

World Journal of *Gastroenterology*

World J Gastroenterol 2017 July 21; 23(27): 4847-5040





EDITORIAL

- 4847 Evolving role of the endoscopist in management of gastrointestinal neuroendocrine tumors

Yazici C, Boulay BR

- 4856 Current research and treatment for gastrointestinal stromal tumors

Lim KT, Tan KY

REVIEW

- 4867 Significance of dormant forms of *Helicobacter pylori* in ulcerogenesis

Reshetnyak VI, Reshetnyak TM

MINIREVIEWS

- 4879 Prognostic significance of red blood cell distribution width in gastrointestinal disorders

Goyal H, Lippi G, Gjymishka A, John B, Chhabra R, May E

- 4892 Endoscopic ultrasound-guided radiofrequency ablation in gastroenterology: New horizons in search

Chaudhary S, Sun SY

ORIGINAL ARTICLE

Basic Study

- 4897 Genetic association and epistatic interaction of the interleukin-10 signaling pathway in pediatric inflammatory bowel disease

Lin Z, Wang Z, Hegarty JP, Lin TR, Wang Y, Deiling S, Wu R, Thomas NJ, Floros J

- 4910 Generation of glyceraldehyde-derived advanced glycation end-products in pancreatic cancer cells and the potential of tumor promotion

Takata T, Ueda T, Sakasai-Sakai A, Takeuchi M

- 4920 Anti-oxidant and anti-inflammatory effects of hydrogen-rich water alleviate ethanol-induced fatty liver in mice

Lin CP, Chuang WC, Lu FJ, Chen CY

- 4935 Human liver chimeric mouse model based on diphtheria toxin-induced liver injury

Ren XN, Ren RR, Yang H, Qin BY, Peng XH, Chen LX, Li S, Yuan MJ, Wang C, Zhou XH

Retrospective Study

- 4942 Perinatal transmission in infants of mothers with chronic hepatitis B in California

Burgis JC, Kong D, Salibay C, Zipprich J, Harriman K, So S

- 4950** Outcome of a session of extracorporeal shock wave lithotripsy before endoscopic retrograde cholangiopancreatography for problematic and large common bile duct stones

Tao T, Zhang M, Zhang QJ, Li L, Li T, Zhu X, Li MD, Li GH, Sun SX

Prospective Study

- 4958** Genetic polymorphisms predict response to anti-tumor necrosis factor treatment in Crohn's disease

Netz U, Carter JV, Eichenberger MR, Dryden GW, Pan J, Rai SN, Galandiuk S

- 4968** New formula for predicting standard liver volume in Chinese adults

Feng LM, Wang PQ, Yu H, Chen RT, Wang J, Sheng X, Yuan ZL, Shi PM, Xie WF, Zeng X

- 4978** Postoperative decrease of serum albumin predicts short-term complications in patients undergoing gastric cancer resection

Liu ZJ, Ge XL, Ai SC, Wang HK, Sun F, Chen L, Guan WX

SYSTEMATIC REVIEW

- 4986** Management of inflammatory bowel disease with *Clostridium difficile* infection

D'Aoust J, Battat R, Bessissow T

META-ANALYSIS

- 5004** Effect of silymarin on biochemical indicators in patients with liver disease: Systematic review with meta-analysis

de Avelar CR, Pereira EM, de Farias Costa PR, de Jesus RP, de Oliveira LPM

- 5018** High expression of anti-apoptotic protein Bcl-2 is a good prognostic factor in colorectal cancer: Result of a meta-analysis

Huang Q, Li S, Cheng P, Deng M, He X, Wang Z, Yang CH, Zhao XY, Huang J

CASE REPORT

- 5034** Liver injury after aluminum potassium sulfate and tannic acid treatment of hemorrhoids

Yoshikawa K, Kawashima R, Hirose Y, Shibata K, Akasu T, Hagiwara N, Yokota T, Imai N, Iwaku A, Kobayashi G, Kobayashi H, Kinoshita A, Fushiya N, Kijima H, Koike K, Saruta M

Contents

World Journal of Gastroenterology
Volume 23 Number 27 July 21, 2017

ABOUT COVER

Editorial board member of *World Journal of Gastroenterology*, Takeshi Ogura, MD, PhD, Associate Professor, 2nd Department of Internal Medicine, Osaka Medical College, Takatsukishi 464-8681, Japan

AIMS AND SCOPE

World Journal of Gastroenterology (*World J Gastroenterol*, *WJG*, print ISSN 1007-9327, online ISSN 2219-2840, DOI: 10.3748) is a peer-reviewed open access journal. *WJG* was established on October 1, 1995. It is published weekly on the 7th, 14th, 21st, and 28th each month. The *WJG* Editorial Board consists of 1375 experts in gastroenterology and hepatology from 68 countries.

The primary task of *WJG* is to rapidly publish high-quality original articles, reviews, and commentaries in the fields of gastroenterology, hepatology, gastrointestinal endoscopy, gastrointestinal surgery, hepatobiliary surgery, gastrointestinal oncology, gastrointestinal radiation oncology, gastrointestinal imaging, gastrointestinal interventional therapy, gastrointestinal infectious diseases, gastrointestinal pharmacology, gastrointestinal pathophysiology, gastrointestinal pathology, evidence-based medicine in gastroenterology, pancreatology, gastrointestinal laboratory medicine, gastrointestinal molecular biology, gastrointestinal immunology, gastrointestinal microbiology, gastrointestinal genetics, gastrointestinal translational medicine, gastrointestinal diagnostics, and gastrointestinal therapeutics. *WJG* is dedicated to become an influential and prestigious journal in gastroenterology and hepatology, to promote the development of above disciplines, and to improve the diagnostic and therapeutic skill and expertise of clinicians.

INDEXING/ABSTRACTING

World Journal of Gastroenterology (*WJG*) is now indexed in Current Contents[®]/Clinical Medicine, Science Citation Index Expanded (also known as SciSearch[®]), Journal Citation Reports[®], Index Medicus, MEDLINE, PubMed, PubMed Central and Directory of Open Access Journals. The 2017 edition of Journal Citation Reports[®] cites the 2016 impact factor for *WJG* as 3.365 (5-year impact factor: 3.176), ranking *WJG* as 29th among 79 journals in gastroenterology and hepatology (quartile in category Q2).

FLYLEAF

I-IX Editorial Board

EDITORS FOR THIS ISSUE

Responsible Assistant Editor: *Xiang Li*
Responsible Electronic Editor: *Dan Li*
Proofing Editor-in-Chief: *Lian-Sheng Ma*

Responsible Science Editor: *Ze-Mao Gong*
Proofing Editorial Office Director: *Jin-Lei Wang*

NAME OF JOURNAL
World Journal of Gastroenterology

ISSN
ISSN 1007-9327 (print)
ISSN 2219-2840 (online)

LAUNCH DATE
October 1, 1995

FREQUENCY
Weekly

EDITORS-IN-CHIEF

Damian Garcia-Olmo, MD, PhD, Doctor, Professor, Surgeon, Department of Surgery, Universidad Autonoma de Madrid; Department of General Surgery, Fundacion Jimenez Diaz University Hospital, Madrid 28040, Spain

Stephen C Strom, PhD, Professor, Department of Laboratory Medicine, Division of Pathology, Karolinska Institutet, Stockholm 141-86, Sweden

Andrzej S Tarnawski, MD, PhD, DSc (Med), Professor of Medicine, Chief Gastroenterology, VA Long Beach Health Care System, University of California, Irvine, CA, 5901 E. Seventh Str., Long Beach,

CA 90822, United States

EDITORIAL BOARD MEMBERS

All editorial board members resources online at <http://www.wjgnet.com/1007-9327/editorialboard.htm>

EDITORIAL OFFICE

Jin-Lei Wang, Director
Yuan Qi, Vice Director
Ze-Mao Gong, Vice Director
World Journal of Gastroenterology
Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501,
Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: editorialoffice@wjgnet.com
Help Desk: <http://www.f6publishing.com/helpdesk>
<http://www.wjgnet.com>

PUBLISHER

Baishideng Publishing Group Inc
7901 Stoneridge Drive, Suite 501,
Pleasanton, CA 94588, USA
Telephone: +1-925-2238242
Fax: +1-925-2238243
E-mail: bpgoffice@wjgnet.com
Help Desk: <http://www.f6publishing.com/helpdesk>

<http://www.wjgnet.com>

PUBLICATION DATE
July 21, 2017

COPYRIGHT

© 2017 Baishideng Publishing Group Inc. Articles published by this Open-Access journal are distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non commercial and is otherwise in compliance with the license.

SPECIAL STATEMENT

All articles published in journals owned by the Baishideng Publishing Group (BPG) represent the views and opinions of their authors, and not the views, opinions or policies of the BPG, except where otherwise explicitly indicated.

INSTRUCTIONS TO AUTHORS

Full instructions are available online at <http://www.wjgnet.com/bpg/gerinfo/204>

ONLINE SUBMISSION
<http://www.f6publishing.com>

Endoscopic ultrasound-guided radiofrequency ablation in gastroenterology: New horizons in search

Satyarth Chaudhary, Si-Yu Sun

Satyarth Chaudhary, Department of Gastroenterology and Hepatology, Kidney Hospital and Lifeline Medical Institutions, Jalandhar, Punjab 144003, India

Si-Yu Sun, Endoscopy Center, Shengjing Hospital of China Medical University, Shenyang 110004, Liaoning Province, China

Author contributions: Both authors equally contributed to this paper with regard to conception and design of the study, literature review and analysis, drafting, critical revision and editing of the manuscript, and final approval of the final version.

Conflict-of-interest statement: No potential conflicts of interest exist.

Open-Access: This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Manuscript source: Invited manuscript

Correspondence to: Dr. Si-Yu Sun, Professor, Endoscopy Center, Shengjing Hospital of China Medical University, No. 36 Sanhao Street, Shenyang 110004, Liaoning Province, China. sun-siyu@163.com
Telephone: +86-24-96615

Received: January 28, 2017

Peer-review started: February 9, 2017

First decision: April 10, 2017

Revised: April 30, 2017

Accepted: June 9, 2017

Article in press: June 12, 2017

Published online: July 21, 2017

Abstract

Radiofrequency ablation (RFA) has been widely used

for the treatment of various solid organ malignancies. Over the last decade, endosonographers have gradually shifted the application of RFA from porcine models to humans to treat a spectrum of diseases. RFA is performed in patients with pancreatic carcinoma who are not candidates for surgery. In this paper, we will discuss various indications for RFA, its procedural details and complications. At present, endoscopic ultrasound-guided RFA is gradually incorporated into the management of various diseases and opens a new avenue for disease treatment.

Key words: Pancreatic carcinoma; Radiofrequency ablation

© **The Author(s) 2017.** Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: Endoscopic ultrasound-guided radiofrequency ablation (RFA) is a rapidly emerging modality, whose application has shifted from porcine models to humans over the last decade. In this review, we provide details on the indications, thermokinetic principles and complications related to RFA, which should be judiciously applied in the management of various diseases.

Chaudhary S, Sun SY. Endoscopic ultrasound-guided radiofrequency ablation in gastroenterology: New horizons in search. *World J Gastroenterol* 2017; 23(27): 4892-4896 Available from: URL: <http://www.wjgnet.com/1007-9327/full/v23/i27/4892.htm> DOI: <http://dx.doi.org/10.3748/wjg.v23.i27.4892>

INTRODUCTION

Over the last two decades, palliation techniques for pancreatic adenocarcinoma have changed significantly. New developments in endoscopic ultrasound-guided

therapies have also rapidly emerged^[1]. Radiofrequency ablation (RFA) utilizes high frequency alternating current and can result in coagulative necrosis^[2,3], and it can be applied percutaneously, intraoperatively or in combination with endoscopic ultrasound (EUS). This modality is gradually gaining popularity among endosonographers at tertiary centers. EUS-RFA is now an established anti-tumor therapy and an alternative to surgery^[4].

Pancreatic adenocarcinoma is an aggressive tumor with a dismal survival rate due to delayed diagnosis. Only 10% of patients qualify for curative surgery^[5]. The majority of patients have an unresectable locally advanced disease with encasement of vessels (superior mesenteric vessels, portal vein and/or hepatic artery)^[6]. One-year survival rate in these patients is less than 5% after diagnosis^[7].

EUS-guided RFA was first used in a porcine model by Goldberg *et al*^[8] in 1999. EUS is used for various therapeutic procedures as it can be precisely applied in pancreatic lesions and helps delineate the area of interest for ablation^[9-11].

EUS provides real-time imaging of deeply located anatomical structures such as the pancreas which is difficult to approach via the percutaneous route^[12]. RFA has been widely utilized in the treatment of liver, lung and kidney tumors^[13-15].

MECHANISM OF RFA

RFA is based on the principle that high frequency alternating current is converted into thermal energy which results in coagulative necrosis of surrounding tissue^[16]. Thermal exposure above 45 °C results in denaturation of cell proteins and is utilized in the treatment of various tumors^[17].

There are three important components in this procedure: the generator, the needle and the tissue.

The generator utilizes alternating current and converts it into thermal energy which is transferred through the exposed part of the needle^[8,18].

RFA also causes thermal damage to the epithelium with a gradual rise in temperature, which results in destruction of cyst epithelium^[19].

CLINICAL APPLICATIONS OF RFA

RFA is principally utilized in various benign and malignant conditions, including intraoperative applications. Studies have suggested that RFA leads to tumor necrosis and a reduction in tumor volume^[20].

RFA can also be used in patients with malignant biliary obstruction for endobiliary ablation in the self-expandable metallic stent to improve stent patency^[21].

A cryothermal probe (ERBE, Elektromedizin GmbH) has been used for palliation in locally advanced pancreatic carcinoma patients, with a technical success rate of 72.8% and median survival of 6 mo post ablation with manageable complications including jaundice,

duodenal stricture and cystic fluid collection^[20-22].

INDICATIONS

EUS-guided RFA is indicated in various diseases including: (1) pancreatic adenocarcinoma^[23]; (2) patients after chemoradiotherapy; (3) patients with progressive tumor growth causing biliary or gastric outlet obstruction^[24]; (4) liver metastasis^[25]; (5) intraductal papillary mucinous neoplasms (IPMN)^[26,27]; and (6) insulinoma^[28,29].

PROCEDURE

A 19 G needle is usually used to puncture the pancreatic tissue under EUS guidance, the stylet is removed to introduce a thin wire which is connected to the generator, and then the tissue is ablated. This principle has been applied using a Habib EUS-RFA catheter (EMcision Ltd., London, United Kingdom) where a monopolar probe with a diameter of 1 Fr and length of 220 cm is utilized with a 2 cm active electrode tip to ablate the tissue^[28,30,31]. It ablates for 2 min, which is considered one ablation with a break of 60 s for cooling. Up to 10 ablations can be applied to the tissue with interspersed cooling periods (Figures 1 and 2). In the case of a cyst, the lesion is aspirated prior to ablation. This technique should not be used in patients with cardiac pacemakers or other active implants.

Another novel 18 G RFA electrode (EUSRA RF Electrode; STARmed, Koyang, South Korea) with a total working length of 150 cm is also used. This electrode has the unique feature of two 0.8 mm diameter holes which are located 5 mm away from the tip, and can be used for aspiration and injection. The active electrode length is 7 mm while the tip exposure length is 10 mm. This RF electrode is attached to the RF generator (VIVA Combo system; STARmed) to ablate the tissue^[32]. It results in the ablation of 1-3 cm of localized tissue from the needle tip^[32-34].

A new flexible hybrid bipolar probe also known as the cryotherm probe (ERBE Elektromedizin, Tübingen, Germany) has recently been introduced, which combines cryotechnology with RFA^[35]. This probe has an advantage over a monopolar probe in that it causes less collateral damage, but it is less efficient than a monopolar probe^[36-38].

Cooling using a cryogenic gas increases the effect of RFA and interstitial devitalization^[12]. It also proves that cooling does not affect the efficacy of ablation^[39].

TIME AND TEMPERATURE UTILIZED IN RFA

RFA was successfully used in other organs such as the liver, intrahepatic tumors and muscle to achieve maximum coagulation within 6 min, prior to its application in the pancreas^[40]. The Manchester group was

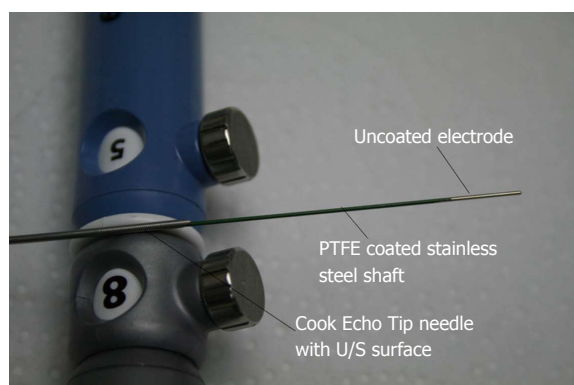


Figure 1 Habib RF needle with Cook Echo Tip needle. Courtesy of EMcision International Inc.



Figure 2 Radiofrequency generator (RITA 1500 X, ANGIODYNAMICS).

among the first to validate and define the thermokinetic principles in the pancreas^[41]. As the distance from the electrode increases, the temperature tends to decrease^[26]. The optimal temperature for thermal ablation was demonstrated in a porcine model by Date^[42] in 2005. It was concluded that optimal thermokinetics was generated at a temperature of 90 °C when applied for 5 min. This leads to ablation of pancreatic tissue without injury to adjacent organs.

A few other studies have also established the relationship between temperature and the rate of complications^[43,44].

It was again established in a study by Girelli *et al.*^[45] that a decrease in temperature from 105 °C to 90 °C leads to an overall reduction in the complication rate from 24% to 8%.

Wu *et al.*^[36] showed that when a temperature of 30 °C was applied, this led to a high rate of post-operative morbidity, where complications included pancreatic fistula, portal thrombosis, septic shock and massive bleeding.

EUS-RFA OF THE PANCREAS IS DIFFERENT TO THAT OF OTHER ORGANS

EUS-RFA is better than planned palliative R2 resections

in pancreatic carcinoma patients as it results in decreased morbidity, mortality and reduced hospital stay. There are certain important and significant differences in ablation of the pancreas compared with other organs: (1) the RFA protocol for other organs cannot be applied to the pancreas as the physical properties of the pancreas are entirely different from those of other organs; (2) the pancreas is surrounded by other organs (the stomach and duodenum), vessels and bile ducts and thus has an increased risk of thermal-induced injury; and (3) pancreatic cancer usually has diffuse margins, whereas hepatic carcinoma or metastasis has discrete margins; therefore, it is difficult to completely ablate pancreatic carcinoma in a single session^[16].

EVALUATION OF EFFICACY OF RFA TREATMENT

Lesion size can be evaluated by imaging at repeated intervals. Tumor progression can be estimated by an improvement in symptoms (abdominal pain, back pain) or biochemical indices (CA19-9 levels)^[46,47].

RATIO OF PASSES TO THE SIZE OF THE LESION

The ratio of the number of passes to the size of the lesion is extremely variable in different studies with a median value of 0.5 (range, 0.36-19). This can be explained by the application of different devices^[41,46,48].

COMPLICATIONS OF RFA

The fear of adverse events related to EUS-RFA also limits its application by clinicians in pancreatic carcinoma patients.

Most complications are related to thermal injury to pancreatic parenchyma (acute pancreatitis) and surrounding structures including thermal damage to superior mesenteric vessels, bile ducts, the portal vein, stomach and duodenum^[12,49-51]. Mild abdominal pain was reported by 25%-33% of patients in various studies^[33]. Frequent complications were gastrointestinal hemorrhage, pancreatic fistula, bile leak, portal vein thrombosis, pseudocyst and sepsis. The overall postoperative morbidity rate was 28.3% and mortality was approximately 4%^[52].

The pancreas is different to other organs such as the liver and kidney where RFA has been successfully utilized for the treatment of carcinomas. Optimal thermokinetic characteristics of the pancreas have not been completely determined, thus there is no standardized protocol for pancreatic RFA. Usually two or more sessions of RFA are required for pancreatic carcinoma ablation^[12,32,33]. Retroperitoneal location, proximity to major vessels, distal bile duct crossing the head of the pancreas and closeness to the stomach

and duodenum are also major hurdles^[44].

CONCLUSION

Normal pancreatic tissue is thermosensitive, thus RFA can lead to an inflammatory response with fibrosis and occasionally cystic collections. A clearer understanding of the principles of thermokinetics in humans is required to effectively ablate abnormal tissues. Better ablation devices with minimal side effects and complications may ensure improved results in the future. Further studies with a large number of subjects will provide a better understanding of this novel technique.

REFERENCES

- 1 **Bhutani MS**, Arora A. New developments in endoscopic ultrasound-guided therapies. *Endosc Ultrasound* 2015; **4**: 304-311 [PMID: 26643698 DOI: 10.4103/2303-9027.170419]
- 2 **Figuerola-Barojas P**, Bakhru MR, Habib NA, Ellen K, Millman J, Jamal-Kabani A, Gaidhane M, Kahaleh M. Safety and efficacy of radiofrequency ablation in the management of unresectable bile duct and pancreatic cancer: a novel palliation technique. *J Oncol* 2013; **2013**: 910897 [PMID: 23690775 DOI: 10.1155/2013/910897]
- 3 **Matsui Y**, Nakagawa A, Kamiyama Y, Yamamoto K, Kubo N, Nakase Y. Selective thermocoagulation of unresectable pancreatic cancers by using radiofrequency capacitive heating. *Pancreas* 2000; **20**: 14-20 [PMID: 10630378]
- 4 **Brugge WR**. EUS-guided tumor ablation with heat, cold, microwave, or radiofrequency: will there be a winner? *Gastrointest Endosc* 2009; **69**: S212-S216 [PMID: 19179160 DOI: 10.1016/j.gie.2008.12.031]
- 5 **Warshaw AL**, Fernández-del Castillo C. Pancreatic carcinoma. *N Engl J Med* 1992; **326**: 455-465 [PMID: 1732772 DOI: 10.1056/NEJM199202133260706]
- 6 **Verslype C**, Van Cutsem E, Dicato M, Cascinu S, Cunningham D, Diaz-Rubio E, Glimelius B, Haller D, Haustermans K, Heinemann V, Hoff P, Johnston PG, Kerr D, Labianca R, Louvet C, Minsky B, Moore M, Nordlinger B, Pedrazzoli S, Roth A, Rothenberg M, Rougier P, Schmoll HJ, Tabernero J, Tempero M, van de Velde C, Van Laethem JL, Zalberg J. The management of pancreatic cancer. Current expert opinion and recommendations derived from the 8th World Congress on Gastrointestinal Cancer, Barcelona, 2006. *Ann Oncol* 2007; **18** Suppl 7: vii1-vii10 [PMID: 17600091 DOI: 10.1093/annonc/mdm210]
- 7 **Jemal A**, Murray T, Ward E, Samuels A, Tiwari RC, Ghafoor A, Feuer EJ, Thun MJ. Cancer statistics, 2005. *CA Cancer J Clin* 2005; **55**: 10-30 [PMID: 15661684]
- 8 **Goldberg SN**, Mallery S, Gazelle GS, Brugge WR. EUS-guided radiofrequency ablation in the pancreas: results in a porcine model. *Gastrointest Endosc* 1999; **50**: 392-401 [PMID: 10462663 DOI: 10.1053/ge.1999.v50.98847]
- 9 **Facciorusso A**, Maso MD, Barone M, Muscatiello N. Echoendoscopic ethanol ablation of tumor combined to celiac plexus neurolysis improved pain control in a patient with pancreatic adenocarcinoma. *Endosc Ultrasound* 2015; **4**: 342-344 [PMID: 26643704]
- 10 **Kongkam P**, Benjasupattananun P, Taytawat P, Navicharoen P, Sriuranpong V, Vajragupta L, Klaikaew N, Ridditit W, Treeprasertsuk S, Rerknimitr R, Kullavanijaya P. Pancreatic cancer in an Asian population. *Endosc Ultrasound* 2015; **4**: 56-62 [PMID: 25789286 DOI: 10.4103/2303-9027.151361]
- 11 **Bhutani MS**. Role of endoscopic ultrasound for pancreatic cystic lesions: Past, present, and future! *Endosc Ultrasound* 2015; **4**: 273-275 [PMID: 26643692 DOI: 10.4103/2303-9027.170400]
- 12 **Carrara S**, Arcidiacono PG, Albarello L, Addis A, Enderle MD, Boemo C, Campagnol M, Ambrosi A, Doglioni C, Testoni PA. Endoscopic ultrasound-guided application of a new hybrid cryotherm probe in porcine pancreas: a preliminary study. *Endoscopy* 2008; **40**: 321-326 [PMID: 18389449 DOI: 10.1055/s-2007-995595]
- 13 **Jansen MC**, van Hillegersberg R, Chamuleau RA, van Delden OM, Gouma DJ, van Gulik TM. Outcome of regional and local ablative therapies for hepatocellular carcinoma: a collective review. *Eur J Surg Oncol* 2005; **31**: 331-347 [PMID: 15837037 DOI: 10.1016/j.ejso.2004.10.011]
- 14 **Simon CJ**, Dupuy DE. Current role of image-guided ablative therapies in lung cancer. *Expert Rev Anticancer Ther* 2005; **5**: 657-666 [PMID: 1611466 DOI: 10.1586/14737140.5.4.657]
- 15 **Boss A**, Clasen S, Kuczyk M, Anastasiadis A, Schmidt D, Graf H, Schick F, Claussen CD, Pereira PL. Magnetic resonance-guided percutaneous radiofrequency ablation of renal cell carcinomas: a pilot clinical study. *Invest Radiol* 2005; **40**: 583-590 [PMID: 16118551]
- 16 **Kim J**. Endoscopic Ultrasound-Guided Treatment of Pancreatic Cystic and Solid Masses. *Clin Endosc* 2015; **48**: 308-311 [PMID: 26240804 DOI: 10.5946/ce.2015.48.4.308]
- 17 **Armellini E**, Crinò SF, Ballarè M, Occhipinti P. Endoscopic ultrasound-guided radiofrequency ablation of a pancreatic neuroendocrine tumor. *Endoscopy* 2015; **47** Suppl 1 UCTN: E600-E601 [PMID: 26671543 DOI: 10.1055/s-0034-1393677]
- 18 **Cosman ER**, Nashold BS, Ovelman-Levitt J. Theoretical aspects of radiofrequency lesions in the dorsal root entry zone. *Neurosurgery* 1984; **15**: 945-950 [PMID: 6514169]
- 19 **Rhim H**, Kim YS, Heo JN, Koh BH, Cho OK, Kim Y, Seo HS. Radiofrequency thermal ablation of hepatic cyst. *J Vasc Interv Radiol* 2004; **15**: 95-96 [PMID: 14709695]
- 20 **Keane MG**, Bramis K, Pereira SP, Fusai GK. Systematic review of novel ablative methods in locally advanced pancreatic cancer. *World J Gastroenterol* 2014; **20**: 2267-2278 [PMID: 24605026 DOI: 10.3748/wjg.v20.i9.2267]
- 21 **Steel AW**, Postgate AJ, Khorsandi S, Nicholls J, Jiao L, Vlavianos P, Habib N, Westaby D. Endoscopically applied radiofrequency ablation appears to be safe in the treatment of malignant biliary obstruction. *Gastrointest Endosc* 2011; **73**: 149-153 [PMID: 21184881 DOI: 10.1016/j.gie.2010.09.031]
- 22 **Arcidiacono PG**, Carrara S, Reni M, Petrone MC, Cappio S, Balzano G, Boemo C, Cereda S, Nicoletti R, Enderle MD, Neugebauer A, von Renteln D, Eickhoff A, Testoni PA. Feasibility and safety of EUS-guided cryothermal ablation in patients with locally advanced pancreatic cancer. *Gastrointest Endosc* 2012; **76**: 1142-1151 [PMID: 23021160 DOI: 10.1016/j.gie.2012.08.006]
- 23 **Changela K**, Patil R, Duddempudi S, Gaduputi V. Endoscopic Ultrasound-Guided Radiofrequency Ablation of the Pancreatic Tumors: A Promising Tool in Management of Pancreatic Tumors. *Can J Gastroenterol Hepatol* 2016; **2016**: 4189358 [PMID: 27478820 DOI: 10.1155/2016/4189358]
- 24 **Li D**, Xie K, Wolff R, Abbruzzese JL. Pancreatic cancer. *Lancet* 2004; **363**: 1049-1057 [PMID: 15051286 DOI: 10.1016/S0140-6736(04)15841-8]
- 25 **Pandya GJ**, Shelat VG. Radiofrequency ablation of pancreatic ductal adenocarcinoma: The past, the present and the future. *World J Gastrointest Oncol* 2015; **7**: 6-11 [PMID: 25685272 DOI: 10.4251/wjgo.v7.i2.6]
- 26 **Park JS**, Seo DW, Song TJ, Park do H, Lee SS, Lee SK, Kim MH. Endoscopic ultrasound-guided ablation of branch-duct intraductal papillary mucinous neoplasms: Feasibility and safety tests using porcine gallbladders. *Dig Endosc* 2016; **28**: 599-606 [PMID: 26856542 DOI: 10.1111/den.12628]
- 27 **Arshad HM**, Bharmal S, Duman DG, Liangpunsakul S, Turner BG. Advanced endoscopic ultrasound management techniques for preneoplastic pancreatic cystic lesions. *J Investig Med* 2017; **65**: 7-14 [PMID: 27574295 DOI: 10.1136/jim-2016-000167]
- 28 **Waung JA**, Todd JF, Keane MG, Pereira SP. Successful management of a sporadic pancreatic insulinoma by endoscopic ultrasound-guided radiofrequency ablation. *Endoscopy* 2016;

- 48 Suppl 1: E144-E145 [PMID: 27081874 DOI: 10.1055/s-0042-104650]
- 29 **Lakhtakia S**, Ramchandani M, Galasso D, Gupta R, Venugopal S, Kalpala R, Reddy DN. EUS-guided radiofrequency ablation for management of pancreatic insulinoma by using a novel needle electrode (with videos). *Gastrointest Endosc* 2016; **83**: 234-239 [PMID: 26394384 DOI: 10.1016/j.gie.2015.08.085]
- 30 **Silviu UB**, Daniel P, Claudiu M, Săndulescu L, Simona F, Ștefan P, Valeriu Ș, Adrian S. Endoscopic ultrasound-guided radiofrequency ablation of the pancreas: An experimental study with pathological correlation. *Endosc Ultrasound* 2015; **4**: 330-335 [PMID: 26643702 DOI: 10.4103/2303-9027.170426]
- 31 **Chapman CG**, Siddiqui UD. New Scopes, New Accessories, New Stents for Interventional Endoscopic Ultrasound. *Clin Endosc* 2016; **49**: 41-46 [PMID: 26855923 DOI: 10.5946/ce.2016.49.1.41]
- 32 **Kim HJ**, Seo DW, Hassanuddin A, Kim SH, Chae HJ, Jang JW, Park DH, Lee SS, Lee SK, Kim MH. EUS-guided radiofrequency ablation of the porcine pancreas. *Gastrointest Endosc* 2012; **76**: 1039-1043 [PMID: 23078928 DOI: 10.1016/j.gie.2012.07.015]
- 33 **Pai M**, Habib N, Senturk H, Lakhtakia S, Reddy N, Cicinnati VR, Kaba I, Beckebaum S, Drymoussis P, Kahaleh M, Brugge W. Endoscopic ultrasound guided radiofrequency ablation, for pancreatic cystic neoplasms and neuroendocrine tumors. *World J Gastrointest Surg* 2015; **7**: 52-59 [PMID: 25914783 DOI: 10.4240/wjgs.v7.i4.52]
- 34 **Song TJ**, Seo DW, Lakhtakia S, Reddy N, Oh DW, Park DH, Lee SS, Lee SK, Kim MH. Initial experience of EUS-guided radiofrequency ablation of unresectable pancreatic cancer. *Gastrointest Endosc* 2016; **83**: 440-443 [PMID: 26344883 DOI: 10.1016/j.gie.2015.08.048]
- 35 **Hines-Peralta A**, Hollander CY, Solazzo S, Horkan C, Liu ZJ, Goldberg SN. Hybrid radiofrequency and cryoablation device: preliminary results in an animal model. *J Vasc Interv Radiol* 2004; **15**: 1111-1120 [PMID: 15466798 DOI: 10.1097/01.RVI.0000136031.91939.EC]
- 36 **Wu Y**, Tang Z, Fang H, Gao S, Chen J, Wang Y, Yan H. High operative risk of cool-tip radiofrequency ablation for unresectable pancreatic head cancer. *J Surg Oncol* 2006; **94**: 392-395 [PMID: 16967436 DOI: 10.1002/jso.20580]
- 37 **Van Goethem BE**, Rosenveldt KW, Kirpensteijn J. Monopolar versus bipolar electrocoagulation in canine laparoscopic ovariectomy: a nonrandomized, prospective, clinical trial. *Vet Surg* 2003; **32**: 464-470 [PMID: 14569575 DOI: 10.1053/jvet.2003.50052]
- 38 **Lee JM**, Han JK, Choi SH, Kim SH, Lee JY, Shin KS, Han CJ, Choi BI. Comparison of renal ablation with monopolar radiofrequency and hypertonic-saline-augmented bipolar radiofrequency: in vitro and in vivo experimental studies. *AJR Am J Roentgenol* 2005; **184**: 897-905 [PMID: 15728615 DOI: 10.2214/ajr.184.3.01840897]
- 39 **Feggrachi S**, Molenaar IQ, Klaessens JH, Besselink MG, Offerhaus JA, van Hillegersberg R. Radiofrequency ablation of the pancreas with and without intraluminal duodenal cooling in a porcine model. *J Surg Res* 2013; **184**: 867-872 [PMID: 23726235 DOI: 10.1016/j.jss.2013.04.068]
- 40 **Goldberg SN**, Gazelle GS, Dawson SL, Rittman WJ, Mueller PR, Rosenthal DI. Tissue ablation with radiofrequency: effect of probe size, gauge, duration, and temperature on lesion volume. *Acad Radiol* 1995; **2**: 399-404 [PMID: 9419582]
- 41 **Date RS**, Biggins J, Paterson I, Denton J, McMahon RF, Siriwardena AK. Development and validation of an experimental model for the assessment of radiofrequency ablation of pancreatic parenchyma. *Pancreas* 2005; **30**: 266-271 [PMID: 15782106]
- 42 **Date RS**. Current status of local ablative techniques in the treatment of pancreatic cancer. *Pancreas* 2006; **33**: 198-199 [PMID: 16868488 DOI: 10.1097/01.mpa.0000229006.39667.ea]
- 43 **Elias D**, Baton O, Sideris L, Lasser P, Pocard M. Necrotizing pancreatitis after radiofrequency destruction of pancreatic tumours. *Eur J Surg Oncol* 2004; **30**: 85-87 [PMID: 14736529]
- 44 **Siriwardena AK**. Radiofrequency ablation for locally advanced cancer of the pancreas. *JOP* 2006; **7**: 1-4 [PMID: 16407612]
- 45 **Girelli R**, Frigerio I, Salvia R, Barbi E, Tinazzi Martini P, Bassi C. Feasibility and safety of radiofrequency ablation for locally advanced pancreatic cancer. *Br J Surg* 2010; **97**: 220-225 [PMID: 20069610 DOI: 10.1002/bjs.6800]
- 46 **Spiliotis JD**, Datsis AC, Michalopoulos NV, Kekelos SP, Vaxevanidou A, Rogdakis AG, Christopoulou AN. Radiofrequency ablation combined with palliative surgery may prolong survival of patients with advanced cancer of the pancreas. *Langenbecks Arch Surg* 2007; **392**: 55-60 [PMID: 17089173 DOI: 10.1007/s00423-006-0098-5]
- 47 **Cantore M**, Girelli R, Mambrini A, Frigerio I, Boz G, Salvia R, Giardino A, Orlandi M, Auriemma A, Bassi C. Combined modality treatment for patients with locally advanced pancreatic adenocarcinoma. *Br J Surg* 2012; **99**: 1083-1088 [PMID: 22648697 DOI: 10.1002/bjs.8789]
- 48 **Hadjicostas P**, Malakounides N, Varianos C, Kitiris E, Lerni F, Symeonides P. Radiofrequency ablation in pancreatic cancer. *HPB (Oxford)* 2006; **8**: 61-64 [PMID: 18333241 DOI: 10.1080/13651820500466673]
- 49 **Gaidhane M**, Smith I, Ellen K, Gatesman J, Habib N, Foley P, Moskaluk C, Kahaleh M. Endoscopic Ultrasound-Guided Radiofrequency Ablation (EUS-RFA) of the Pancreas in a Porcine Model. *Gastroenterol Res Pract* 2012; **2012**: 431451 [PMID: 23049547 DOI: 10.1155/2012/431451]
- 50 **Yoon WJ**, Brugge WR. Endoscopic ultrasonography-guided tumor ablation. *Gastrointest Endosc Clin N Am* 2012; **22**: 359-369, xi [PMID: 22632957 DOI: 10.1016/j.giec.2012.04.017]
- 51 **Seo DW**. EUS-Guided Antitumor Therapy for Pancreatic Tumors. *Gut Liver* 2010; **4** Suppl 1: S76-S81 [PMID: 21103299 DOI: 10.5009/gnl.2010.4.S1.S76]
- 52 **Pezzilli R**, Ricci C, Serra C, Casadei R, Monari F, D'Ambra M, Corinaldesi R, Minni F. The problems of radiofrequency ablation as an approach for advanced unresectable ductal pancreatic carcinoma. *Cancers (Basel)* 2010; **2**: 1419-1431 [PMID: 24281165 DOI: 10.3390/cancers2031419]

P- Reviewer: Araujo RLC, McKenna O, Seth D **S- Editor:** Qi Y
L- Editor: Wang TQ **E- Editor:** Zhang FF





Published by **Baishideng Publishing Group Inc**
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: <http://www.f6publishing.com/helpdesk>
<http://www.wjgnet.com>



ISSN 1007-9327

