Tumors of the ampulla of Vater may with several different histologic variants, including adenomas, adenocarcinomas, neuroendocrine tumors, lipomas, fibromas, lymphomas, and hamartomas. Adenoma is the most common one. Ampullary adenoma can occur sporadically or in the patients with familial adenomatous polyposis (FAP).

Tumors of the ampulla of Vater can cause symptoms and signs of abdominal pain, jaundice, anemia due to occult gastrointestinal bleeding, recurrent pancreatitis, abnormal liver function tests, biliary or pancreatic duct dilation on imaging studies. Traditional treatments for ampullary tumors are surgical approaches, including transduodenal local resection or pancreaticoduodenectomy (PD). The former has the lower morbidity and mortality rates, but are associated with higher recurrence rates. On the other hand, PD are known with higher mortality rates, despite of the low recurrence rate.

Suzuki et al proposed endoscopic ampullectomy in 1983. From then on, a lot of endoscopists underwent the procedure successfully. Nowadays endoscopic ampullectomy has been widely accepted for the treatment of benign ampullary adenomas in Asia and Western countries. Complete resection can be achieved in more than 85% of cases with low morbidity and mortality.

**Indications**

Our indications for endoscopic ampullectomy are a tumor-type adenoma with focal dysplasia. If any malignant cells got by the biopsy, it should be carcinoma in situ. The lesion should be without muscular layer, pancreatic or bile duct involvement, because the rate of lymph node metastasis was 28% for T1, 50.9% for T2, 71.7% for T3, and 77.3% for T4. Clinically, we also exclude ulcerative mass, high level of serum CA19-9 and positive positron emission tomographic scan (PET) on ampulla of Vater. We conducted the usefulness of PET scan in differentiate malignant ampullary tumors from benign ones and showed 100% malignant ampullary tumors showed PET (+) and 20% of benign tumors showed PET (+). However, median SUV is high in malignant ones 7.5 (3.1-14.4) vs 3.85 (0-9.5).

**Pre-ampullectomy evaluation**

Appearance, size, presence of malignancy and tumor invasiveness should be evaluated. All ampullary tumors should be carefully examined with a duodenoscope. According to the gross endoscopic appearance of the tumor, an ulcerative type tumor is often with invasive cancer and is not suggested for limited surgery. A direct relationship between high grade dysplasia/cancer occurrence and larger tumor sizes has been observed. Multiple biopsies should be taken as it is
difficult to distinguish an ampullary adenoma from other nature of tumor including adenocarcinoma based on the endoscopic appearance. One study revealed the villous adenoma of the major papilla is complicated by carcinoma in approximately 30% of cases. A minimum of 6 biopsies have been recommended by Binmoeller KF et al to increase histologic yield. However, the consistency of endoscopic biopsies for detection of malignancy is only approximately 50% in our series, because the foci of malignant tissue in the ampullary adenoma can be missed. Another study showed one-third of endoscopic biopsies in a series of ampullary lesions to be misleading. Therefore, careful examination of the ampullectomy specimen is very important.

Tumor invasiveness (staging)
The tumor invasiveness (T) and metastasis determine the management of ampullary tumors. Ultrasound, CT scan, MRI and PET scan are useful for detection of metastasis which exclude the endoscopic or surgical ampullectomy. Cholangiography and pancreatography are as part of the pre-ampullectomy assessment to look for ductal involvement if EUS is not available. For the T staging, a lot of studies indicate EUS and IDUS are the superior tools to other image modalities and are able to accurately determine the depth of tumor invasion relative to the duodenal wall layers and detect involvement of the bile and pancreatic ducts. The accuracy of EUS for T staging is 60 to 90% and 73 to 93% by IDUS. A recent survey of endoscopic ampullectomy carried out by Menees SB et al showed that among the participants, 67% “always”, 31% “sometimes” 2% “never” used EUS before ampullectomy. However, we recommend EUS to be performed before endoscopic or surgical resection, because of its high accuracy in T staging.

Techniques of endoscopic ampullectomy
Basically, endoscopic ampullectomy is a technique of snare polypectomy of ampullary tumors performed with a standard duodenoscope. En-bloc resection, instead of piece-meal removal, of the tumors with snare is the goal of treatment. But sometimes, piecemeal resection is required. The rate of en-bloc resection is 85.7% in our series. We undergo snare polypectomy of the ampullary tumor with setting of pure-cutting, 120-150 Watt. There is no established consensus regarding the mode of resection current. Some investigators preferred pure-cutting current to avoid edema caused by the coagulation mode, but it is associated with the risk of bleeding. On the other hand, the blended cut has been suggested by others because it is thought to be associated with a lower risk of bleeding. There are no data comparing the different type of snare over another. We prefer more rigid braided snare. Operators should place the standard oval snare tip against the wall of the duodenum at the superior aspect of the mass, then the snare is slowly opened with the endoscope advancing slightly to allow the snare to open around the entire lesion. If necessary, we will make a small cut with the tip of snare over the wall of the duodenum at the superior aspect of the mass to stabilize the position of the snare. We did not routinely perform prior submucosal injection of saline or epinephrine in most cases. It may cause edema of remaining tissue leading to difficulty in stenting and pancreatitis. Routine pancreatic stenting is tried for all cases after endoscopic ampullectomy. The pancreatic stent placement after resection has been shown to prevent post-ampullectomy pancreatitis (from
33% to 0%). Biliary stenting depends on the flow of bile after procedures.

**Rescue procedures for residual tumors**
If there are residual tumors, repeated snaring resection or argon plasma coagulation is used for ablation. Argon plasma coagulation is usually applied only after pancreatic stenting or clear identification of the orifice of pancreatic duct to prevent pancreatitis caused by thermal injury. Prior to APC, biopsies should be done on any suspicious area before ablation.

**Complications**
Bleeding, pancreatitis, cholangitis and perforation are complications of endoscopic ampullectomy. In our series, there was 9.2% for bleeding, 9.2% for pancreatitis and 9.2% for cholangitis. There was no perforation or mortality. The bleeding was treated endoscopically. All the post-ampullectomy pancreatitis in our series was mild and treated conservatively.

**Post-ampullectomy histological evaluation**
Histological evaluation of the resected specimen is essential. Surgery is indicated if there is invasive carcinoma or intraductal tumor extension that cannot be resected endoscopically. We refer the cases with malignant tissue invading more than submucosal layer for surgery after endoscopic ampullectomy. In our series, 18.2% of cases were referred for rescue surgery. Incomplete removal of adenoma will be treated with rescue APC. If resected specimen shows the malignancy limited to mucosa and there is negative lymph node PET scan, close follow-up without surgery is the choice. Ito K et al. had demonstrated the possibility of EP as an alternative to surgery for selected patients with early ampullary cancer.

**Summary**
Endoscopic ampullectomy is a safe and mature procedure alternative to surgical intervention. Endoscopic ampullectomy has the benefit of lower morbidity and mortality, and is a preferred treatment modality for benign ampullary tumors without intraductal ductal extension. To selection of appropriate candidates for endoscopic ampullectomy, accurate staging of ampullary tumors is important. EUS/IDUS is most accurate tool for T staging. Endoscopic ampullectomy with successful tumor eradication can be achieved by endoscopists with extensive expertise. Resected specimens should be checked carefully to determine the necessity of rescue managements. As tumor recurrence indeed occurs, regular interval endoscopic surveillance of the resected sites is essential.