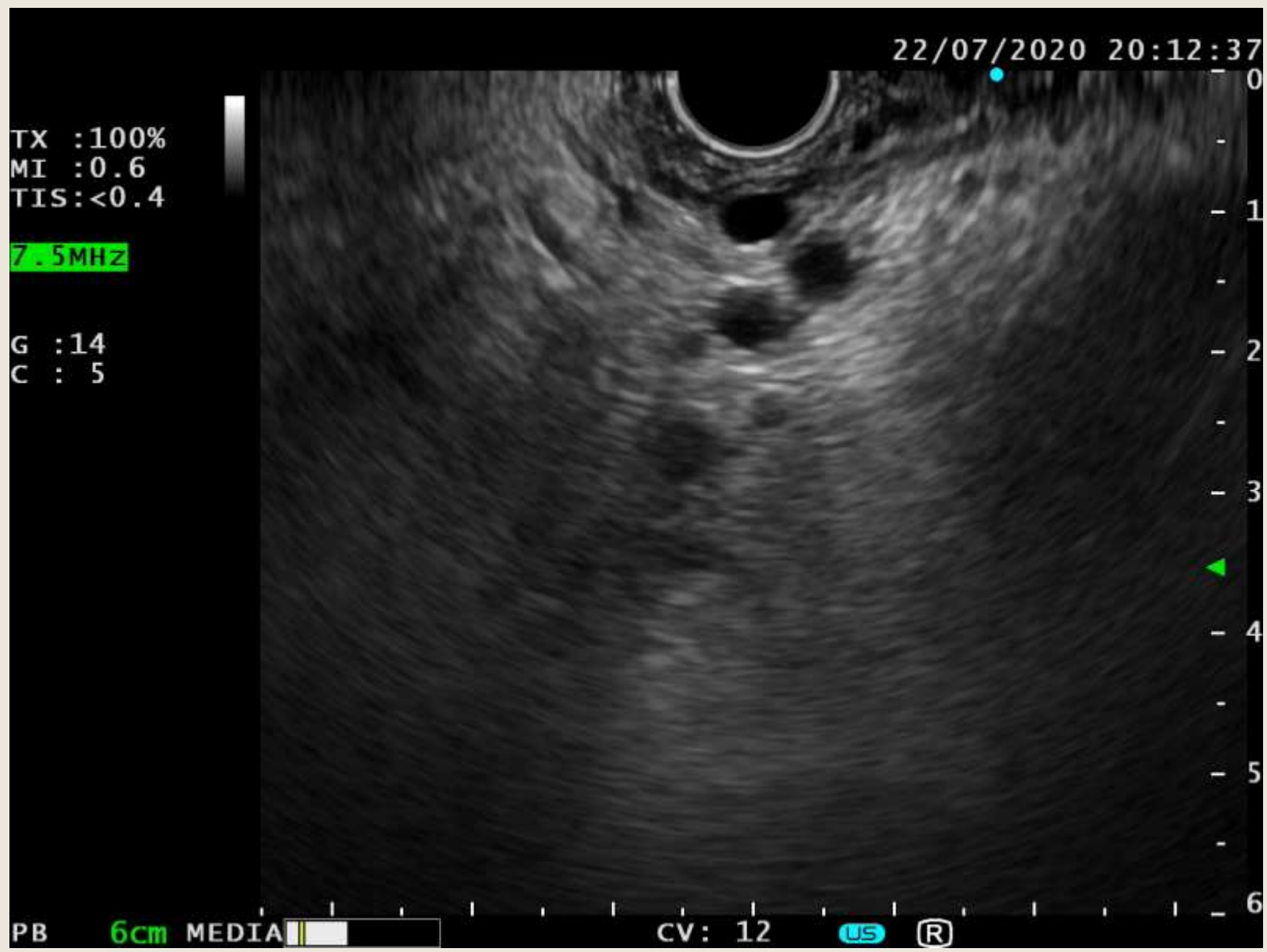
EUS-SVD

- Eus-guided Selective Varices Devascularization (EUS-SVD) is the precise puncture of esophageal, gastric or ectopic varices from the direction of the source vessels under the real-time guidance of EUS. It is a new endoscopic treatment technology to block the lumen and blood flow of esophageal varices by injecting sclerosing agents, glue and/or inserting coils.
- Compared with EVO, EUS-SVD has the advantages of more intuitive operation, high efficiency, safety and economy.

GOV before EUS-SVD



EUS-SVD



EUS Diagnosis of Protruding Duodenal Lesions

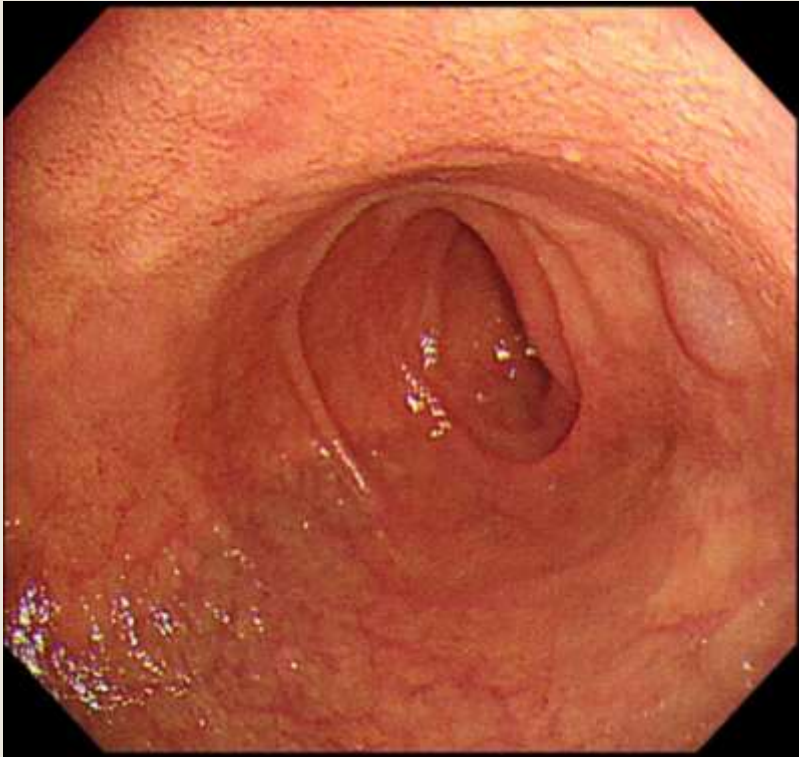
Echo of lesion	Lesion type	Layer of origins	EUS feature
Anechoic	Brunner gland cyst	The 3 rd layer (Submucosal layer)	Posterior wall enhancement
	Variceal	The 3 rd layer (Submucosal layer)	Traceable vascular structure, Doppler shows blood flow
	Lymphangioma	The 3 rd layer (Submucosal layer)	Often multilocular, no blood flow, easy to deform under pressure
	Cavernous hemangioma	The 3 rd layer (Submucosal layer)	Polycystic, may have blood flow on Doppler

Echo of lesion	Lesion type	Layer of origins	EUS feature
hypoechoic	GIST	The 4 th layer	Clear boundary, Homogeneous echo
	Neuroendocrine tumors	The 2 nd layer, may involve the 3 rd layer	"pepper-salt" form of the inner structure, with smooth boundaries. Rich blood flow inside the lesion.
	Schwannoma	The 4 th layer	Clear boundary, Homogeneous echo
	Metastasis	Any layer	
	lymphoma	The 2 nd or 3 rd layer, may involve the 4 th layer	No clear boundary

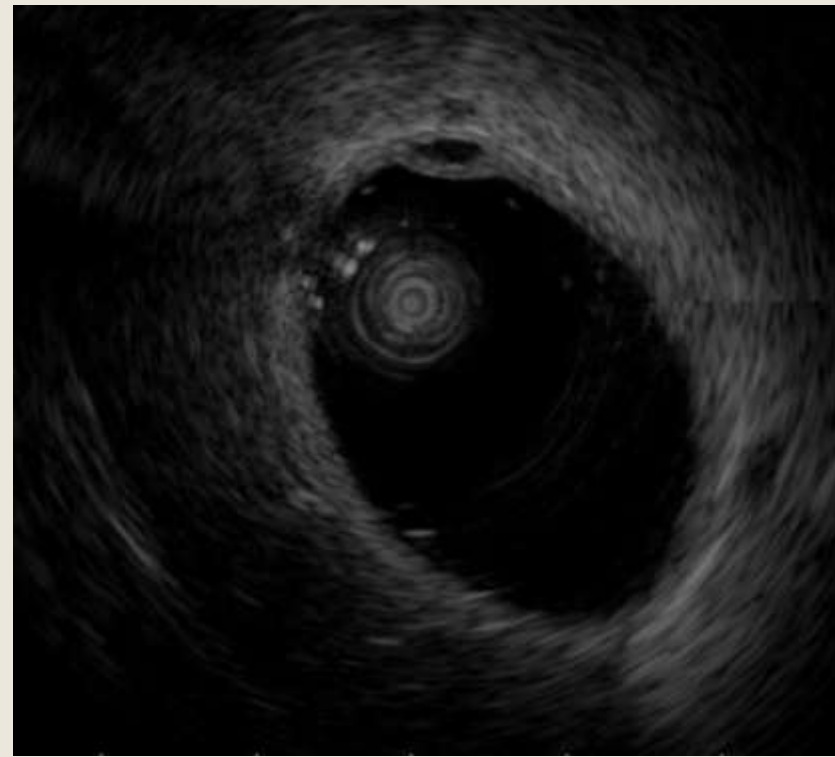
Echo of lesion	Lesion type	Layer of origins	EUS feature
hyperechoic	lipoma	The 3 rd layer (Submucosal layer)	Homogeneous echo with rear echo attenuation
	Brunner adenoma	The 2 nd and 3 rd layer	Clear boundary, Homogeneous echo

Echo of lesion	Lesion type	Layer of origins	EUS feature
Mixed echo	heterotopic pancreas	The 3 rd layer (Submucosal layer) May involve the muscularis propria	Heterogeneous echo May have glandular structures, may have cystic dilatation due to pancreatic fluid retention
	Brunner Cystadenoma	The 2 nd and 3 rd layer	Clear boundary, Homogeneous echo May have cystic structure inside

Cyst

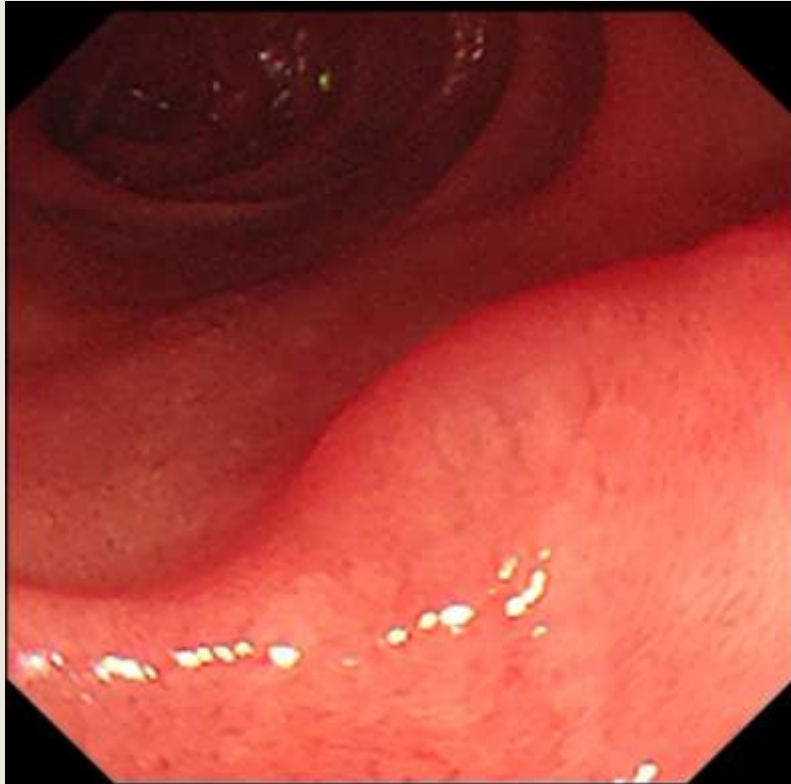


Submucosal protrusion on the posterior wall of the bulb, translucent cystic lesion

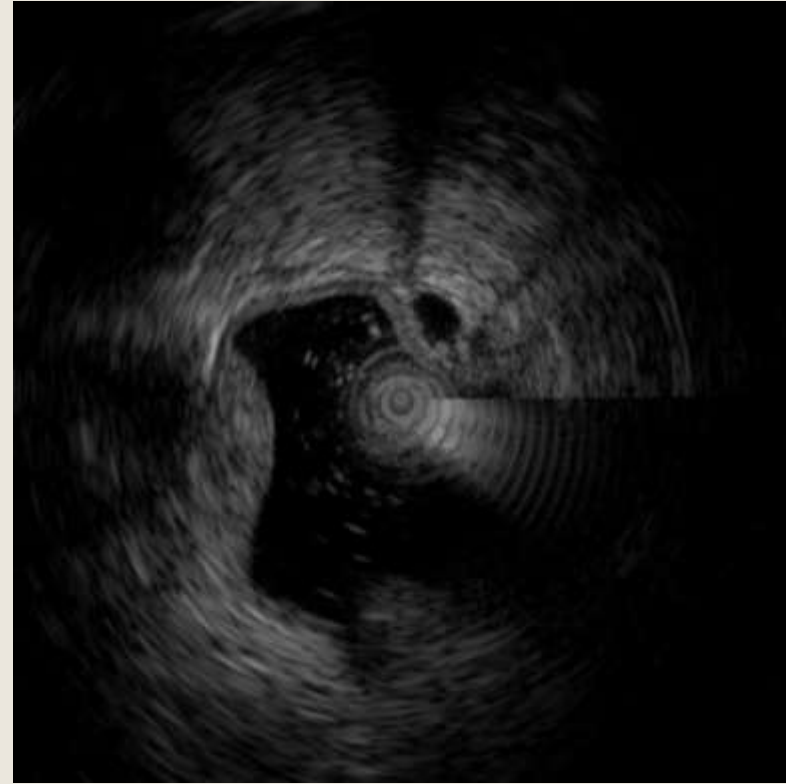


The submucosa is anechoic with clear boundary

Cyst

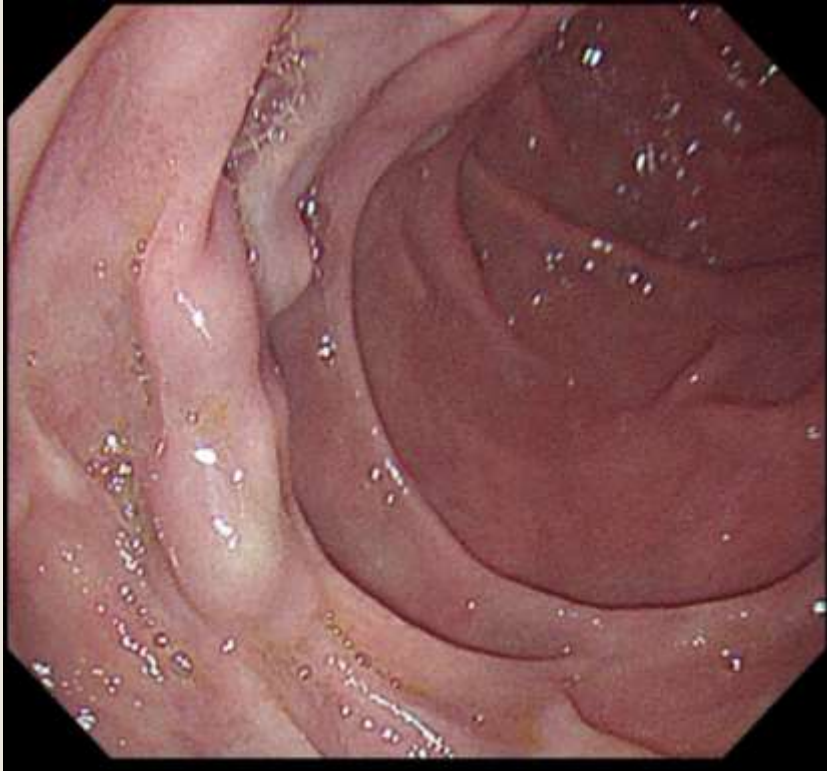


Submucosal protrusion on the opposite side of the papilla of the descending duodenum, with smooth mucosal surface

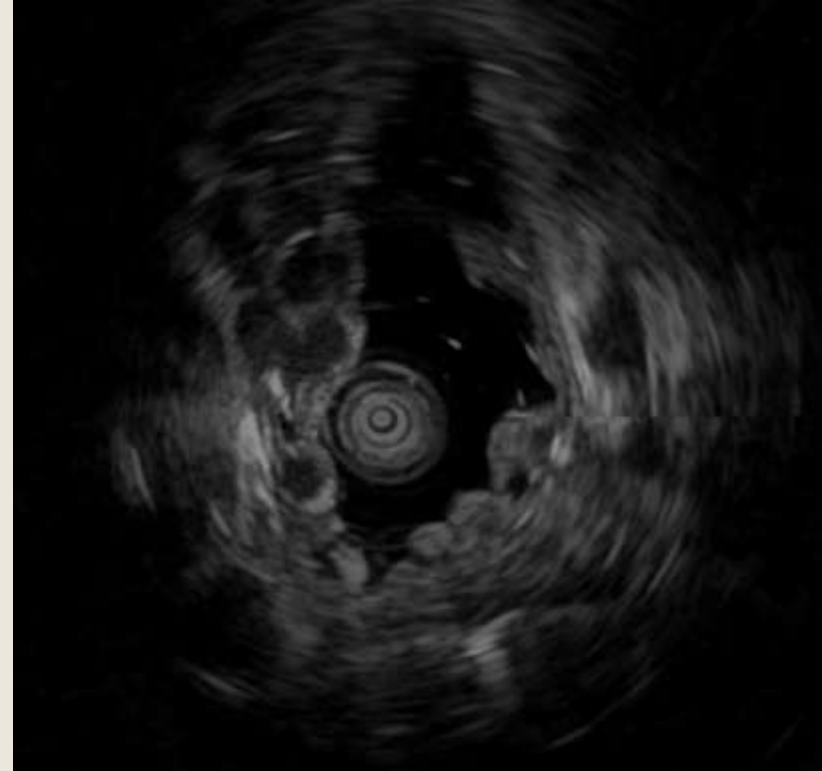


Submucosal anechoic lesion with rear enhancement.
Clear boundary

Variceal



Submucosal gourd-shaped protrusion near the papilla of the descending duodenum, with smooth mucosal surface

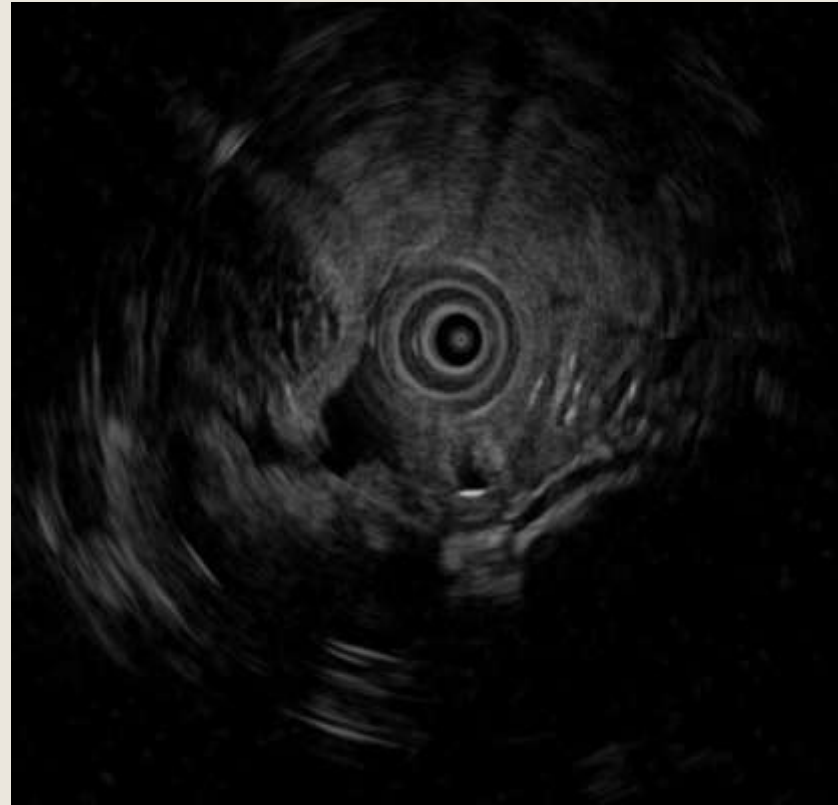


Submucosal anechoic luminal structure, part of which is tortuous and clustered

Lymphatic dilation

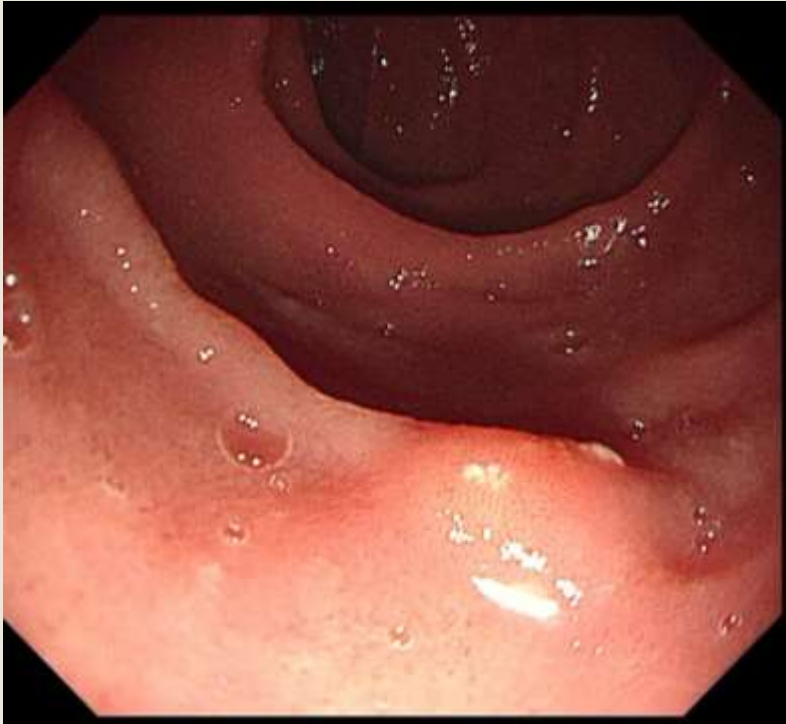


Submucosal protrusion with white spots on the surface

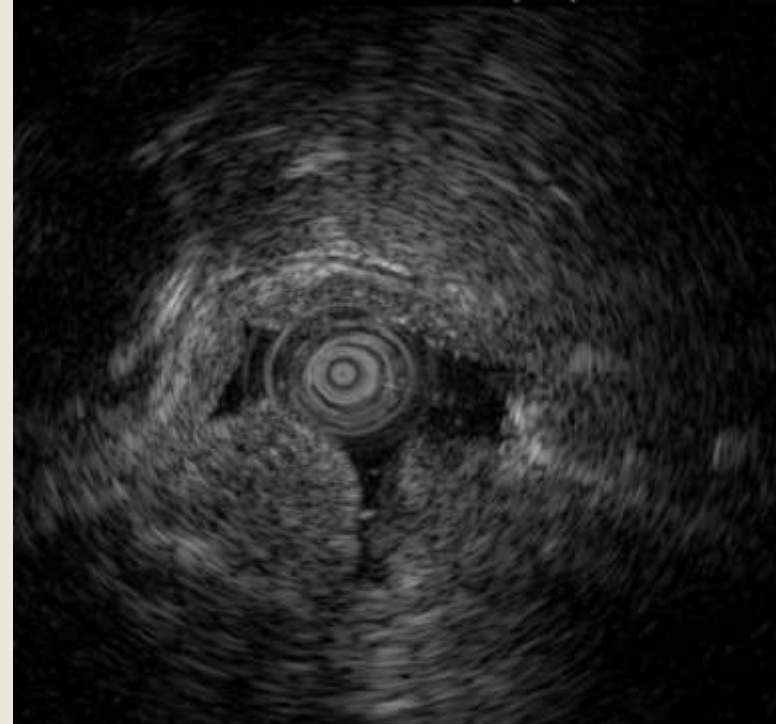


Submucosal hypoechoic lesion with tubular structure inside

Lymphatic dilation



Submucosal protrusion with white spots on the surface

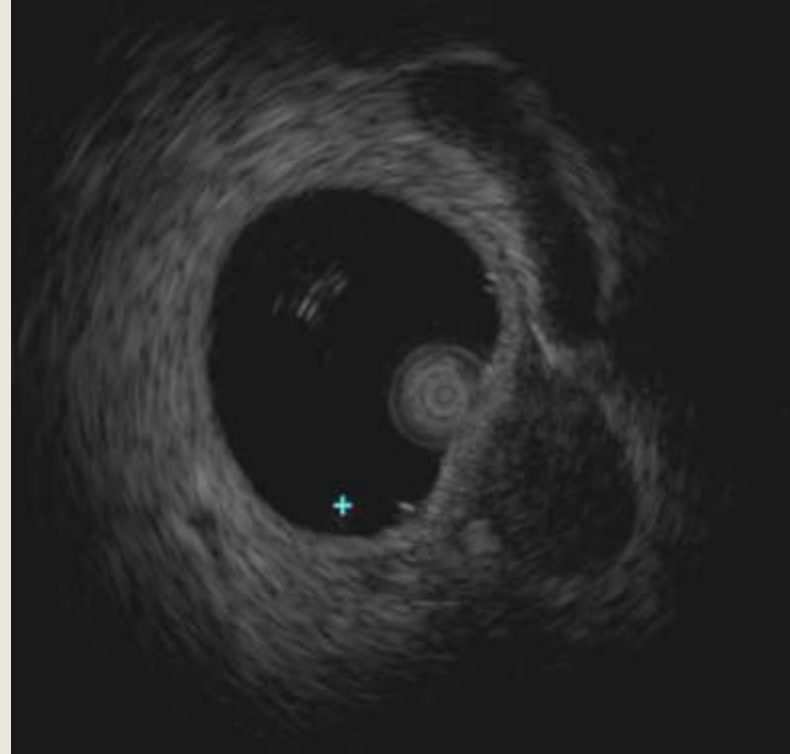


Moderate to low echo in the submucosa
With honeycombed structure inside

Stromal tumor

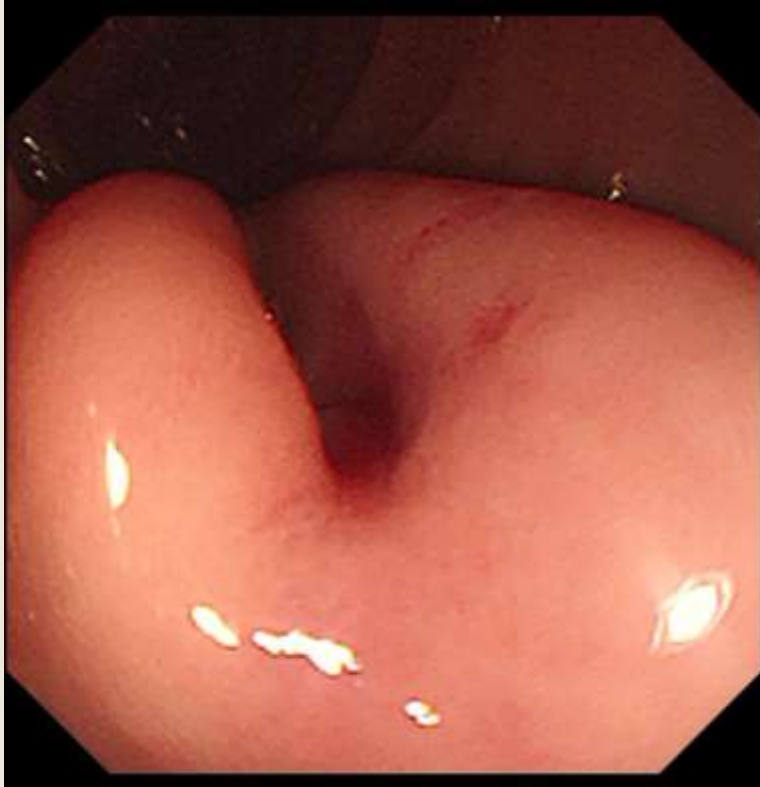


Protruding lesion on the greater curvature of the bulb , with smooth mucosal surface

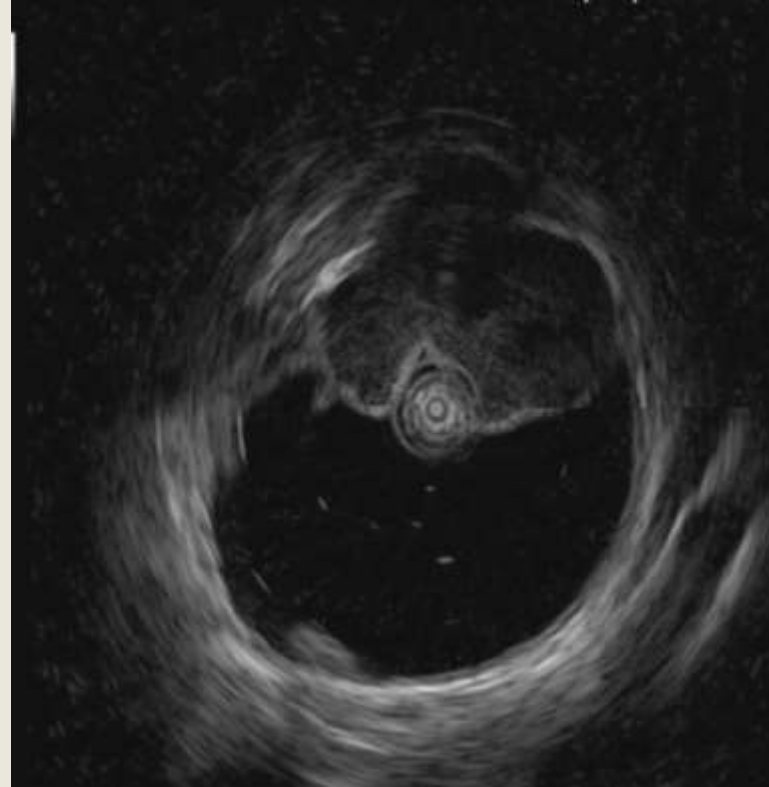


Hypoechoic mass originating from the muscularis propria
Less homogeneous internal echo
Well-defined boundaries
Extraluminal growth

Stromal tumor

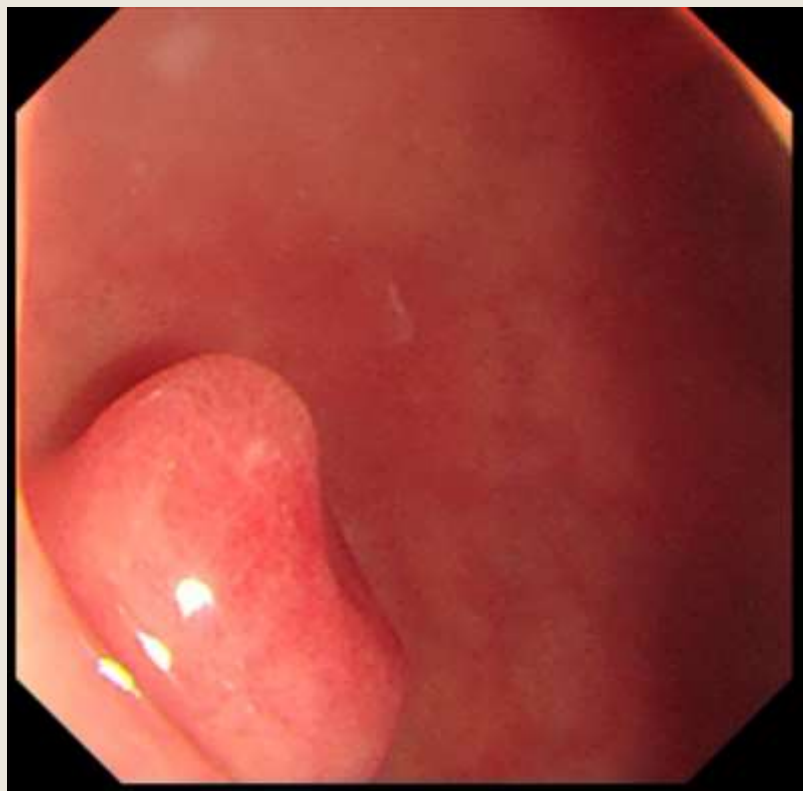


Irregular submucosal protrusion in descending duodenum with central depression

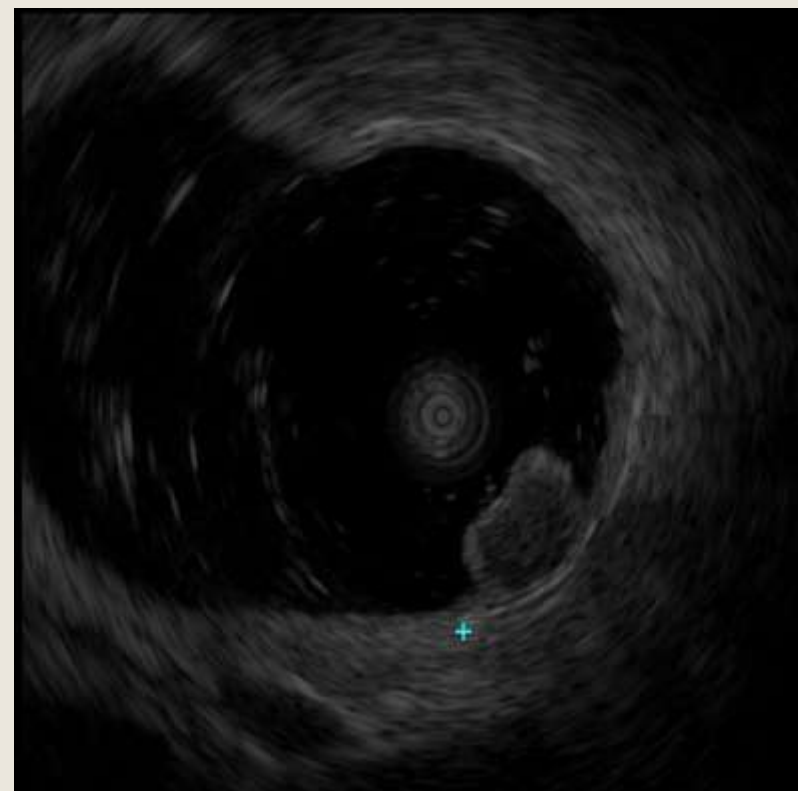


Originating from the muscularis propria
Lobulated, less homogeneous internally
With clear boundaries

Neuroendocrine tumor



Polypoid protrusion on the greater curvature of the anterior wall of the bulb, with hyperemia on the surface and a slight depression

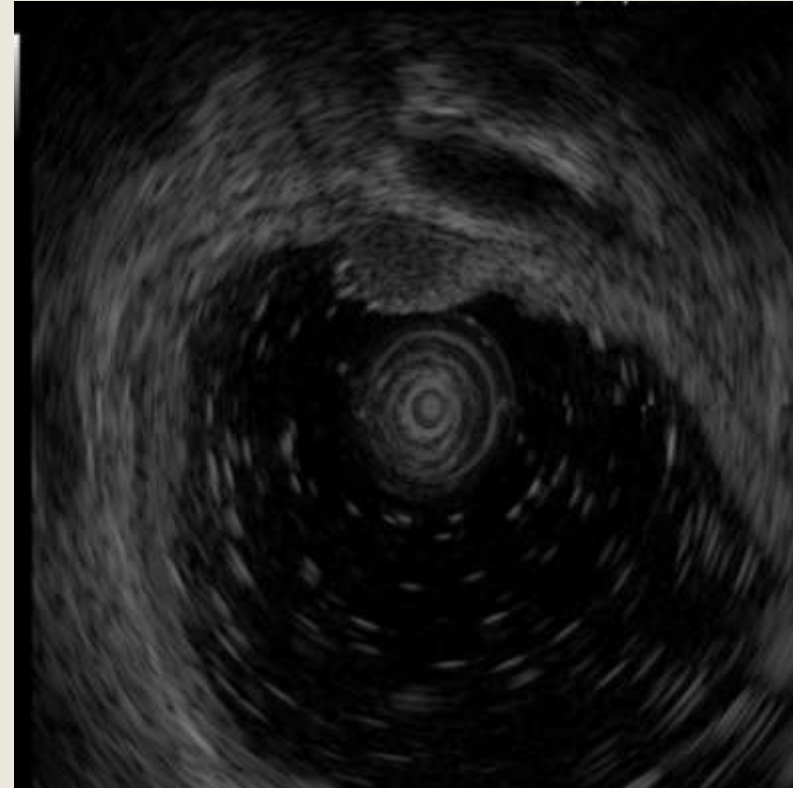


Hypoechoic mass originating in the 2nd layer
Well-defined borders

Neuroendocrine tumor

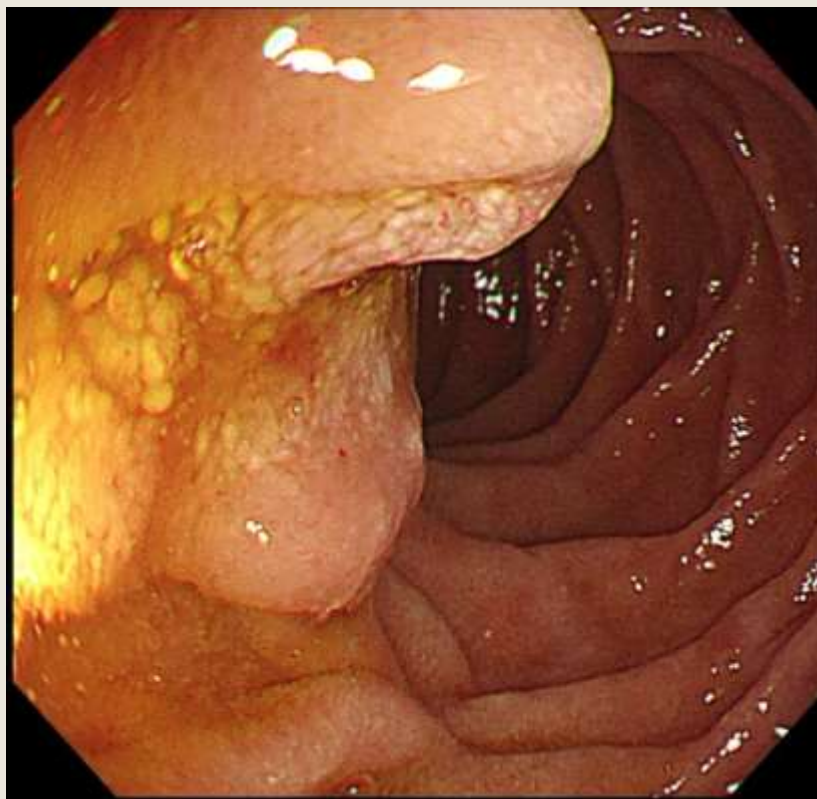


Submucosal protrusion of the anterior wall of bulb, which near the antrum
With smooth mucosal surface

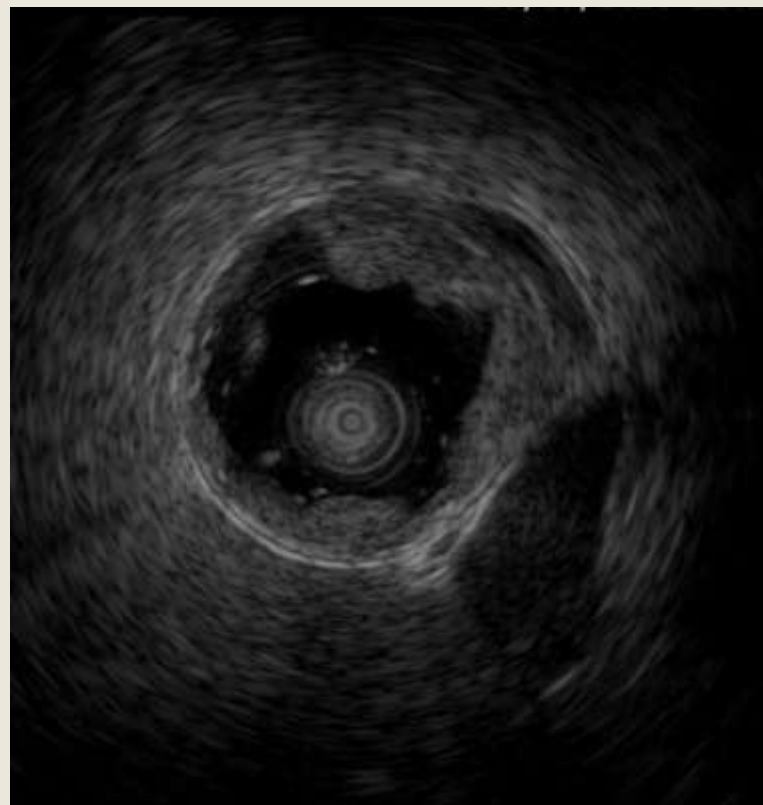


Hypoechoic mass originating in the 2nd layer and involving the 3rd layer

Follicular lymphoma



Disc-shaped protrusion in the descending part, coarse villi can be seen on the surface

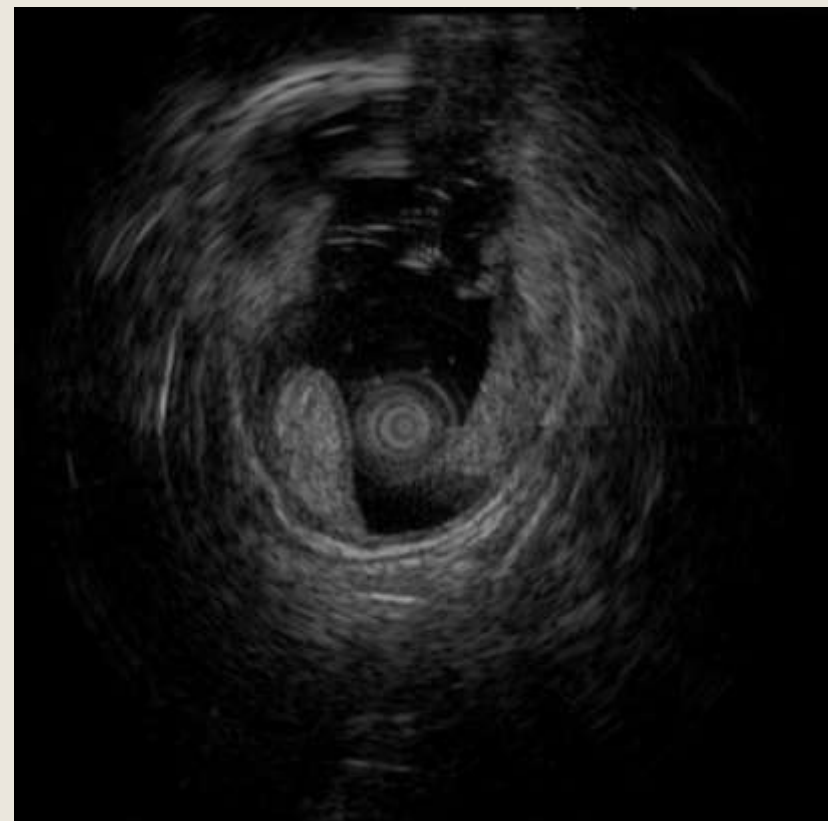


Hypoechoic thickening of local mucosa and submucosa

Lipoma

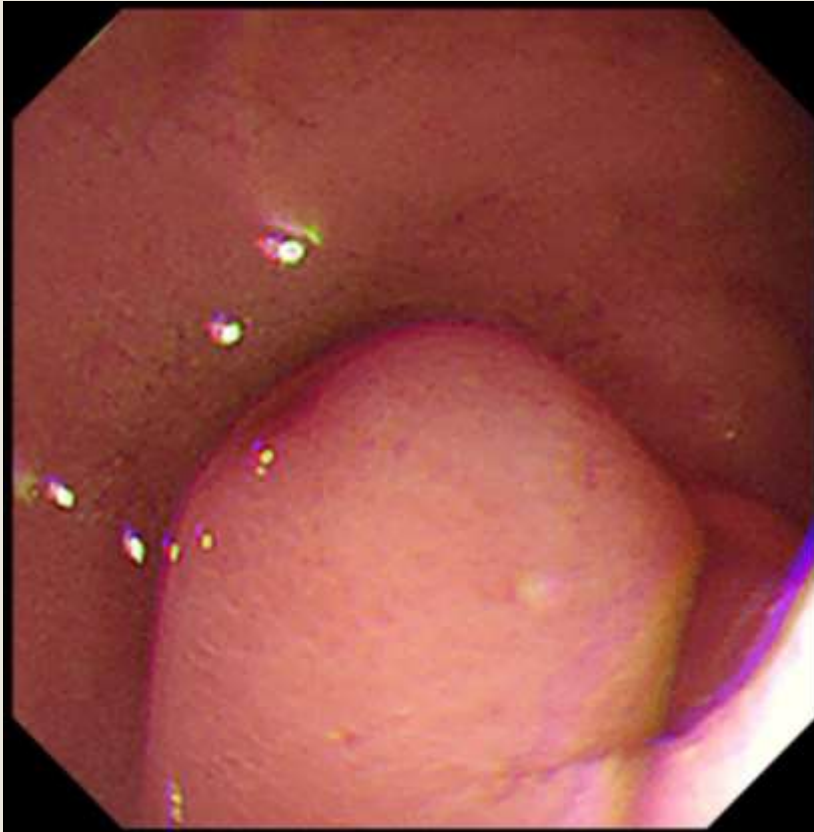


Submucosal protrusion in descending duodenum with a smooth surface and soft texture

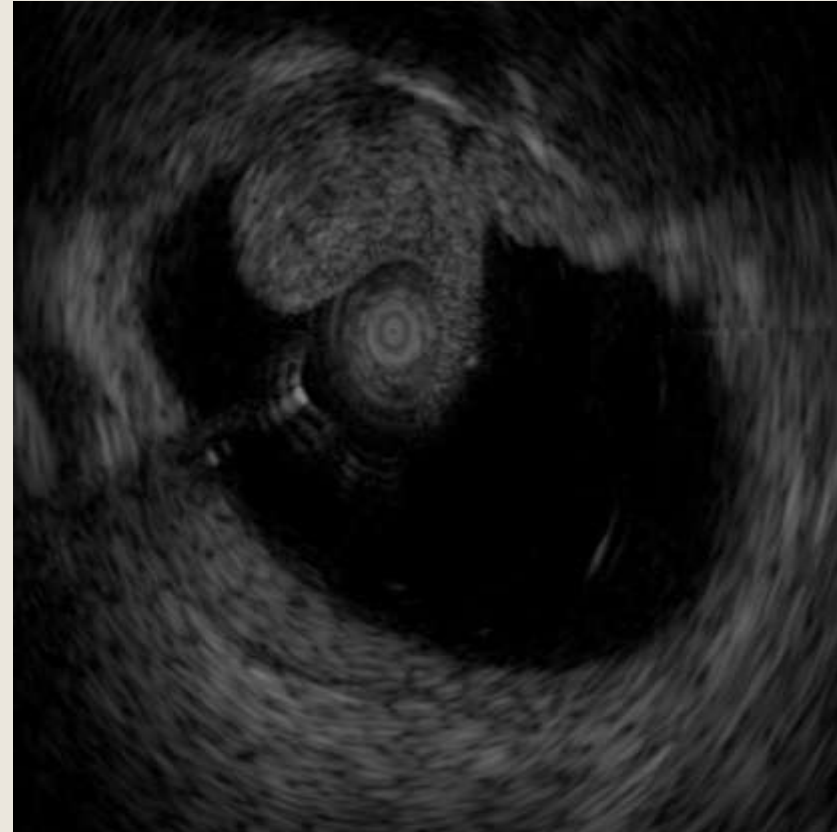


Hyperechoic submucosal mass with homogeneous echo and clear boundary

Brunner adenoma

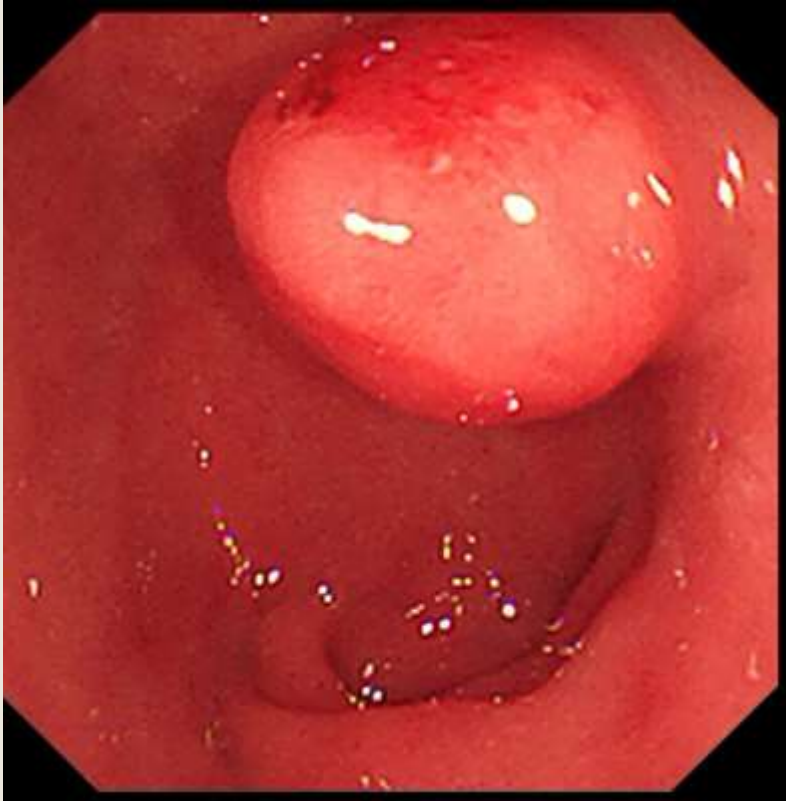


Protrusion on the greater curvature of the bulb with smooth surface

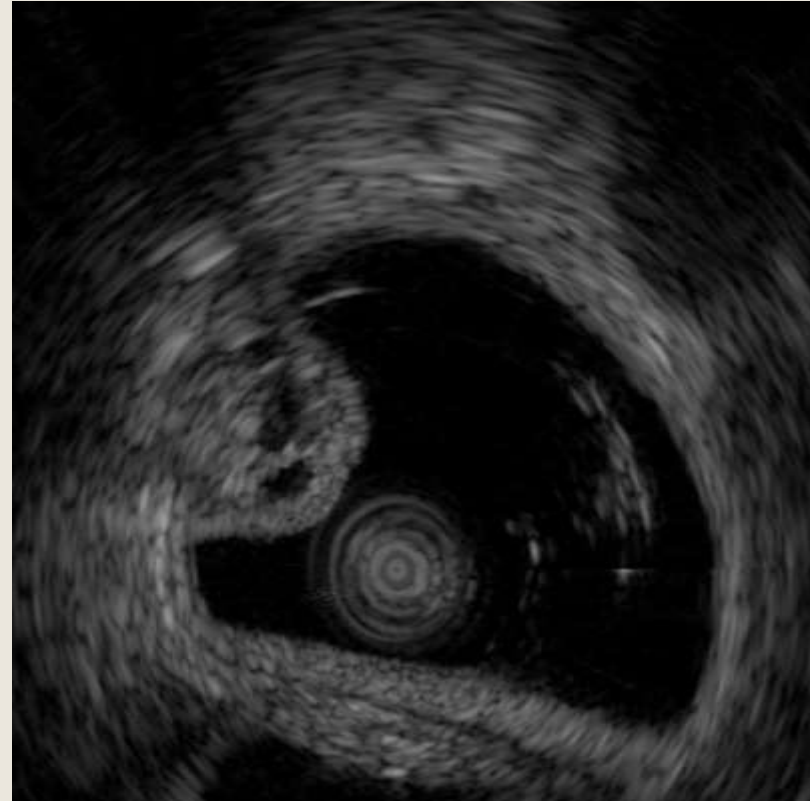


Hyperechoic lesion of the mucosal and submucosal layer with a clear boundary.

Brunner Cystadenoma



Polypoid protrusion in the bulb with hyperemia and erosion on the surface

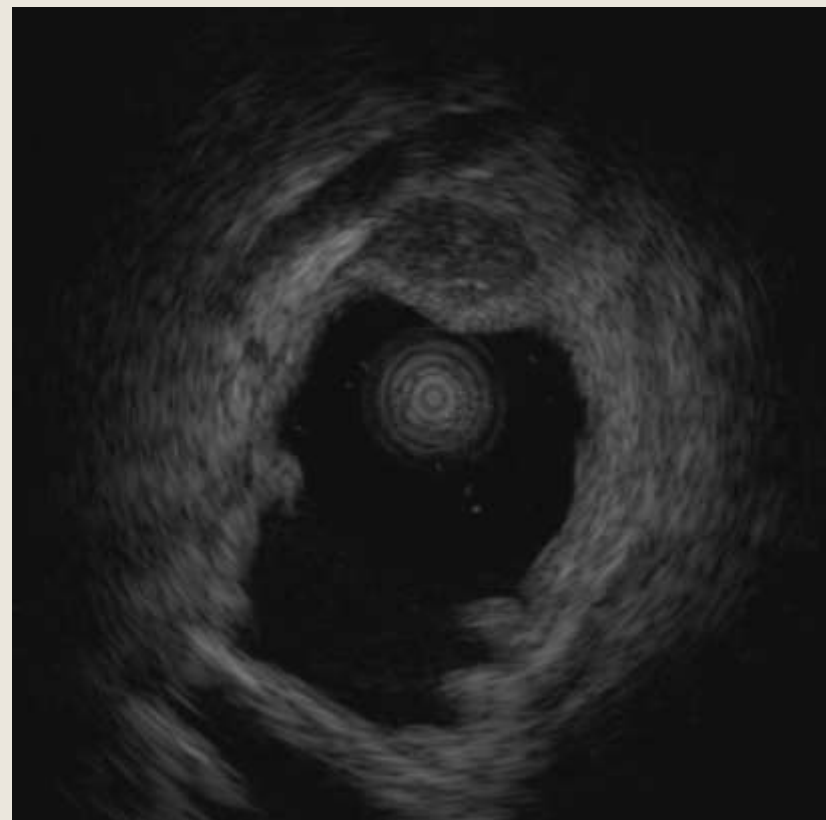


Submucosal lesion with mixed echo with honeycomb cysts inside

heterotopic pancreas

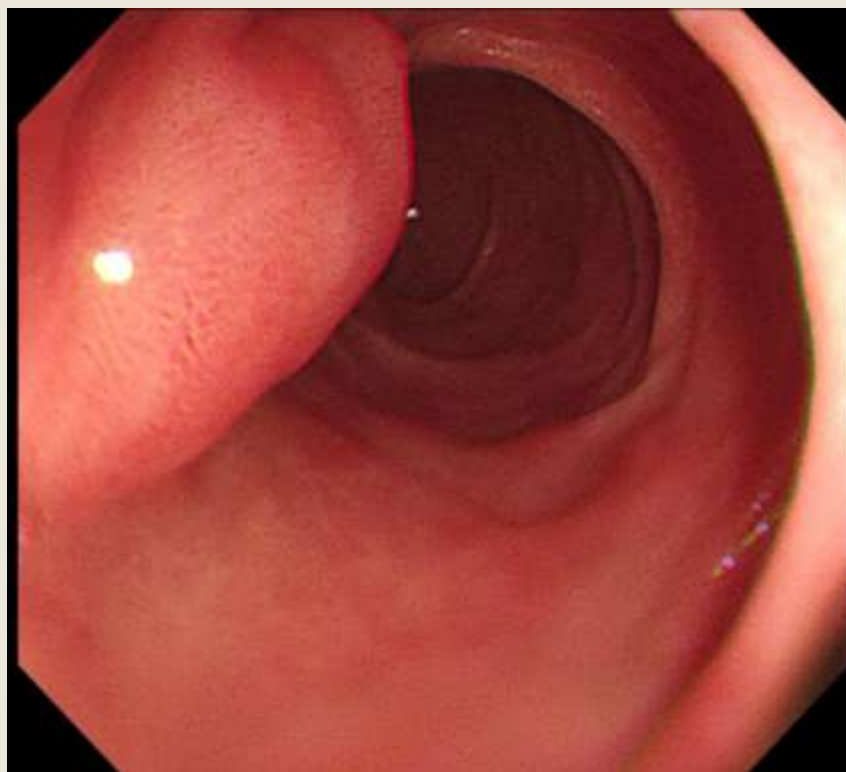


Submucosal protrusion of duodenum with mild depression on the surface

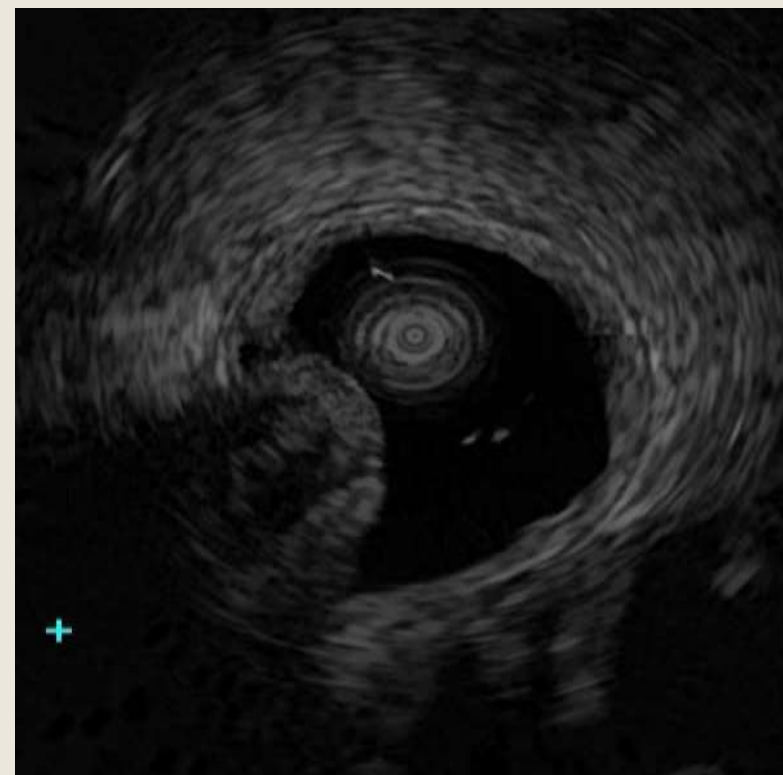


Hypoechoic mass originating from the muscularis propria with a clear boundary
Adjacent to gastroduodenal artery
With heterogenous echo and hyperechoic spots inside

Enlarged major duodenal papilla

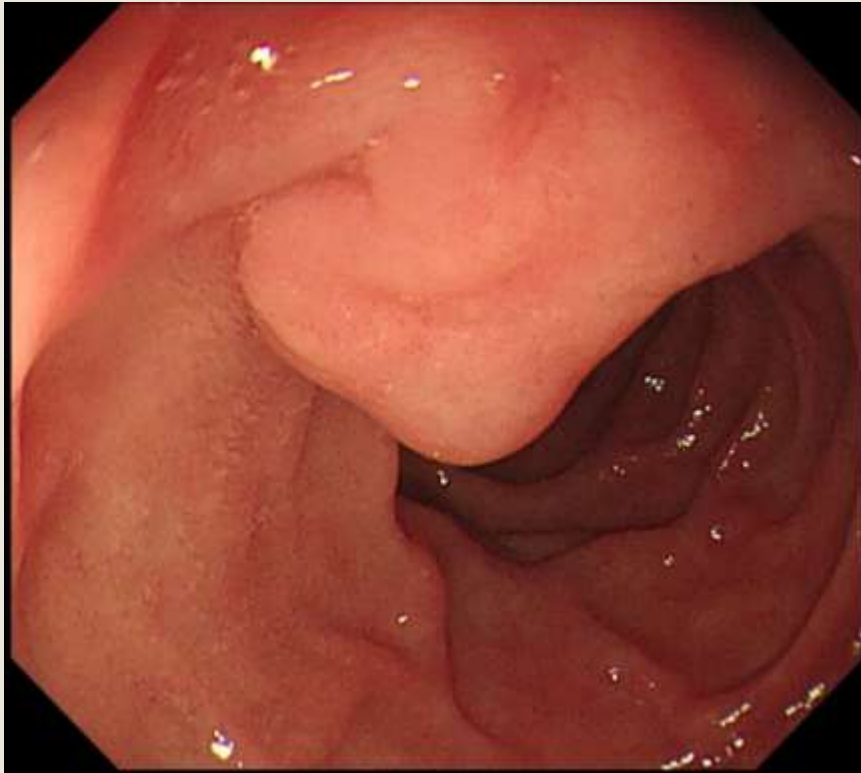


Slightly swollen of duodenal papilla
with hyperemia on the surface

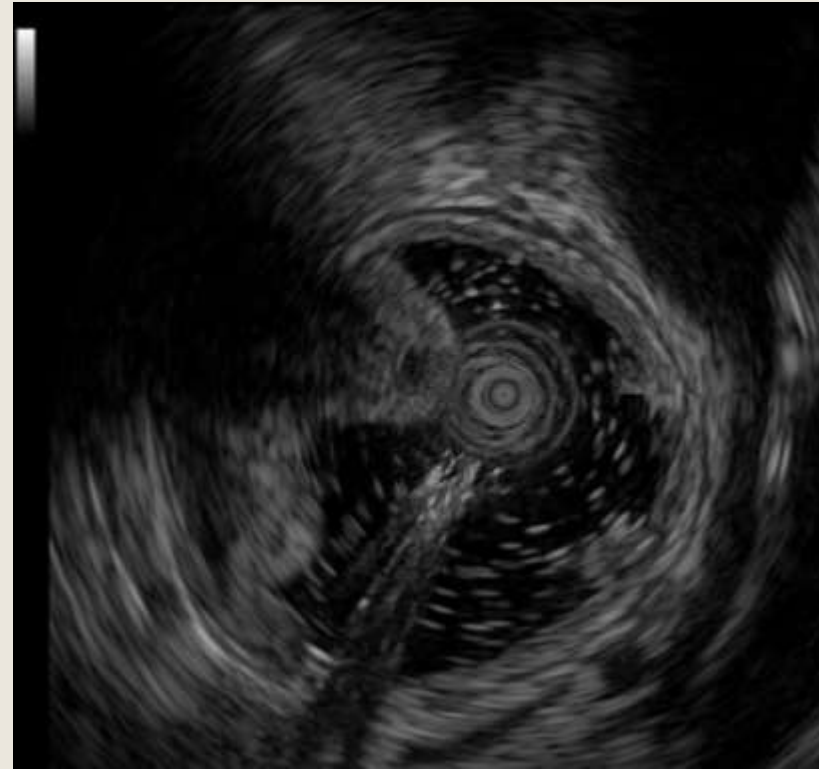


Normal mucosal and submucosal layer
With sphincteroid hypoechoic structure
inside

Minor duodenal papilla



Mucosal protrusion of the oral side of the major duodenal papilla



Hypoechoic intraluminal protrusion with homogenous echo inside.
Connected to the pancreas
Rear Attenuation
Lumen-like structure inside

THANKS



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浙江省第一医院

THE FIRST HOSPITAL OF ZHEJIANG PROVINCE

Medicine is developed for happy life

医学的目的在于重获幸福