CASE REPORT

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Endoscopic Ultrasound-Guided Absolute Ethanol Ablation in the Management of Pancreatic Insulinoma: A Case Report

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Abstract

Insulinoma is a rare pancreatic neuroendocrine tumor characterized by endogenous hyperinsulinemic hypoglycemia. Surgical resection remains the gold standard; however, in selected patients who are unsuitable for surgery or decline operative management, minimally invasive procedures such as endoscopic ultrasound (EUS)-guided ethanol ablation may be an effective alternative. We present a case of a 54-year-old female with a solitary insulinoma successfully managed with EUS-guided ethanol ablation. The patient achieved immediate and sustained resolution of hypoglycemia without complications. This report highlights the potential role of EUS-guided ethanol ablation as an effective and safe modality.

Key words: insulinoma, ethanol ablation, hypoglycemia, endoscopic ultrasound

INTRODUCTION

Insulinomas are the most common functioning pancreatic neuroendocrine tumors, although their overall incidence remains low (approximately 1–4 cases per million annually).[1] Patients typically present with Whipple's triad: fasting hypoglycemia, symptoms of neuroglycopenia, and relief upon glucose administration.[1] Surgical resection is curative in most cases; however, alternative approaches are needed for patients unfit for surgery or who decline operative management. We describe a rare case of a symptomatic insulinoma treated successfully using endoscopic ultrasound (EUS)-guided ethanol injection.

CASE

A 54-year-old Vietnamese female presented with recurrent episodes of confusion and dizziness, particularly during fasting states. The patient had been self-administering oral glucose solution three times daily (150–200 mL per dose) for the past two years to prevent hypoglycemic episodes. During hospitalization for a hypoglycemic episode, the patient consistently exhibited blood glucose values ranging from 1.9 to 2.5 mmol/L. Insulin was found to be markedly elevated at 244 μIU/mL (2.6–24.9) and the C-peptide level was increased to 10.5 ng/mL (0.78–5.19). Abdominal contrast-enhanced computed tomography (CT) identified a 1.2 cm hyperenhancing lesion located in the pancreatic head (Figures 1 and 2).

On EUS, a circumscribed homogeneously heterogeneous mass measuring 10.8 mm was visualized in the pancreatic head, situated adjacent to the common bile duct (CBD) and the main pancreatic duct (MPD) (Figure 3).

Given the location of the insulinoma in the pancreatic head adjacent to the main pancreatic duct and common bile duct, surgical treatment was expected to require pancreaticoduodenectomy. The patient had no major comorbidities that would independently increase her surgical risk. However, after comprehensive counseling regarding the benefits and potential complications of surgery, she declined operative management and expressed a preference for a minimally invasive treatment. EUS-guided radiofrequency ablation (RFA) was not offered because this technique was not available at our institution at the time of treatment. The case was subsequently discussed by a multidisciplinary team, and EUS-guided ethanol ablation was offered as an alternative. Due to the tumor being located in the pancreatic head adjacent to the main pancreatic duct, the patient underwent endoscopic retrograde cholangiopancreatography (ERCP) with pancreatic stent placement to prevent post-procedural ductal stricture or leakage (Figure 4). The procedure was performed by an experienced interventional gastroenterologist with expertise in EUS-guided procedures and ERCP, within a multidisciplinary center capable of managing pancreaticobiliary complications.

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Under EUS guidance, the tumor appeared as a homogeneously hyperechoic, well-defined, round lesion located near the main pancreatic duct, with internal vascularity. Tumor volume was estimated using the ellipsoid formula based on three perpendicular diameters.[2] The ethanol volume was kept below the estimated tumor volume and adjusted according to the spread of the hyperechoic cloud under real-time EUS guidance. A total of 1 mL of 99% ethanol was injected through a 22-gauge needle, with the hyperechoic cloud diffusely covering the entire lesion (Figure 5).

The procedure was uneventful and well tolerated. At 12 hours post-procedure, the patient was alert with a soft, non-distended abdomen and tolerated oral intake. No hypoglycemic episodes were observed. Blood glucose levels remained stable between 5 and 7 mmol/L. The patient was discharged on the fourth day post-procedure. Follow-up contrast-enhanced CT imaging at one month showed that the previously hyperenhancing lesion in the pancreatic head was no longer clearly visible and was replaced by a small hypoenhancing area. No pancreatic duct dilatation, peripancreatic fluid collection, or other radiologic evidence of post-procedural complications was observed. The prophylactic pancreatic duct stent was also no longer visible, consistent with spontaneous passage; therefore, no endoscopic removal was required (Figure 6).

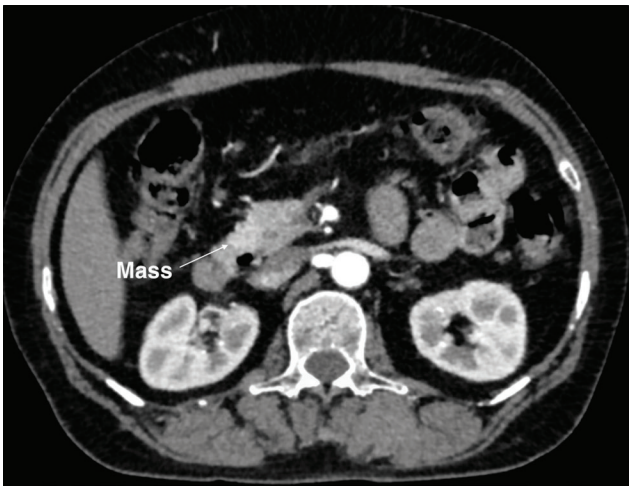


Figure 1. Abdominal computed tomography (CT) demonstrating a 12 × 13 mm hyperenhancing mass in the pancreatic head *(white arrow)*. The pancreatic duct and common bile duct were not dilated. No peripancreatic fluid collection or regional lymphadenopathy was evident.

At the one-year follow-up after ethanol ablation, the patient remained free of hypoglycemia and showed no evidence of complications, including pancreatitis. The patient expressed satisfaction with the minimally invasive procedure.

DISCUSSION

Insulinoma is one of the most common types of neuroendocrine tumors with hormonal manifestations and the most common cause of endogenous hyperinsulinemia. More than 95% of insulinomas are benign.[3,4] Surgical resection remains the gold standard treatment, with a high cure rate when complete excision is achieved.[5] In cases where the tumor is large, multifocal, or located close to or involving the pancreatic duct, extensive surgical resection such as pancreatectomy may be necessary. The specific type of pancreatectomy is determined by the tumor's location; however, major procedures—including Whipple's operation, pylorus-preserving pancreaticoduodenectomy, subtotal pancreatectomy, or distal pancreatectomy—are associated with substantial morbidity, even in high-volume centers, with reported rates ranging from 10% to 43%.[6] Performing a high-morbidity surgical procedure to treat a benign tumor may be suboptimal, particularly in elderly patients or those with significant comorbidities. In such cases, minimally invasive ablative therapies represent a safer and potentially effective alternative.

The sensitivity of EUS for detecting pancreatic insulinomas can be as high as 87 %, although this performance is largely dependent on the skill and experience of the

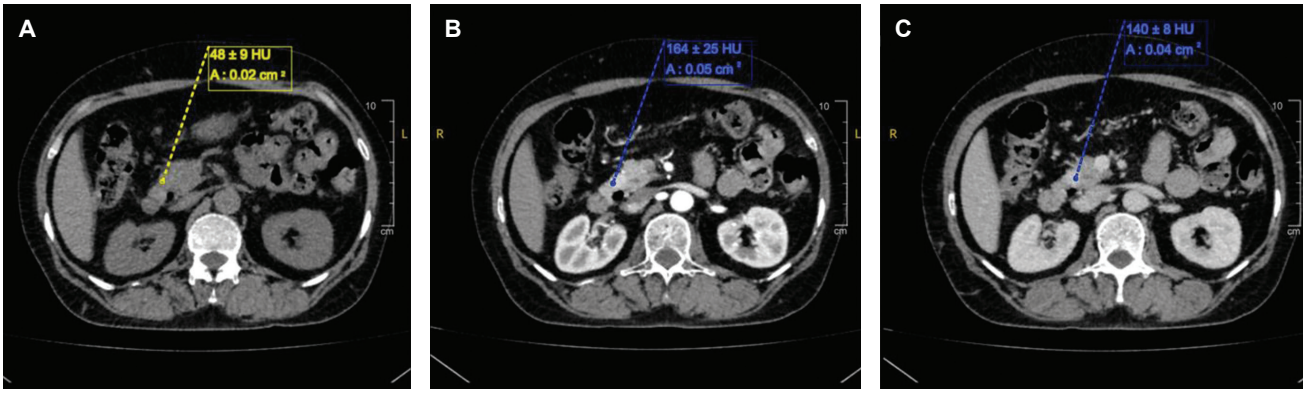


Figure 2. CT attenuation measurements of the pancreatic head mass across different phases: **(A)** non-contrast phase, showing an attenuation of 48 Hounsfield units (HU); **(B)** arterial phase, showing increased attenuation of 164 HU; and **(C)** venous phase, showing attenuation of 140 HU. Yellow **(A)** and blue **(B, C)** dashed lines point to the region of interest placed within the mass for each measurement. The pancreatic duct and common bile duct were not dilated. No peripancreatic fluid collection or lymphadenopathy was observed.

operator.[7] Ethanol causes tissue necrosis through protein denaturation, cellular dehydration, and thrombosis of small vessels, ultimately leading to tumor ablation.[8] Several studies and case series have reported that EUS-guided ethanol injection provides effective symptom control with favorable safety profiles. In a systematic review by El Sayed et al., 35 case reports and case series involving 75 patients were identified, including 47 patients who underwent EUS-guided ethanol ablation, 27 who underwent RFA, and one who received both techniques in the same session.[9] This limited published experience highlights that EUS-guided ethanol ablation remains an uncommon therapeutic approach, supporting the relevance of additional case reports, particularly for lesions in challenging anatomical locations such as the pancreatic head. More recently, a 2023 single-center study by Yan et al., reported 14 EUS-guided ethanol ablation procedures in nine patients. Although four patients remained relapse-free during long-term follow-up, five experienced recurrent symptoms after the initial treatment, and one episode of acute pancreatitis occurred.

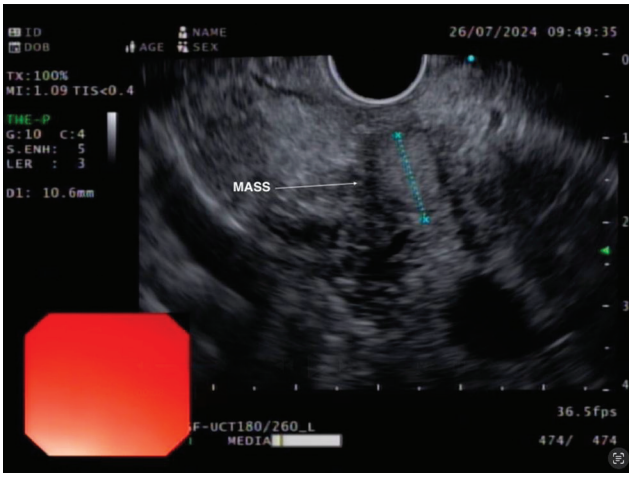


Figure 3. Endoscopic ultrasound (Linear GF180 Olympus) revealed a well-defined, homogeneously hyperechoic, round lesion measuring 10.6 mm in the pancreatic head *(white arrow)*.

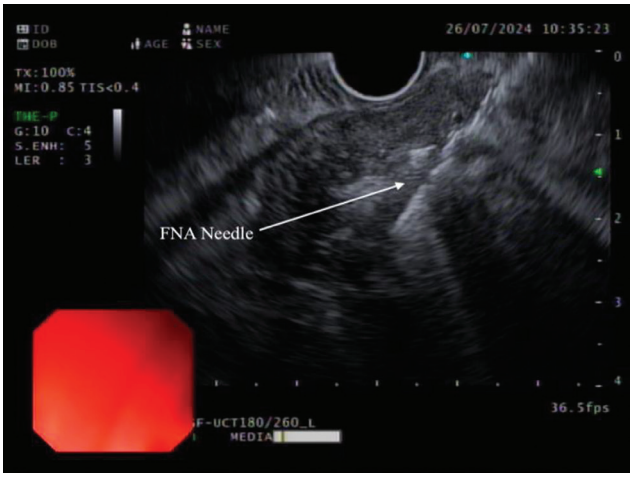


Figure 5. The pancreatic lesion was injected with ethanol under endoscopic ultrasound (EUS) guidance. The white arrow indicates the fine-needle aspiration (FNA) needle within the lesion.

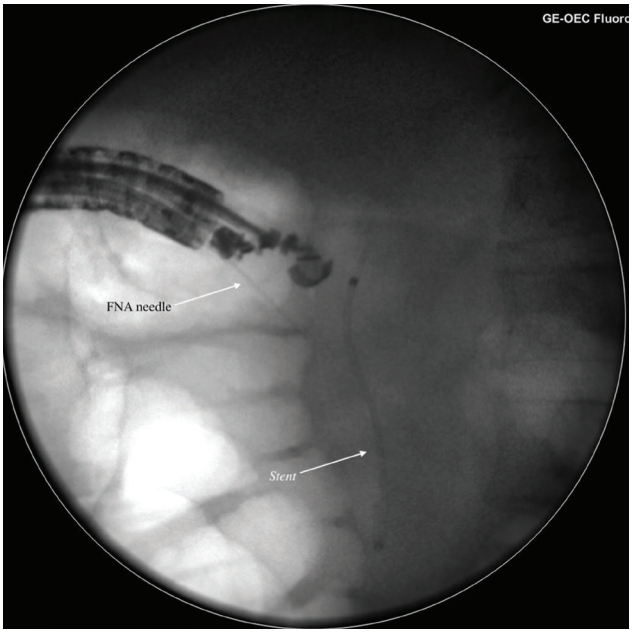


Figure 4. The patient underwent endoscopic retrograde cholangiopancreatography (ERCP) with prophylactic main pancreatic duct stenting to prevent pancreatic duct injury after ethanol injection. On fluoroscopic imaging, the needle used for ethanol injection was positioned adjacent to the main pancreatic duct. White arrows indicate the fine-needle aspiration (FNA) needle used for ethanol injection and the pancreatic duct stent.

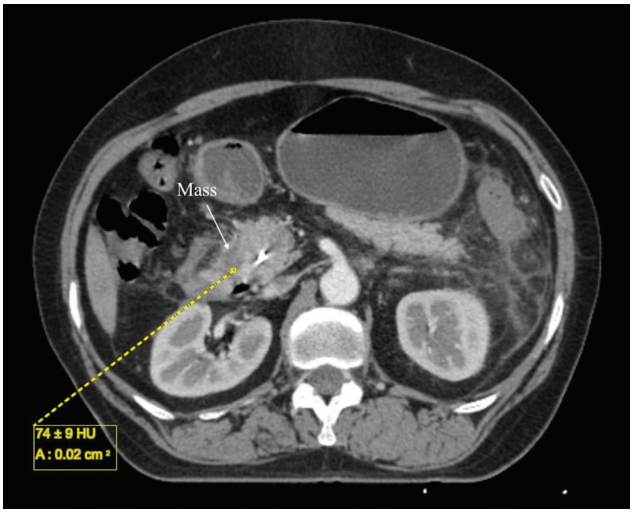


Figure 6. Follow-up contrast-enhanced abdominal CT one month after ethanol ablation showing disappearance of the previously hyperenhancing pancreatic head lesion, replaced by a small hypoenhancing area *(white arrow)*. No pancreatic duct dilatation, peripancreatic fluid collection, or other radiologic evidence of post-procedural complications was observed.

These findings suggest that EUS-guided ethanol ablation can provide effective symptom control, but repeated treatment and long-term surveillance may be required.[10]

In this case, the patient had no major comorbidities that independently increased her operative risk. Although the pancreatic lesion was relatively small, its location in the head of the pancreas meant that surgical removal would have required a Whipple procedure, a major operation with considerable morbidity and risk. After being informed of the potential benefits and risks of surgery, EUS-guided ablation, and other available alternatives, the patient declined surgery and preferred a minimally invasive approach. The treatment options included pancreatic surgery, EUS-guided ethanol ablation, and EUS-guided RFA. Surgery was declined by the patient, while RFA was unavailable at our institution; therefore, following multidisciplinary discussion, EUS-guided ethanol ablation was selected based on the patient's preference, tumor location, and local expertise. Because the tumor was located adjacent to the main pancreatic duct, prophylactic pancreatic duct stenting via ERCP was performed before ablation to reduce the risk of post-procedural ductal stricture or leakage. As EUS-guided ethanol ablation remains a non-standard and technically demanding procedure, it should be performed by an experienced interventional endoscopist at a specialized center with access to ERCP, pancreatic surgery, and multidisciplinary support. The procedure in this case was performed by an interventional gastroenterologist with 25 years of endoscopic experience and 15 years of experience in EUS and ERCP. Our center performs approximately 900 EUS procedures and 1,400 ERCP procedures annually, and the endoscopist has performed approximately 50 EUS-guided interventional procedures, including ethanol injection and celiac plexus neurolysis. This was the first case of EUS-guided absolute ethanol ablation of a pancreatic insulinoma performed at our institution.

Clinical response to ethanol ablation was assessed based on both symptomatic and biochemical improvement. In the present case, the patient had complete resolution of recurrent hypoglycemia after the procedure, with no further documented hypoglycemic episodes. Blood glucose levels remained stable at 5–7 mmol/L, and the patient no longer required oral glucose supplementation. The response was sustained during follow-up, as she remained free of hypoglycemia at one year after treatment.

Although EUS-guided ethanol ablation has been reported to be effective, it is not without potential risks. Potential complications include abdominal pain, acute pancreatitis, pancreatic necrosis, local hematoma, ethanol leakage, injury to the pancreatic or bile ducts and, theoretically, systemic ethanol intoxication, particularly if a large volume is injected or if ethanol diffuses outside the target lesion. In a systematic review by El Sayed et al., the overall clinical success rate was 98.5% including ethanol ablation and RFA; all reported adverse events resolved and no periprocedural deaths were documented.[9] In our case, contrast-enhanced CT performed one month after ablation showed disappearance of the previously hyperenhancing pancreatic head lesion, with only residual hypoenhancing areas. No post-procedural complications, including pancreatitis, peripancreatic fluid collection, bleeding, pancreatic duct obstruction or biliary obstruction, were observed. This aligns with prior reports that EUS-guided ethanol ablation offers durable glycemic control and minimal complications when performed by experienced operators.[11]

Currently, there are no established selection criteria to determine which pancreatic insulinomas are suitable for EUS-guided ethanol ablation. Most reported cases have involved lesions smaller than 2 cm that were clearly localized and accessible by EUS.[12] No standardized recommendations currently exist regarding the optimal ethanol dose or needle type, and multiple ablation sessions may be required in some cases. The ethanol volume in this case was kept below the estimated tumor volume and further adjusted according to the intratumoral spread of the hyperechoic cloud under EUS, aiming to reduce the risks of ethanol leakage and post-procedural pancreatitis.

In the literature, long-term data on recurrence rates are still limited. Therefore, careful patient selection and procedural planning remain critical for success.

CONCLUSION

EUS-guided ethanol ablation is a minimally invasive and effective therapeutic option for insulinoma, particularly in patients who decline surgical intervention. This case demonstrates its potential to achieve effective local tumor ablation, symptom resolution, and long-term glycemic control without significant adverse events. Careful patient selection and procedural planning, including adjunctive techniques such as prophylactic stenting, may enhance both efficacy and safety.

Ethical Consideration
Patient's consent was obtained before submission of the manuscript.

Statement of Authorship
All authors certified fulfillment of ICMJE authorship criteria.

CRediT Author Statement
TQL: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration; **VQV:** Investigation, Resources, Writing – review and editing; **LTN:** Methodology, Investigation, Data curation, Writing – review and editing, Visualization; **ATN:** Investigation, Resources, Writing – review and editing; **TTN:** Validation, Formal analysis, Data curation, Writing – review and editing.

Data Availability Statement
No datasets were generated or analyzed for this study.

Author Disclosure
The authors declared no conflict of interest.

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