EUS-guided radiofrequency ablation: Where we are?

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Pancreatic adenocarcinoma remains one of the leading causes of cancer death in the world and it has the lowest survival rate among cancers. In the United States, the incidence also continues to increase for pancreatic cancers, the death rate rose over the past decade and the 5-year survival rate remains the lowest for cancers of the pancreas at 9%.[1,2] Even following potential curative resection more than 80% of the patients ultimately die of the disease due to local recurrence and/or distant metastasis.[3] Other lesions of the pancreas including cystic neoplasms (PCNs) and neuroendocrine tumors (NETs) are increasingly being discovered mainly incidentally because of the advances in conventional imaging. Clinically, NETs are mostly nonfunctional and do not induce any secretory disorders. Incidental nonfunctional NETs currently lead to difficult management decisions. PCNs are mainly discovered incidentally as well. Most have a benign pattern, with few of them becoming malignant, and include intraductal papillary mucinous neoplasms (IPMNs) and mucinous cystadenomas (MCAs). EUS-guided radiofrequency ablation (EUS-RFA) is becoming an interesting alternative for these lesions instead of doing major surgery with high morbidity and mortality for small mostly benign lesions.[4]

Access this article online	
Quick Response Code:	Website: www.eusjournal.com
	DOI: 10.4103/eus.eus_33_20

In 1999, Goldberg *et al.*,[5] first conducted EUS-RFA on 13 porcine models. The pancreatic lesions were localized under EUS guidance, RF current (285 ± 120 mA) was delivered for 6 min. The pathological examination demonstrated a discrete histological progression of coagulation necrosis followed by fibrotic capsule contraction.

The results of the first in human's EUS-RFA for cystic neoplasms and neuroendocrine tumors of the pancreas were published in 2015 in a pilot, multicenter, and safety feasibility study.[6] In that study, EUS-FRA was applied with a monopolar RF probe (1.2 mm Habib EUS-RFA catheter) placed through a 19- or 22-gauge fine-needle aspiration needle. Eight patients were recruited in this study. Six had a pancreatic cystic neoplasm and two had a neuroendocrine tumor in the head of pancreas. The mean size of the cystic neoplasm and NET was 36.5 mm and 27.5 mm, respectively. The EUS-RFA was successfully completed in all cases. In regards to the NET patients, there was a change in vascularity and central necrosis after EUS-RFA. No major complications were observed within 48 h of the procedure.

How to cite this article: Okasha HH, Naga YM, El Sherbiny M. EUS-guided radiofrequency ablation: Where we are? Endosc Ultrasound 2020;9:277-9.

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Received: 2020-04-02; **Accepted:** 2020-04-30; **Published online:** 2020-07-09

RFA uses high-frequency alternating current to destroy solid tumors. When attached to a generator, RF current is emitted from the exposed portion of the electrode and this current translates into ion agitation within the surrounding tissue, which is converted by friction into heat and induces cellular death by means of coagulation necrosis.[7]

With the possible applications for EUS-RFA as above, the pancreatic head, surrounded by different structures and in a close relation to the common bile duct as well as major blood vessels (superior mesenteric vessels as well as the portal vein) may limit the indications of RFA to locally advanced nonmetastatic pancreatic cancer. In addition, the pancreatic tissue, which is biologically very thermosensitive when subjected to high levels of heat will cause an inflammatory response followed by edema, fibrotic changes, and in a final stage, cystic transformation.[8]

Procedure-related mortality or severe complications such as major bleeding, perforation, severe pancreatitis, or pancreatic fistula/leak are very rare with endoscopic RFA of pancreatic lesions. Most studies report only transient increases in serum amylase and lipase levels, which are often asymptomatic or associated with mild abdominal discomfort. This is in contrast to the major complications described during non-endoscopic RFA application.[9]

A review article in 2016 by Changela *et al.* identified five human case series from India, the UK, South Korea, and China and a case report from Italy. Technical success was reported as 100% in these human studies and no major clinical complications or adverse outcomes were reported.[10]

In 2017, Crinò *et al.*[11] reported data from 8 patients with locally advanced pancreatic ductal adenocarcinoma and one patient with pancreatic head metastasis from renal clear cell carcinoma. An ablated area inside the tumor was achieved in all treated patients and no early or late major adverse event was observed after a mean follow-up of 6 months. In 2018, Choi *et al.*[12] reported 10 patients with diagnoses of nonfunctioning neuroendocrine tumor (7 patients), solid pseudopapillary neoplasm (2 patients), and one patient with insulinoma, with a median largest diameter of the tumors of 20 mm and median follow-up of 13 months. They reported two patients developing adverse events; one episode of abdominal pain and one of pancreatitis. Barthet *et al.*[4] published a prospective multicenter study in 2019 with 30 patients and a 1-year follow-up with either a NET <2 cm or a pancreatic cystic neoplasm, either a branch duct IPMN or MCA. Technical success was achieved in all of pancreatic cystic neoplasms and neuroendocrine tumors. They reported 10% complication rate, initially one patient developed pancreatitis and one developed small-bowel perforation. After these initial patients, the authors modified the protocol and this resulted in a decrease in complications (3.5%), with one patient having a pancreatic ductal stenosis. In 2019, Oleinikov *et al.*[13] published a cohort of 18 adults with functional and nonfunctional pancreatic NETs. They reported technical success in 96% of ablated lesions, with a single case, where the tumor was in close proximity to the main pancreatic duct, a complete ablation was not achieved. The authors reported no major complications 48 h postprocedure and no clinically significant recurrences were observed during mean follow-up ranging from 2 to 21 months [Table 1].

EUS is a rapidly emerging therapy, and more data about safety, clinical indications, and long-term durability are needed.

Table 1. Studies of EUS-guided radiofrequency ablation

Name	Year	Study type	Number of patients	Technical success (%)	Complications
Crinò *et al.*	2017	Retrospective	9	100	Three patients experienced mild post-procedural abdominal pain
Choi *et al.*	2018	Prospective	10	100	Two adverse events (12.4%; 1 moderate and 1 mild)
Oleinikov *et al.*	2019	Retrospective	18	96	No major complications 48 h postprocedure No recurrences during mean follow-up of 8.7 6 4.6 months
Barthet *et al.*	2019	Prospective	30	100	Complication rate was 10%, initially one patient developed pancreatitis and one developed small-bowel perforation After modifications in the protocol a decrease in complications to 3.5 % (one patient having a pancreatic ductal stenosis)

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Bray F, Ferlay J, Soerjomataram I, *et al*. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2018;68:394-424.
2. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2020. *CA Cancer J Clin* 2020;70:7-30.
3. Gillen S, Schuster T, Meyer Zum Büschenfelde C, *et al*. Preoperative/neoadjuvant therapy in pancreatic cancer: A systematic review and meta-analysis of response and resection percentages. *PLoS Med* 2010;7:e1000267.
4. Barthet M, Giovannini M, Lesavre N, *et al*. Endoscopic ultrasound-guided radiofrequency ablation for pancreatic neuroendocrine tumors and pancreatic cystic neoplasms: A prospective multicenter study. *Endoscopy* 2019;51:836-42.
5. Goldberg SN, Mallery S, Gazelle GS, *et al*. EUS-guided radiofrequency ablation in the pancreas: Results in a porcine model. *Gastrointest Endosc* 1999;50:392-401.
6. Pai M, Habib N, Senturk H, *et al*. Endoscopic ultrasound guided radiofrequency ablation, for pancreatic cystic neoplasms and neuroendocrine tumors. *World J Gastrointest Surg* 2015;7:52-9.
7. Gaidhane M, Smith I, Ellen K, *et al*. Endoscopic ultrasound-guided radiofrequency ablation (EUS-RFA) of the pancreas in a porcine model. *Gastroenterol Res Pract* 2012;2012:431451.
8. Silviu UB, Daniel P, Claudiu M, *et al*. Endoscopic ultrasound-guided radiofrequency ablation of the pancreas: An experimental study with pathological correlation. *Endosc Ultrasound* 2015;4:330-5.
9. Rustagi T, Chhoda A. Endoscopic radiofrequency ablation of the pancreas. *Dig Dis Sci* 2017;62:843-50.
10. Changela K, Patil R, Duddempudi S, *et al*. Endoscopic ultrasound-guided radiofrequency ablation of the pancreatic tumors: A promising tool in management of pancreatic tumors. *Can J Gastroenterol Hepatol* 2016;Vol 2016, ID 4189358:1-5.
11. Crinò SF, D'Onofrio M, Bernardoni L, *et al*. EUS-guided radiofrequency ablation (EUS-RFA) of solid pancreatic neoplasm using an 18-gauge needle electrode: Feasibility, safety, and technical success. *J Gastrointestin Liver Dis* 2018;27:67-72.
12. Choi JH, Seo DW, Song TJ, *et al*. Endoscopic ultrasound-guided radiofrequency ablation for management of benign solid pancreatic tumors. *Endoscopy* 2018;50:1099-104.
13. Oleinikov K, Dancour A, Epshtein J, *et al*. Endoscopic ultrasound-guided radiofrequency ablation: A new therapeutic approach for pancreatic neuroendocrine tumors. *J Clin Endocrinol Metab* 2019;104:2637-47.