ISSN 1948-5190 (online)

World Journal of *Gastrointestinal Endoscopy*

World J Gastrointest Endosc 2020 October 16; 12(10): 323-407

Published by Baishideng Publishing Group Inc

World Journal of Gastrointestinal Endoscopy

Contents

Monthly Volume 12 Number 10 October 16, 2020

ABOUT COVER

Editor-in-Chief of *World Journal of Gastrointestinal Endoscopy*, Dr. Koulaouzidis is currently with the Centre for Liver & Digestive Disorders at the Royal Infirmary of Edinburgh, United Kingdom. He obtained his Medical Degree in 1995 from the Medical School of the Aristotle University of Thessaloniki, Greece. He subsequently earned a Doctorate in Medicine from the Medical School of the University of Edinburgh, United Kingdom and a Doctorate in Philosophy from Lunds Universitet, Sweden. He has published extensively on capsule endoscopy and has co-authored several books chapters. His PubMed-indexed record of articles numbers > 200. He has developed a niche as an international Key Opinion Leader in clinical capsule endoscopy and an advocate of minimally-invasive/precision gastrointestinal diagnosis. He is also the co-founder of a promising MedTech start-up and holds other specialty interests, including colonoscopy, colorectal cancer, and microscopic colitis. (L-Editor: Filipodia)

AIMS AND SCOPE

The primary aim of *World Journal of Gastrointestinal Endoscopy* (*WJGE*, *World J Gastrointest Endosc*) is to provide scholars and readers from various fields of gastrointestinal endoscopy with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGE mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal endoscopy and covering a wide range of topics including capsule endoscopy, colonoscopy, double-balloon enteroscopy, duodenoscopy, endoscopic retrograde cholangiopancreatography, endosonography, esophagoscopy, gastrointestinal endoscopy, gastroscopy, laparoscopy, natural orifice endoscopic surgery, proctoscopy, and sigmoidoscopy.

INDEXING/ABSTRACTING

The *WJGE* is now abstracted and indexed in Emerging Sources Citation Index (Web of Science), PubMed, PubMed Central, China National Knowledge Infrastructure (CNKI), and Superstar Journals Database.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Li-Li Wang*; **Production Department Director:** *Yun-Xiaojian Wu*; **Editorial Office Director:** *Jia-Ping Yan*.

NAME OF JOURNAL
World Journal of Gastrointestinal Endoscopy

ISSN
ISSN 1948-5190 (online)

LAUNCH DATE
October 15, 2009

FREQUENCY
Monthly

EDITORS-IN-CHIEF
Anastasios Koulaouzidis, Bing Hu, Sang Chul Lee

EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/1948-5190/editorialboard.htm

PUBLICATION DATE
October 16, 2020

COPYRIGHT
© 2020 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

World Journal of Gastrointestinal Endoscopy

Submit a Manuscript: https://www.f6publishing.com

World J Gastrointest Endosc 2020 October 16; 12(10): 323-340

DOI: 10.4253/wjge.v12.i10.323

ISSN 1948-5190 (online)

REVIEW

Endoscopic retrograde cholangiopancreatography guided interventions in the management of pancreatic cancer

Muhammad Nadeem Yousaf, Hamid Ehsan, Ahsan Wahab, Ahmad Muneeb, Fizah S Chaudhary, Richard Williams, Christopher J Haas

ORCID number: Muhammad Nadeem Yousaf 0000-0002-7979-8929; Hamid Ehsan 0000-0002-4607-3171; Ahsan Wahab 0000-0003-3597-1838; Ahmad Muneeb 0000-0001-7748-6748; Fizah S Chaudhary 0000-0001-6458-5755; Richard Williams 0000-0002-7979-8000; Christopher J Haas 0000-0002-3745-6998.

Author contributions: Yousaf MN and Ehsan H were involved in manuscript writing and overalled data collection; Wahab A, Muneeb A and Chaudhary FS did the review of manuscript and data; Williams R and Haas CJ did the manuscript supervision, review, and revision.

Conflict-of-interest statement: The authors have no conflict-of-interests.

Muhammad Nadeem Yousaf, Hamid Ehsan, Fizah S Chaudhary, Richard Williams, Christopher J Haas, Department of Medicine, Medstar Union Memorial Hospital, Baltimore, MD 21218, United States

Muhammad Nadeem Yousaf, Fizah S Chaudhary, Richard Williams, Christopher J Haas, Department of Medicine, MedStar Good Samaritan Hospital, Baltimore, MD 21239, United States

Muhammad Nadeem Yousaf, Fizah S Chaudhary, Richard Williams, Christopher J Haas, Department of Medicine, Medstar Franklin Square Medical Center, Baltimore, MD 21237, United States

Muhammad Nadeem Yousaf, Fizah S Chaudhary, Richard Williams, Christopher J Haas, Department of Medicine, MedStar Harbor Hospital, Baltimore, MD 21225, United States

Ahsan Wahab, Department of Hospital Medicine, Baptist Medical Center South, Montgomery, AL 36116, United States

Ahmad Muneeb, Department of Medicine, Faisalabad Medical University, Faisalabald 38000, Punjab, Pakistan

Corresponding author: Muhammad Nadeem Yousaf, MD, Doctor, Department of Medicine, Medstar Union Memorial Hospital, 201 E University Pkwy, Baltimore, MD 21218, United States. nadeem.yousaf200@gmail.com

Abstract

Pancreatic cancer is the leading cause of cancer-related morbidity and mortality with an overall five-year survival of less than 9% in the United States. At presentation, the majority of patients have painless jaundice, pruritis, and malaise, a triad that develops secondary to obstruction, which often occurs late in the course of the disease process. The technical advancements in radiological imaging and endoscopic interventions have played a crucial role in the diagnosis, staging, and management of patients with pancreatic cancer. Endoscopic retrograde cholangiopancreatography (ERCP)-guided diagnosis (with brush cytology, serial pancreatic juice aspiration cytologic examination technique, or biliary biopsy) and therapeutic interventions such as pancreatobiliary decompression, intraductal and relief of gastric outlet obstruction play a pivotal role in the management of advanced pancreatic cancer and are increasingly used due to improved morbidity

Manuscript source: Unsolicited manuscript

Received: June 16, 2020
Peer-review started: June 16, 2020
First decision: July 21, 2020
Revised: July 23, 2020
Accepted: September 22, 2020
Article in press: September 22, 2020
Published online: October 16, 2020

P-Reviewer: Kim JH, Minaga K, Nakai Y, Zeng YY
S-Editor: Zhang H
L-Editor: A
P-Editor: Wang LL

and complication rates compared to surgical management. In this review, we highlight various ERCP-guided diagnostic and therapeutic interventions for the management of pancreatic cancer.

Key Words: Pancreatic cancer; Endoscopic retrograde cholangiopancreatography; Malignant stricture; Biliary drainage; Biliary stent; Gastric outlet obstruction

Core Tip: Endoscopic retrograde cholangiopancreatography (ERCP)-guided interventions have an important role in the diagnosis, treatment, and palliation of pancreatic cancer. ERCP-guided biliary tissue sampling assists in diagnosing pancreatic cancer and permit therapeutic interventions during the same procedure (if needed). Advanced pancreatic cancers may result in biliary or gastric outlet obstruction. ERCP-guided deployment of either biliary or enteral stents provides effective palliation and improves the quality of life. The selection of biliary stent subtype depends on multiple factors including life expectancy, risk of complications, cost, and the need for ERCP-guided reinterventions. Self-expandable metal stents are preferred over plastic stents because of longer luminal patency, lower rates of stent dysfunction, and overall cost.

Citation: Yousaf MN, Ehsan H, Wahab A, Muneeb A, Chaudhary FS, Williams R, Haas CJ. Endoscopic retrograde cholangiopancreatography guided interventions in the management of pancreatic cancer. *World J Gastrointest Endosc* 2020; 12(10): 323-340
URL: https://www.wjgnet.com/1948-5190/full/v12/i10/323.htm
DOI: https://dx.doi.org/10.4253/wjge.v12.i10.323

INTRODUCTION

While pancreatic cancer is the 13th most common type of cancer globally, it is the fourth leading cause of cancer-related death in the United States with an estimated 55600 new cases and 47050 deaths in 2020[1]. Despite ongoing advances in the diagnosis and management of pancreatic cancer, its five-year survival rate is less than 9% due to a notable absence of symptoms in the early stages of the disease and relatively late patient presentation at a time when patients already have an advanced disease[1,2]. When symptomatic, the extent of signs and symptoms vary depending on the size and location of the tumor (head, body, or tail)[3]. Painless jaundice secondary to biliary obstruction is one of the most common presenting manifestations of pancreatic cancer involving the head of the pancreas, uncinate process, and occasionally the body of the pancreas in cases of locally advanced malignancy. Other clinical presentations include abdominal/epigastric pain, weight loss, anorexia, and fatigue. Cancers involving the head of the pancreas are detected at an earlier stage (1/3 in stage I) due to obstructive cholestasis, whereas cancer involving the body or tail of the pancreas often remains asymptomatic until stage IV at the time of diagnosis[3].

Pancreatic cancers originate from both exocrine (ductal adenocarcinoma, intraductal papillary mucinous neoplasm (IPMN) with invasive behavior, mucinous cystic neoplasms, and adenosquamous carcinoma) and endocrine components (neuroendocrine cancers). Pancreatic ductal adenocarcinoma is the most common exocrine malignancy, responsible for 83% of cases followed by IPMN, 6% of cases[4]. Pancreatic ductal adenocarcinoma is the most common pancreatic cancer associated with extrahepatic bile duct obstruction, resulting in jaundice during the course of its disease. Progressive biliary obstruction may result in cholestasis, pruritis, and if unchecked may result in malabsorption, liver failure, and premature mortality. Biliary decompression, therefore, has a crucial role in the management of pancreatic cancer. Among patients who have resectable pancreatic cancer, a preoperative biliary decompression is suggested[5]. Palliation with biliary decompression is also critical to relieving symptoms among those with advanced or unresectable cancer[5]. Percutaneous transhepatic or endoscopic retrograde cholangiopancreatography (ERCP)-guided biliary drainage are the most common interventions used in the management of pancreatic cancers associated with biliary obstruction. Endoscopic ultrasound (EUS) is an emerging intervention that is increasingly utilized in the management of pancreatic cancers. In this review, we specifically focus on the role of ERCP in the diagnosis and management of pancreatic cancer.

ERCP-GUIDED DIAGNOSTIC INTERVENTIONS

ERCP is a commonly performed diagnostic and therapeutic procedure in the management of pancreatobiliary disorders. Endoscopy is often combined with fluoroscopy and contrast medium, permitting a detailed visualization of the anatomy of the pancreatobiliary ductal systems. With the advancement of diagnostic imaging modalities such as high-resolution computed tomography and magnetic retrograde cholangiopancreatography, coupled with the significant risk of post-ERCP pancreatitis, the use of diagnostic ERCP has decreased. Cross-sectional radiological imaging is helpful for the identification and characterization of pancreatobiliary masses. Recently published consensus guidelines recommended ERCP-guided biliary sampling for an unresectable mass when there is a concurrent need for biliary decompression, however, for resectable masses, or when ERCP tissue acquisition unsuccessful, EUS-guided fine needle biopsy is preferred[6]. The capability of EUS in obtaining tissue samples for pathological staining and diagnosis of pancreatic malignancy has shifted the role of ERCP primarily to therapeutic interventions[7-9]. Indeed, the diagnostic yield of EUS is comparable to ERCP and carries a markedly reduced risk of complications. Multiple prospective and retrospective studies focusing on individuals with pancreatic cancer have shown the overall superior diagnostic yield of EUS over ERCP with a range of sensitivity of 43%-94% (median 81%) *vs* 13%-81% (median 52%) and specificity of 93%-100% (median 100%) *vs* 75%-100% (median 100%) (Table 1)[10-17]. In a recent RCT, Lee *et al*[18] showed 96.7% sensitivity for diagnosis of malignancy in extrinsic type biliary stricture (due to pancreatic cancer) by using a combined approach of initial ERCP-guided transpapillary biliary biopsy (ERCP-TPB) followed by EUS-guided fine needle biopsy in those negative for malignancy on initial ERCP-TPB. For intrinsic (biliary tract cancer) biliary stricture, an initial and followed up ERCP-TPB are adequate in diagnosis of malignancy with a 96.6% sensitivity[18]. ERCP, in contrast, allows for the opportunity to perform both intervention and diagnosis in the same procedure – pancreatobiliary drainage and specimen collection for cytopathology. In case of known or suspected pancreatic cancer, ERCP is used in the management of biliary obstruction. Cytological and histological specimens for pathological diagnosis are essential in the management of pancreatic cancer, guiding the selection of chemoradiation therapy, and ERCP-mediated procedures such as ERCP-guided brush cytology, needle aspiration, or forceps biopsy are occasionally utilized. Fluoroscopy guided biliary brush cytology, biliary biopsy, and cholangioscopy-guided biopsy are the most common ERCP techniques for tissue acquisition.

ERCP-guided biliary brush cytology

Biliary brush cytology is obtained by advancing 8 French (Fr) cytology brush over a guidewire beyond the stricture using a specialized catheter. The brush is moved back and forth across the stricture to obtain an adequate sample. The brush is then withdrawn into the catheter before removal of the endoscope and catheter as a unit to improve the diagnostic yield of a sample and prevent contamination. A series of prospective and retrospective studies including 1285 patients with malignant biliary strictures has shown the sensitivity of brush cytology sample obtained from the bile duct ranged from 30% to 78% (median 54%) with a specificity of 97% to 100% (median 100%) for the diagnosis of malignant biliary strictures (Table 2)[10,15,19-37]. To increase the diagnostic yield of brush cytology, various technical modifications have been evaluated. Farrell *et al*[38] compared brushing alone with a combined approach of stricture dilation coupled with endoscopic aspiration with 22-gauge needle and brushing and demonstrated an increased diagnostic yield of cytology with a sensitivity of 57% *vs* 85% ($P < 0.02$) and a specificity of 80% *vs* 100%, with the standard and modified techniques, respectively. Overall, biliary brushing is a safe technique associated with minimal risk of adverse events such as pancreatitis and bile duct perforation.

ERCP-guided endobiliary forceps biopsy

Fluoroscopic-guided biliary biopsy improves the diagnostic yield over simple biliary brush cytology by obtaining biliary tissue sampling deeper to the epithelial layer. It can be performed by passing 5-Fr to 10-Fr biopsy forceps at the lower edge of stricture.

Table 1 Prospective/retrospective studies comparing the overall yield of endoscopic ultrasound and endoscopic retrograde cholangiopancreatography in the diagnosis of pancreatic cancer

Ref.	Year	No. of patients	No. of patients with pancreatic cancer	Diagnostic yield of EUS		Diagnostic yield of ERCP	
				Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Moura *et al*[10]	2018	50	48	94	100	60	100
Weilert *et al*[11]	2014	51	34	94	100	50	100
Oppong *et al*[12]	2010	37	32	53	100	29	100
Ross *et al*[13]	2008	114	68	83	100	13	100
Wakatsuki *et al*[14]	2005	83	68	93	100	33	100
Rösch *et al*[15]	2004	50	16	43	100	54	100
Glasbrenner *et al*[16]	2000	95	50	78	93	81	88
Cellier *et al*[17]	1998	41	41	55	90	78	75
Total	-	521	357	81[1]	100[1]	52[1]	100[1]

Decimal numbers are rounded off.

[1]Median. EUS: Endoscopic ultrasound; ERCP: Endoscopic retrograde cholangiopancreatography.

The specimen can be collected at the level of stricture by opening and closing the biopsy forceps under the guidance of fluoroscopy. While the optimal number of individual biopsy specimens remains a matter of contention, general protocol suggests a minimum of three tissue samples to establish the diagnosis of malignant stricture[30,39,40]. A series of 19 prospective and retrospective studies on 1101 patients with malignant biliary strictures evaluated with endobiliary forceps biopsy have shown that sensitivity ranges from 36% to 81% (median 61%) with specificity from 90% to 100% (median 100%) for the diagnosis of malignant biliary strictures (Table 3)[10,15,26,29,30,34-37,41-51]. The diagnostic yield is much higher with the combination of forceps biopsy and brush cytology with a pooled sensitivity of 63% to 86% and a specificity of 97% to 100%[30,52]. Despite the increased sensitivity and specificity, forceps biopsy remains technically challenging and a user-dependent procedure, and as such is less commonly performed than brush cytology. Indeed, it is related to a number of unique adverse events, such as bleeding and perforation of common hepatic duct, secondary to a variety of factors – forceps size and stiffness, number of biopsy passes, and the technical capability of the endoscopist[20,30,44].

Cholangiopancreatoscopic-guided biopsy

Cholangiopancreatoscopy involves direct luminal visualization of the biliary and pancreatic ductal systems. Conventionally, it was performed by two endoscopists using a mother-daughter per-oral scope setup where one endoscopist handle ERCP scope while other endoscopist operate a fragile scope within biopsy channel of main ERCP scope. The introduction of ultraslim gastroscope loaded with anchoring balloon (a slight modification in this technique) enabled a single operator to perform this procedure without issues of scope fragility. Novel intraductal visualization techniques employing the Spyglass system have augmented diagnostic yield by permitting the endoscopist the opportunity to obtain targeted tissue under direct visualization. This system involves the use of a disposable SpyScope with a tip-deflecting access catheter, working catheter, SpyBite biopsy forceps, and two irrigation channels enabling a single operator to perform the procedure. Cholangioscopy-guided biopsy can be performed by advancing a cholangioscope through the biopsy channel of a duodenoscope, enabling direct visualization and biopsy of a biliary stricture. The classic cholangioscopic features of malignant biliary strictures are cholangioscopic visualization of intraductal nodules surrounded by tortuous, irregularly dilated blood vessels, and the presence of papillary or villous mucosal projections[53,54]. ERCP-guided cholangioscopy has increased the diagnostic yield of bile duct biopsy by allowing the collection of suspected neoplastic tissue under direct visualization. In cases of main pancreatic duct IPMN, a premalignant condition of the pancreas, ERCP-guided pancreatoscopy with biopsy may be helpful in making the diagnosis, particularly due to its classic, pathognomonic features fish egg-like, villous and prominent mucosal

Table 2 Prospective/retrospective studies on the diagnostic yield of endoscopic retrograde cholangiopancreatography guided brush cytology for malignant biliary stricture

Ref.	Year	No. of patients	No of patients with malignant strictures	TP on brush cytology	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Moura *et al*[10]	2018	50	48	40	40	100	100	7
Agarwal *et al*[21]	2018	40	40	27	68	NA	NA	NA
Sethi *et al*[33]	2016	162	106	58	55	100	100	54
Shieh *et al*[22]	2014	32	32	25	78	NA	NA	NA
Weber *et al*[36]	2008	58	58	24	41	NA	NA	NA
Kitajima *et al*[37]	2007	60	NA	NA	72	100	NA	NA
Fogel *et al*[23]	2006	102	94	28	30	NA	NA	NA
Rösch *et al*[15]	2004	50	28	28	46	100	NA	NA
Stewart *et al*[24]	2001	406	246	147	60	98	98	61
Macken *et al*[25]	2000	106	62	35	57	100	100	62
Jailwala *et al*[26]	2000	133	104	31	30	100	100	28
Glasbrenner *et al*[27]	1999	78	57	32	56	91	94	43
Mansfield *et al*[28]	1997	54	52	17	54	100	100	8
Sugiyama *et al*[35]	1996	43	31	25	48	100	NA	NA
Pugliese *et al*[29]	1995	94	64	35	54	100	100	50
Ponchon *et al*[30]	1995	210	128	45	35	97	96	44
Lee *et al*[31]	1995	149	106	40	37	100	100	39
Foutch *et al*[32]	1991	30	17	06	33	100	100	58
Pugliese *et al*[34]	1987	22	12	08	66	88	NA	NA
Total	-	1879	1285	651	54[1]	100[1]	-	-

[1]Median value of available data. TP: True positive; PPV: Positive predictive value; NPV: Negative predictive value; NA: Data not available. Decimal numbers are rounded off.

protrusions which carry a sensitivity of 68% and a specificity of 87%[55-57]. Cholangioscopy is 88% to 100% sensitive and 77% to 92% specific for the diagnosis of pancreatobiliary malignancy[54,58-62]. Common complications with cholangiopancreatoscopy are bile duct perforation, hemorrhage, air embolization, pancreatitis, and cholangitis. The overall risk of complications with this modality is higher than ERCP, therefore, the utility of cholangiopancreatoscopy is reserved for selected cases of inaccessible ductal lesions[63].

ERCP-guided naso-pancreatic drainage

ERCP-guided naso-pancreatic drainage (ENPD) is a method to collect pancreatic juice using a specialized drainage catheter compatible with standard duodenoscope. ENPD was first implemented by Endo *et al*[64] in 1974 for cytodiagnosis of pancreatic cancer. A slight modification of the standard ENPD technique wherein pancreatic juice collection is performed after injection of synthetic secretin, has been shown to provide a dedicated sample with a sufficient number of cells for cytological analysis and has improved the diagnostic sensitivity from 50.9% to 70.4%[65]. Of note, in this study, an additional 13 pancreatic cancer patients were diagnosed using the modified ENPD technique that were missed with EUS-fine needle aspiration (EUS-FNA), making the modified ENPD technique preferred, particularly in instances where tissue collection with EUS-FNA is unsuccessful or impossible[65]. Another modification of ENPD involving placement of a 4 or 5 Fr tube (with 8-12 hole) in the main pancreatic duct and collection of pancreatic juice 2-6 times daily for up to 3 d has increased the diagnostic yield for detection of pancreatic cancer with 80% sensitivity, 100% specificity, 100% positive predictive value, 71% negative predictive value, and 87%

Table 3 Prospective/retrospective studies on the diagnostic yield of fluoroscopic guided endobiliary forceps biopsy for malignant biliary stricture

Ref.	Year	No. of patients	No of patients with malignant strictures	TP on forceps biopsy	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Moura *et al*[10]	2018	50	48	40	44	100	100	7
Tanaka *et al*[47]	2018	123	123	80	65	NA	NA	NA
Naitoh *et al*[48]	2016	208	160	97	61	100	100	43.2
Chen *et al*[49]	2016	79	65	35	54	100	100	31.82
Nishikawa *et al*[50]	2014	72	64	32	50	96	97	40.7
Kawashima *et al*[51]	2012	61	34	26	76	100	NA	NA
Hartman *et al*[41]	2012	81	38	30	76	100	100	81
Draganov *et al*[42]	2012	26	17	5	29	100	100	43
Wright *et al*[43]	2011	133	117	84	72	100	100	36
Weber *et al*[36]	2008	58	58	31	53	NA	NA	NA
Kitajima *et al*[37]	2007	60	NA	NA	62	100	NA	NA
Rösch *et al*[15]	2004	50	28	28	36	100	NA	NA
Jailwala *et al*[26]	2000	133	104	48	43	90	94	31
Schoefl *et al*[44]	1997	103	58	38	65	100	100	69
Sugiyama *et al*[35]	1996	43	31	25	81	100	100	67
Ponchon *et al*[30]	1995	128	82	35	43	97	97	41
Pugliese *et al*[29]	1995	52	36	19	53	100	100	48
Kubota *et al*[45]	1993	41	32	26	81	100	100	75
Pugliese *et al*[34]	1987	22	06	06	100	100	NA	NA
Total	-	1453	1101	685	61[1]	100[1]	-	-

[1]Median value of available data. Decimal numbers are rounded off. TP: True positive; PPV: Positive predictive value; NPV: Negative predictive value; NA: Data not available.

overall accuracy[66]. Iiboshi *et al*[67] reported similar results of ENPD with 100% sensitivity, 83.3% specificity, and 95% accuracy in the diagnosis of in situ pancreatic cancer. For pancreatic cancers smaller than 1 cm, the diagnostic yield of EUS-FNA is limited. ERCP-guided serial pancreatic juice aspiration cytologic examination (SPACE) technique is a promising modality that may be superior to EUS-FNA for diagnosing pancreatic cancer at early stages (stage 0 and stage I)[68]. A multicenter Japanese study on 200 (51 with stage 0 and 149 with stage I) pancreatic cancer patients has shown a better cytological confirmation of stage 0 pancreatic cancer using ERCP-guided SPACE technique as compared to EUS-FNA (72% *vs* 17%). In contrast, for stage I pancreatic cancer, EUS-FNA has been shown to be superior to ENPD (84% *vs* 60%)[69]. Post-ENPD pancreatitis and cholangitis are the commonly reported complications[65].

ENDOSCOPIC RETROGRADE-GUIDED THERAPEUTIC INTERVENTIONS

ERCP-guided biliary decompression

While 15% of pancreatic cancer patients are candidates for surgical resection, preoperative biliary decompression may be required. It is also a commonly employed feature in these individuals for palliation. ERCP-guided biliary drainage or decompression with transpapillary stenting is the mainstay of management for patients with biliary obstruction and its related complications. In patients with advanced pancreatic malignancy, endoscopic and surgical biliary drainage showed similar success rate and long-term symptomatic relief[70,71]. Endoscopic biliary decompression, however, is minimally invasive, more convenient, and relatively safer than surgical bypass for biliary decompression, especially for patients with unresectable pancreatic cancer[72]. Endoscopic decompression is associated with fewer complications, shorter hospital stays, lower cost, and better quality of life.

Indications

A recent cross-sectional study on 411409 inpatient ERCP procedures revealed that malignant biliary obstruction was the fourth most common indication for ERCP in the past decade, with balloon dilation or stenting of biliary or pancreatic strictures often performed[7]. Indeed, with these interventions, there is a noted improvement of pruritus, jaundice, and known complications of malignant biliary obstruction such as acute cholangitis and renal dysfunction[73]. Preoperative ERCP-guided biliary decompression is a preferred approach for patients who encounter delays in surgical intervention due to a decision to initiate neoadjuvant therapy and in those with severe malnourishment requiring nutritional support[74-76]. In unresectable pancreatic cancer, ERCP-guided transpapillary biliary stenting not only improves patient's symptoms and quality of life but is also associated with reduced mortality and morbidity[77].

Technical accessibility and consideration

The procedural feasibility of ERCP-guided transpapillary biliary stenting is above 90% with a short term efficacy in terms of symptomatic relief of over 80%[78,79]. Sphincterotomy with adjunctive guidewire rather than standard catheter for biliary canalization is associated with rapid access to the bile duct, a higher success rate (85% to 95%), and lower risk of complications[80,81]. ERCP-mediated biliary decompression can be performed by the deployment of either a self-expandable metal stent (SEMS) or plastic stent over the guidewire threaded across a malignant stricture. Stent selection depends on several factors such as the level of biliary dysfunction, the need for reintervention, complication rate, cost, and the likelihood of short- and long-term patient survival[82]. SEMS have a significantly lower risk of complications and stent dysfunction compared with plastic stents[82]. A recent meta-analysis showed a lower rate of stent dysfunction, subsequent rate of reinterventions, and longer median survival for SEMS when compared with plastic stents[83]. Compared to percutaneous and surgical biliary decompressions, ERCP-mediated biliary stenting not only improved patient symptoms and quality of life but was also associated with reduced mortality and morbidity[77]. In cases of unsuccessful ERCP-transpapillary biliary stenting, EUS-guided biliary drainage with transmural stenting has been increasingly used as an alternative option for palliation in malignant biliary obstruction[6]. A recent meta-analysis (10 studies including 3 RCT) compared the efficacy of EUS-guided biliary decompression with ERCP in the palliation of malignant biliary obstruction and demonstrated a similar technical (94.8% *vs* 96.5%) and clinical (93.8% *vs* 95.7%) success rates respectively[84].

Types of biliary stents

Plastic stents: Plastic biliary stents are usually made of polyethylene, polyurethane, or Teflon that are available in different sized diameters including 7, 8.5, 10 and 11.5 Fr and lengths ranging from 5 cm to 15 cm. Large diameter stents are preferable because of better flow rate, infrequent stasis, and decreased incidence of stent occlusion. These stents are designed into various shapes - straight, curved, single, or double pigtails. The introduction of sidewall anchoring flaps and pigtails on either end of the stent prevents stent migration. The choice of stent depends upon multiple factors including the likely etiology of the lesion, as well as location and length of the biliary stricture. Plastic stents are preferred for benign lesions, whereas metal stents are favored in malignant lesions. Plastic stents offer the benefit of ease of deployment, abrogate the need for biliary sphincterotomy, and are less expensive in the management of individuals with shorter life expectancy[85,86]. Plastic stents also have a more limited duration of patency and often require stent exchange every 10 to 12 wk to circumvent stent occlusion, thus making them a relatively unfavorable therapeutic option for the management of malignant biliary obstruction in those with a longer life expectancy. A large RCT has shown an overall superiority of metal stents over plastic stents in managing patients with longer survival times, whereas no differences in the rate of adverse events and mortality were reported[87].

Self-expanding metal stents: Endoscopic biliary SEMS employ a large diameter stent (8-10 mm), which has been shown to significantly reduce the risk of stent occlusion (approximately 50% lower than plastic stents) while not completely eliminating the risk of complete obstruction[82]. SEMS are manufactured as fully-covered or partially-covered devices. While the original SEMS were comprised of uncovered metal [stainless steel, nitinol (a mixture of titanium and nickel)] or platinol (a combination of the platinum core with encasement of nitinol), which reduced the risk of stent migration, but these were associated with significant stent dysfunction secondary to tumor ingrowth or occlusive biliary sludge, which when coupled with the limited ability to remove these metal stents, created major disadvantages and further complications. To address these issues, second-generation SEMS were manufactured as partially-covered or fully-covered devices with a polyurethane, polycaprolactone, or silicone membrane that resulted in a significantly lower risk of tumor ingrowth and reduced difficulties associated with stent retrieval/removal. Despite these advances, fully-covered biliary SEMS pose several challenges such as higher risks of stent migration, pancreatitis, and cholecystitis. Furthermore, fully-covered SEMS have several specific anatomical restrictions, primarily due to their covered nature. For example, proximal biliary lesions at the level of hilum have unique anatomical considerations specifically related to biliary drainage from intrahepatic side branches. As such in this scenario, partially-covered SEMS are preferred over fully-covered SEMS particularly as lesions become more proximal, as partially-covered SEMS would allow effective drainage of the intrahepatic side branches through fenestrations of uncovered portions of the stent. Multiple RCT and retrospective studies have shown the superiority of uncovered SEMS over covered SEMS for long-term stent patency, however no significant difference in patency between two SEMS after 6 and 12 mo, and no difference in patient survival or complication rates such as pancreatitis, cholangitis, cholecystitis, perforation, bleeding, length of hospital stay, and incidence of recurrent biliary obstruction (Table 4)[47,88-106]. Taken together, uncovered SEMS are associated with higher rates of stent dysfunction due to tumor ingrowth whereas covered SEMS have a higher rate of stent migration and a lower risk of sludge-mediated occlusion (Table 4)[47,88-106]. Overall, no difference was observed in the rates of pancreatitis and cholecystitis between covered and uncovered SEMS[47,88-106].

Compared to plastic stents, metal stents are 15-30 times more expensive and technically difficult to deploy[82]. SEMS provides longer stent patency (6 to 9 mo) than plastic stents (3 to 4 mo). Multiple studies have shown no significant difference in technical or therapeutic success rates, complication rates, and 30 d mortality, however, these studies did show a lower rate of stent occlusion and overall risk of obstruction for uncovered SEMS at four-months[85]. The selection of biliary stent subtype depends on multiple factors including life expectancy, risk of complications, cost, and the need for ERCP-guided reinterventions (if needed) for stent replacement / manipulation.

Safety and complications of ERCP-guided biliary decompression: ERCP-guided biliary drainage is a relatively safe, minimally invasive intervention compared to percutaneous or surgical biliary decompression. It is however associated with several complications including post-ERCP pancreatitis, cholangitis, cholecystitis, biliary ductal perforation, stent migration or obstruction, liver abscess, and hemorrhage[107,108]. Several factors have been associated with higher complication rates such as degree of obstructive jaundice, previous gastrointestinal surgeries, and multiple comorbidities[109-112]. Such high-risk patients have demonstrated an increased risk of post-ERCP complications and are managed conservatively with rectal indomethacin or diclofenac, adequate hydration, nutritional support, and early use of antibiotics. After plastic biliary stenting, close follow up is required for early identification of recurrent biliary obstruction due to stent occlusion. For those patients with a longer life expectancy (more than 3 mo) and when close follow up is impossible, scheduled stent exchange is required[6]. In case of biliary decompression using SEMS, on demand biliary reintervention is recommended based on clinical judgement[6].

ERCP-guided preoperative biliary drainage for resectable pancreatic cancers

The role of preoperative biliary drainage (PBD) in the management of resectable pancreatic cancer is still controversial. Routine PBD is not recommended, however, in cases of pruritus or cholangitis, biliary stenting can be considered following interdisciplinary consultation[6]. Factors such as liver dysfunction, hyperbilirubinemia, coagulopathy, and cholangitis correlate with the severity of biliary obstruction and are associated with deleterious effects on renal or cardiovascular function, malnutrition, and an increased risk of postoperative morbidities[111,112]. Therefore, some surgeons recommend PBD before performing a Whipple procedure for symptomatic relief and associated prevention of complications due to cholestasis in patients with obstructive jaundice. In a retrospective study, Coates *et al*[113] compared the impact of PBD on short

Table 4 Randomized controlled trials and retrospective studies comparing covered with un-covered biliary self-expanding metal stents for malignant distal biliary obstruction

Ref.	Year	Study design	Type of stent	No. of patients	Pancreatic malignancy (%)	Stent patency (d)	Patient survival (d)	No. of stent dysfunction	No. of complications
Seo *et al*[15]	2019	RCT	Uncovered, Covered	60, 59	100	NA, NA	NA, NA	10[1], 0	12, 14
Conio *et al*[88]	2018	RCT	Uncovered, Covered	80, 78	72.5, 75.6	541 (Median)[1], 240 (Median)	112 (Median), 134 (Median)	10, 12	10, 19
Flores-Carmona *et al*[89]	2016	RCT	Uncovered, Covered	46, 22	52.5, 50	NA, NA	NA, NA	4, 3	NA, NA
Mangiavillano *et al*[90]	2015	RCT	Uncovered, Covered	21, 23	NA	194 (Median)[1], 89 (Median)	NA, NA	NA, NA	1, 1
Lee SJ *et al*[91]	2014	RCT	Uncovered, Covered	20, 20	30, 60	413.3 ± 63 (mean ± SD)[1], 207.5 ± 46 (mean ± SD)	359.9 ± 61.5 (mean ± SD), 350.5 ± 43.8 (mean ± SD)	4[1], 10	0, 3
Ung *et al*[92]	2013	RCT	Uncovered, Covered	34, 34	79, 88	127 (Median), 153 (Median)	157 (Median), 154 (Median)	NA, NA	0, 2
Kitano *et al*[93]	2013	RCT	Uncovered, Covered	60, 60	100, 100	166.9 ± 124.9 (mean ± SD)[1], 219.3 ± 159.1 (mean ± SD)	223 (Median), 285(Median)	22, 14	2, 2
Fukuda *et al*[94]	2012	RCT	Uncovered, Covered	71, 72	84.5, 83.3	314 (Median)[1], 552(Median)	NA, NA	23, 17	NA, NA
Krokidis *et al*[95]	2011	RCT	Uncovered, Covered	40, 40	100, 100	166.0 ± 82.8 (mean ± SD)[1], 234.0 ± 132 (mean ± SD)	203.2 ± 74.8 (Median ± SD), 247.0 ± 126.7 (Median ± SD)	12[1], 4	4, 5
Krokidis *et al*[96]	2010	RCT	Uncovered, Covered	30, 30	0, 0	166.0 ± 87.7 (mean ± SD)[1], 227.3 ± 139.7 (mean ± SD)	180.5 ± 82.6 (Median ± SD), 243.5.0 ± 141.1 (Median ± SD)	10[1], 4	4, 3
Kullman *et al*[97]	2010	RCT	Uncovered, Covered	200, 200	77, 76	154 (Mean), 199 (Mean)	174 (Median), 116 (Median)	45, 47	20, 14
Telford *et al*[98]	2010	RCT	Uncovered, Covered	61, 68	77, 86	711 (Median), 357 (Median)	239 (Median), 227 (Median)	12[1], 23	27[1], 48
Cho *et al*[99]	2009	RCT	Uncovered, Covered	38, 39	NA	195 (Median), 227 (Median)	NA, NA	NA, NA	4, 10
Gonzalez-Huix *et al*[100]	2008	RCT	Uncovered, Covered	53, 61	58.5, 52.5	NA, NA	NA, NA	6[1], 8	14[1], 23
Yoon *et al*[46]	2006	Retrospective	Uncovered, Covered	41, 36	68.2, 86	319 (Mean), 398 (Mean)	308 ± 42 (mean ± SD), 392 ± 60 (mean ± SD)	11[1], 15	1, 4
Park *et al*[101]	2006	Retrospective	Uncovered, Covered	108, 98	65.7, 54.1	143.5 (Mean), 148.9 (Mean)	207 (Mean), 209 (Mean)	20, 21	3, 17
Isayama *et al*[102]	2004	RCT	Uncovered, Covered	55, 57	58.2, 59.6	193 (Mean)[1], 225 (Mean)	237 (Mean), 255 (Mean)	21[1], 8	3, 8
Lee *et al*[103]	2004	RCT	Uncovered, Covered	21, 22	38.1, 40.9	127 (Median)[1], 216 (Median)	NA, NA	11, 4	NA, NA
Smith *et al*[105]	1995	RCT	Uncovered, Covered	24, 22	70.1, 77.3	NA, NA	NA, NA	NA, NA	3, 3

[1]Statistically significant data; RCT: Randomized controlled trial; NA: Data not available.

term (90 d) postoperative outcome and demonstrated a need for repeat surgical intervention in patients who underwent pancreatoduodenectomy without preoperative ERCP, with no significant difference in the rate of complications, hospital stay, and 30-90 d mortality between two groups. PBD also prepares the patient for neoadjuvant chemotherapy due to improved liver function test and the relative contraindication to chemotherapy use with hyperbilirubinemia after relieving biliary obstruction. However, PBD was criticized in several studies because of reported increased morbidity, mortality, prolonged hospital stay after preoperative biliary stenting[114-116].

ERCP-PBD using covered SEMS is preferred over uncovered SEMS and plastic stents because of a decreased risk of stent dysfunction and longer stent patency[6]. In a recent RCT, Seo *et al*[106] have shown comparable success rates of covered and uncovered SEMS in pancreatic cancer patients undergoing PBD before and after neoadjuvant therapy, however, covered SEMS were suggested to be superior in cases of diagnosis uncertainty. If a biliary stricture turns out to be malignant, there is no need to replace covered SEMS with uncovered SEMS because risk of stent dysfunction due to tumor ingrowth is negligible. Shorter stent lengths (4 cm as opposed to 6 or 8 cm) and the presence of an in situ gallbladder were significant predictors associated with failure to attain prolonged biliary drainage with a hazard ratio of 2.1 and 6.9[106]. The type of stent selection should be individualized based on these factors. Recent meta-analyses and systematic reviews demonstrated an increased risk of complications without a significant survival difference in patients undergoing PBD *vs* direct surgery[76,117-119]. Severe hyperbilirubinemia was not present in the majority of studies included in meta-analysis, hence the role of PBD in patients with severe biliary obstruction is uncertain. To further investigate the effects of preoperative ERCP on pancreatic cancer survival rates, Rustgi *et al*[120] assessed overall survival among 2890 patients with pancreatic cancers from 2000 through 2011. Of these, 1864 patients underwent ERCP within 6 mo of surgery and 1026 patients underwent surgical resection without preoperative ERCP. After adjustment of confounding factors, patients in the preoperative ERCP group did not demonstrate an increased risk of mortality compared to patients who proceeded directly to surgical resection[121,122]. This study did not comment on ERCP-related adverse events such as biliary sepsis, and thus warrants further analysis. In clinical practice, however, preoperative ERCP is often performed due to issues related to either delay in the definitive surgical resection or the provision of neoadjuvant chemotherapy. Overall, PBD should be avoided in patients undergoing early surgical resection (usually under 2 wk), however, those with persistent symptoms (pruritis), severe jaundice, and delay in surgery for medical optimization, PBD may be justified.

ERCP-guided biliary drainage in neoadjuvant treatment of pancreatic cancer

In patients with borderline resectable pancreatic malignancy, neoadjuvant chemotherapy or chemoradiation is clearly beneficial, whereas their role in outright surgically resectable malignancy remains unclear[76]. Neoadjuvant therapy enables the surgical resection of a borderline resectable disease by downstaging of pancreatic tumors and has shown to improve the outcomes of surgical management in treating patients with metastasis. Furthermore, PBD is a prerequisite for neoadjuvant therapy to prevent chemotherapy-induced hepatotoxicity and may be pursued 3 mo prior to surgical resection[76]. A meta-analysis including six RCT favored the biliary decompression using SEMS in patients with unresectable cancer or those unfit for surgical resection due to multiple comorbidities or advanced disease[75]. Among patients with resectable pancreatic cancer who may undergo surgical resection within three months, the placement of a plastic biliary stent should be adequate as prolonged biliary drainage avoids interruptions of medical treatment by improving symptoms of biliary obstruction or cholangitis. Hence the placement of SEMS appears reasonable to consider in these patients. An RCT on SEMS *vs* surgery to palliate malignant obstructive jaundice in stage IV pancreatic cancer has demonstrated the added benefits of cost-effectiveness, reduced hospital stay, and procedural morbidity in patients palliated with SEMS, a finding that was balanced however by the noted difficulty in SEMS removal during surgery[74].

Role of ERCP in gastric outlet obstruction

Indications: An estimated of 15% of patients with pancreatic cancer experience mechanical gastric outlet obstruction (GOO) during the course of their disease, especially if malignant lesions involve the gastric antrum, proximal or distal duodenum[121,122]. Endoscopic-guided enteral stent placement is an effective palliative option in the management of advanced pancreatic cancer[121]. Endoscopic palliation of

GOO is typically indicated in patients with a shorter life expectancy usually less than 6 mo.

Technical accessibility and consideration: Endoscopic palliation of GOO involves the advancement of a guidewire across the malignant stricture and endoscopic deployment of an enteral stent (covered or uncovered). Simultaneous obstructions of both gastro-duodenal outlet and bile duct are often found in patients with advanced pancreatic cancer. In these cases, the anatomical level of the malignant stricture is classified as obstruction involving proximal duodenum at the level of duodenal bulb or genu (type I), second part of duodenum involving papilla (type II) or distal to papilla in the third part of duodenum (type III)[122]. This anatomical classification is important because the level of obstruction determines the management approach. In type I obstruction, an anatomical consideration that enables the advancement of a scope through the duodenal stricture (often with dilatation), biliary stenting should be performed prior to duodenal stent placement. If there are technical difficulties associated with endoscope passage through a duodenal stricture, then duodenal stenting should be performed first, with subsequent advancement of the scope through the duodenal stent to perform either immediate or delayed (after a few days) biliary stenting. In type II obstruction, ERCP-guided transpapillary stenting may be challenging due to difficulty in finding papillary opening. In this situation, EUS-guided transmural or antegrade biliary stenting is recommended and duodenal stenting could be performed simultaneously[122]. In type III obstruction, the sequence of either biliary or duodenal stent placement is not critical. ERCP-guided transpapillary stenting is associated with poor clinical outcome in patients with combined biliary and GOO because of risk of cholangitis from duodenobiliary reflux of food particles and digestive juice[122]. Endoscopic enteral stenting should be performed in cases of a solitary malignant stricture without evidence of distal obstruction from the site of stent deployment. Palliative gastric decompression with the placement of jejunal feeding tube or total parenteral nutrition should be considered in case of multiple strictures or GOO, especially if distal to the location of planned stent deployment[123]. In patients who fail standard endoscopic management of GOO, there is increasing use of less invasive EUS-guided gastrojejunostomy due to its advantages to establish longer patency, fewer adverse events, and higher clinical and technical success rates[122,124].

Safety and complications: Overall, the placement of SEMS is associated with more favorable results in patients with poor performance status and a relatively shorter life expectancy, whereas gastrojejunostomy (GJJ) may offer more durable results in patients with a more favorable prognosis[123,125]. A systemic review (including 32 studies) and several prospective studies on the endoscopic placement of SEMS studies have shown an overall technical success rate of 97% (91% to 100%) and the clinical success rate of 89% (63% to 95%)[126-134]. Another systemic review (44 studies) has shown a higher clinical success rate (89%) of endoscopically placed enteral stents compared to GJJ[125]. Placement of enteral SEMS is associated with a shorter hospital stay and early resumption of oral intake, with similar major complication rates noted between SEMS and GJJ[126]. Enteral stents are associated with an increased risk of stent migration or malfunction (17%) typically due to tumor ingrowth and/or food impaction, a complication that is managed endoscopically with the clearance of impacted food or stent replacement[123]. More recently, a meta-analysis (including 13 studies) on 1624 patients with malignant GOO showed comparable stent dysfunction and similar clinical and technical success rates of covered *vs* uncovered SEMS. Covered SEMS, however, showed lower rates of luminal occlusion (RR: 0.44; 95%CI: 0.28-0.68) at the expense of higher stent migration (RR: 4.28; 95%CI: 2.89-6.34) and overall adverse events (RR: 1.75; 95%CI: 1.09-2.83)[135]. Covered SEMS are associated with stent migration, usually within 8 wk of placement, requiring endoscopic repositioning or replacement. Other complications of enteral stenting are hemorrhage (1%), enteral perforation (1%), peritonitis, pancreatitis, cholangitis, biliary or intestinal obstruction, and abdominal pain[123].

CONCLUSION

ERCP plays a vital role in the management of pancreatic cancer. ERCP-guided brush cytology and forceps biopsy of malignant biliary strictures provide reasonable tissue for diagnostic confirmation of disease. ERCP-guided SPACE technique is a promising modality that may be superior than EUS-FNA for diagnosing pancreatic case at early stages. The therapeutic interventions of ERCP are helpful in effective preoperative biliary decompression in those with resectable pancreatic cancer. In patients with unresectable pancreatic cancer, palliation with ERCP-guided biliary decompression by the placement of either plastic or self-expanding metal stents relieves symptoms to improve quality of life. Selection of stents should be individualized depending upon patient's clinical presentation, weighing not only the risks and benefits, but also the physician's clinical judgement. GOO is a common complication of advanced pancreatic cancer, ERCP-guided enteral stenting is preferred modality over surgical gastrojejunostomy in the management of GOO in patients with poor performance and shorter life expectancy.

REFERENCES

1 **Siegel RL**, Miller KD, Jemal A. Cancer statistics, 2020. *CA Cancer J Clin* 2020; **70**: 7-30 [PMID: 31912902 DOI: 10.3322/caac.21590]

2 **Rawla P**, Sunkara T, Gaduputi V. Epidemiology of Pancreatic Cancer: Global Trends, Etiology and Risk Factors. *World J Oncol* 2019; **10**: 10-27 [PMID: 30834048 DOI: 10.14740/wjon1166]

3 **Porta M**, Fabregat X, Malats N, Guarner L, Carrato A, de Miguel A, Ruiz L, Jariod M, Costafreda S, Coll S, Alguacil J, Corominas JM, Solà R, Salas A, Real FX. Exocrine pancreatic cancer: symptoms at presentation and their relation to tumour site and stage. *Clin Transl Oncol* 2005; **7**: 189-197 [PMID: 15960930 DOI: 10.1007/BF02712816]

4 **Winter JM**, Cameron JL, Campbell KA, Arnold MA, Chang DC, Coleman J, Hodgin MB, Sauter PK, Hruban RH, Riall TS, Schulick RD, Choti MA, Lillemoe KD, Yeo CJ. 1423 pancreaticoduodenectomies for pancreatic cancer: A single-institution experience. *J Gastrointest Surg* 2006; **10**: 1199-210; discussion 1210-1 [PMID: 17114007 DOI: 10.1016/j.gassur.2006.08.018]

5 **Han J**, Chang KJ. Endoscopic Ultrasound-Guided Direct Intervention for Solid Pancreatic Tumors. *Clin Endosc* 2017; **50**: 126-137 [PMID: 28391669 DOI: 10.5946/ce.2017.034]

6 **Nakai Y**, Isayama H, Wang HP, Rerknimitr R, Khor C, Yasuda I, Kogure H, Moon JH, Lau J, Lakhtakia S, Ratanachu-Ek T, Seo DW, Lee DK, Makmun D, Dy F, Liao WC, Draganov PV, Almadi M, Irisawa A, Katanuma A, Kitano M, Ryozawa S, Fujisawa T, Wallace MB, Itoi T, Devereaux B. International consensus statements for endoscopic management of distal biliary stricture. *J Gastroenterol Hepatol* 2020; **35**: 967-979 [PMID: 31802537 DOI: 10.1111/jgh.14955]

7 **Ahmed M**, Kanotra R, Savani GT, Kotadiya F, Patel N, Tareen S, Fasullo MJ, Kesavan M, Kahn A, Nalluri N, Khan HM, Pau D, Abergel J, Deeb L, Andrawes S, Das A. Utilization trends in inpatient endoscopic retrograde cholangiopancreatography (ERCP): A cross-sectional US experience. *Endosc Int Open* 2017; **5**: E261-E271 [PMID: 28382324 DOI: 10.1055/s-0043-102402]

8 **Adler DG**, Baron TH, Davila RE, Egan J, Hirota WK, Leighton JA, Qureshi W, Rajan E, Zuckerman MJ, Fanelli R, Wheeler-Harbaugh J, Faigel DO; Standards of Practice Committee of American Society for Gastrointestinal Endoscopy. ASGE guideline: the role of ERCP in diseases of the biliary tract and the pancreas. *Gastrointest Endosc* 2005; **62**: 1-8 [PMID: 15990812 DOI: 10.1016/j.gie.2005.04.015]

9 **Scheiman JM**, Carlos RC, Barnett JL, *et al*. Can endoscopic ultrasound or magnetic resonance cholangiopancreatography replace ERCP in patients with suspected biliary disease? A prospective trial and cost analysis. *Am J Gastroenterol* 2001; **96**: 2900-4 [DOI: 10.1016/S0002-9270(01)02807-6]

10 **Moura DTH**, de Moura EGH, Matuguma SE, Dos Santos ME, Moura ETH, Baracat FI, Artifon E, Cheng S, Bernardo WM, Chacon D, Tanigawa R, Jukemura J. EUS-FNA versus ERCP for tissue diagnosis of suspect malignant biliary strictures: a prospective comparative study. *Endosc Int Open* 2018; **6**: E769-E777 [PMID: 29876515 DOI: 10.1055/s-0043-123186]

11 **Weilert F**, Bhat YM, Binmoeller KF, Kane S, Jaffee IM, Shaw RE, Cameron R, Hashimoto Y, Shah JN. EUS-FNA is superior to ERCP-based tissue sampling in suspected malignant biliary obstruction: results of a prospective, single-blind, comparative study. *Gastrointest Endosc* 2014; **80**: 97-104 [PMID: 24559784 DOI: 10.1016/j.gie.2013.12.031]

12 **Oppong K**, Raine D, Nayar M, Wadehra V, Ramakrishnan S, Charnley RM. EUS-FNA versus biliary brushings and assessment of simultaneous performance in jaundiced patients with suspected malignant obstruction. *JOP* 2010; **11**: 560-567 [PMID: 21068487 DOI: 10.6092/1590-8577/3398]

13 **Ross WA**, Wasan SM, Evans DB, Wolff RA, Trapani LV, Staerkel GA, Prindiville T, Lee JH. Combined EUS with FNA and ERCP for the evaluation of patients with obstructive jaundice from presumed pancreatic malignancy. *Gastrointest Endosc* 2008; **68**: 461-466 [PMID: 18384788 DOI: 10.1016/j.gie.2007.11.033]

14 **Wakatsuki T**, Irisawa A, Bhutani MS, Hikichi T, Shibukawa G, Takagi T, Yamamoto G, Takahashi Y, Yamada Y, Watanabe K, Obara K, Suzuki T, Sato Y. Comparative study of diagnostic value of cytologic sampling by endoscopic ultrasonography-guided fine-needle aspiration and that by endoscopic retrograde pancreatography for the management of pancreatic mass without biliary stricture. *J Gastroenterol Hepatol* 2005; **20**: 1707-1711 [PMID: 16246190 DOI: 10.1111/j.1440-1746.2005.03900.x]

15 **Rösch T**, Hofrichter K, Frimberger E, Meining A, Born P, Weigert N, Allescher HD, Classen M, Barbur M, Schenck U, Werner M. ERCP or EUS for tissue diagnosis of biliary strictures? A prospective comparative study. *Gastrointest Endosc* 2004; **60**: 390-396 [PMID: 15332029 DOI: 10.1016/s0016-5107(04)01732-8]

16 **Glasbrenner B**, Schwarz M, Pauls S, Preclik G, Beger HG, Adler G. Prospective comparison of endoscopic ultrasound and endoscopic retrograde cholangiopancreatography in the preoperative assessment of masses in the pancreatic head. *Dig Surg* 2000; **17**: 468-474 [PMID: 11124550 DOI: 10.1159/000051942]

17 **Cellier C**, Cuillerier E, Palazzo L, Rickaert F, Flejou JF, Napoleon B, Van Gansbeke D, Bely N, Ponsot P, Partensky C, Cugnenc PH, Barbier JP, Devière J, Cremer M. Intraductal papillary and mucinous tumors of the pancreas: accuracy of preoperative computed tomography, endoscopic retrograde pancreatography and

endoscopic ultrasonography, and long-term outcome in a large surgical series. *Gastrointest Endosc* 1998; **47**: 42-49 [PMID: 9468422 DOI: 10.1016/s0016-5107(98)70297-4]

18 **Lee YN**, Moon JH, Choi HJ, Kim HK, Choi SY, Choi MH, Lee TH, Lee TH, Cha SW, Park SH. Diagnostic approach using ERCP-guided transpapillary forceps biopsy or EUS-guided fine-needle aspiration biopsy according to the nature of stricture segment for patients with suspected malignant biliary stricture. *Cancer Med* 2017; **6**: 582-590 [PMID: 28220692 DOI: 10.1002/cam4.1034]

19 **de Bellis M**, Sherman S, Fogel EL, Cramer H, Chappo J, McHenry L Jr, Watkins JL, Lehman GA. Tissue sampling at ERCP in suspected malignant biliary strictures (Part 2). *Gastrointest Endosc* 2002; **56**: 720-730 [PMID: 12397282 DOI: 10.1067/mge.2002.129219]

20 **Korc P**, Sherman S. ERCP tissue sampling. *Gastrointest Endosc* 2016; **84**: 557-571 [PMID: 27156656 DOI: 10.1016/j.gie.2016.04.039]

21 **Agarwal P RS**, Yadav S, Bhalla S, Mehrotra R, Gupta S, Gupta V, Goel MM. Role of Endoscopic Retrograde Cholangiopancreatography Guided Brush Cytology in Evaluation of Malignant Biliary Tract Strictures: Experience of a Tertiary Care Teaching Centre in Northern India. *Journal of clinical and diagnostic research* 2018; **12**: EC14-EC18 [DOI: 10.7860/JCDR/2018/38090.12395]

22 **Shieh FK**, Luong-Player A, Khara HS, Liu H, Lin F, Shellenberger MJ, Johal AS, Diehl DL. Improved endoscopic retrograde cholangiopancreatography brush increases diagnostic yield of malignant biliary strictures. *World J Gastrointest Endosc* 2014; **6**: 312-317 [PMID: 25031790 DOI: 10.4253/wjge.v6.i7.312]

23 **Fogel EL**, deBellis M, McHenry L, Watkins JL, Chappo J, Cramer H, Schmidt S, Lazzell-Pannell L, Sherman S, Lehman GA. Effectiveness of a new long cytology brush in the evaluation of malignant biliary obstruction: a prospective study. *Gastrointest Endosc* 2006; **63**: 71-77 [PMID: 16377319 DOI: 10.1016/j.gie.2005.08.039]

24 **Stewart CJ**, Mills PR, Carter R, O'Donohue J, Fullarton G, Imrie CW, Murray WR. Brush cytology in the assessment of pancreatico-biliary strictures: a review of 406 cases. *J Clin Pathol* 2001; **54**: 449-455 [PMID: 11376018 DOI: 10.1136/jcp.54.6.449]

25 **Macken E**, Drijkoningen M, Van Aken E, Van Steenbergen W. Brush cytology of ductal strictures during ERCP. *Acta Gastroenterol Belg* 2000; **63**: 254-259 [PMID: 11189981]

26 **Jailwala J**, Fogel EL, Sherman S, Gottlieb K, Flueckiger J, Bucksot LG, Lehman GA. Triple-tissue sampling at ERCP in malignant biliary obstruction. *Gastrointest Endosc* 2000; **51**: 383-390 [PMID: 10744806 DOI: 10.1016/s0016-5107(00)70435-4]

27 **Glasbrenner B**, Ardan M, Boeck W, Preclik G, Möller P, Adler G. Prospective evaluation of brush cytology of biliary strictures during endoscopic retrograde cholangiopancreatography. *Endoscopy* 1999; **31**: 712-717 [PMID: 10604612 DOI: 10.1055/s-1999-73]

28 **Mansfield JC**, Griffin SM, Wadehra V, Matthewson K. A prospective evaluation of cytology from biliary strictures. *Gut* 1997; **40**: 671-677 [PMID: 9203949 DOI: 10.1136/gut.40.5.671]

29 **Pugliese V**, Conio M, Nicolò G, Saccomanno S, Gatteschi B. Endoscopic retrograde forceps biopsy and brush cytology of biliary strictures: a prospective study. *Gastrointest Endosc* 1995; **42**: 520-526 [PMID: 8674921 DOI: 10.1016/s0016-5107(95)70004-8]

30 **Ponchon T**, Gagnon P, Berger F, Labadie M, Liaras A, Chavaillon A, Bory R. Value of endobiliary brush cytology and biopsies for the diagnosis of malignant bile duct stenosis: results of a prospective study. *Gastrointest Endosc* 1995; **42**: 565-572 [PMID: 8674929 DOI: 10.1016/s0016-5107(95)70012-9]

31 **Lee JG**, Leung JW, Baillie J, Layfield LJ, Cotton PB. Benign, dysplastic, or malignant--making sense of endoscopic bile duct brush cytology: results in 149 consecutive patients. *Am J Gastroenterol* 1995; **90**: 722-726 [PMID: 7733076]

32 **Foutch PG**, Kerr DM, Harlan JR, Kummet TD. A prospective, controlled analysis of endoscopic cytotechniques for diagnosis of malignant biliary strictures. *Am J Gastroenterol* 1991; **86**: 577-580 [PMID: 2028947]

33 **Sethi R**, Singh K, Warner B, Mahadeva U, Wilkinson M. The impact of brush cytology from endoscopic retrograde cholangiopancreatography (ERCP) on patient management at a UK teaching hospital. *Frontline Gastroenterol* 2016; **7**: 97-101 [PMID: 27103983 DOI: 10.1136/flgastro-2015-100643]

34 **Pugliese V**, Barone D, Saccomanno S, Conio M, Aste H, Santi L. Tissue sampling from the common bile duct through endoscopic retrograde cholangiopancreatography, endoscopic papillo(sphinctero)tomy and drainage in juxtapapillary malignancies. *Surg Endosc* 1987; **1**: 83-87 [PMID: 3503369 DOI: 10.1007/BF00312690]

35 **Sugiyama M**, Atomi Y, Wada N, Kuroda A, Muto T. Endoscopic transpapillary bile duct biopsy without sphincterotomy for diagnosing biliary strictures: a prospective comparative study with bile and brush cytology. *Am J Gastroenterol* 1996; **91**: 465-467 [PMID: 8633492]

36 **Weber A**, von Weyhern C, Fend F, Schneider J, Neu B, Meining A, Weidenbach H, Schmid RM, Prinz C. Endoscopic transpapillary brush cytology and forceps biopsy in patients with hilar cholangiocarcinoma. *World J Gastroenterol* 2008; **14**: 1097-1101 [PMID: 18286693 DOI: 10.3748/wjg.14.1097]

37 **Kitajima Y**, Ohara H, Nakazawa T, Ando T, Hayashi K, Takada H, Tanaka H, Ogawa K, Sano H, Togawa S, Naito I, Hirai M, Ueno K, Ban T, Miyabe K, Yamashita H, Yoshimura N, Akita S, Gotoh K, Joh T. Usefulness of transpapillary bile duct brushing cytology and forceps biopsy for improved diagnosis in patients with biliary strictures. *J Gastroenterol Hepatol* 2007; **22**: 1615-1620 [PMID: 17573833 DOI: 10.1111/j.1440-1746.2007.05037.x]

38 **Farrell RJ**, Jain AK, Brandwein SL, Wang H, Chuttani R, Pleskow DK. The combination of stricture dilation, endoscopic needle aspiration, and biliary brushings significantly improves diagnostic yield from malignant bile duct strictures. *Gastrointest Endosc* 2001; **54**: 587-594 [PMID: 11677474 DOI: 10.1067/mge.2001.118715]

39 **Rustgi AK**, Kelsey PB, Guelrud M, Saini S, Schapiro RH. Malignant tumors of the bile ducts: diagnosis by biopsy during endoscopic cannulation. *Gastrointest Endosc* 1989; **35**: 248-251 [PMID: 2547687 DOI: 10.1016/s0016-5107(89)72768-1]

40 **Kimura H**, Matsubayashi H, Sasaki K, Ito H, Hirosawa K, Uesaka K, Kanemoto H, Ono H. Factors

affecting the yield of endoscopic transpapillary bile duct biopsy for the diagnosis of pancreatic head cancer. *Pancreatology* 2013; **13**: 524-529 [PMID: 24075518 DOI: 10.1016/j.pan.2013.08.005]
41 **Hartman DJ**, Slivka A, Giusto DA, Krasinskas AM. Tissue yield and diagnostic efficacy of fluoroscopic and cholangioscopic techniques to assess indeterminate biliary strictures. *Clin Gastroenterol Hepatol* 2012; **10**: 1042-1046 [PMID: 22677575 DOI: 10.1016/j.cgh.2012.05.025]
42 **Draganov PV**, Chauhan S, Wagh MS, Gupte AR, Lin T, Hou W, Forsmark CE. Diagnostic accuracy of conventional and cholangioscopy-guided sampling of indeterminate biliary lesions at the time of ERCP: a prospective, long-term follow-up study. *Gastrointest Endosc* 2012; **75**: 347-353 [PMID: 22248602 DOI: 10.1016/j.gie.2011.09.020]
43 **Wright ER**, Bakis G, Srinivasan R, Raju R, Vittal H, Sanders MK, Bernadino K, Stefan A, Blaszyk H, Howell DA. Intraprocedural tissue diagnosis during ERCP employing a new cytology preparation of forceps biopsy (Smash protocol). *Am J Gastroenterol* 2011; **106**: 294-299 [PMID: 21102569 DOI: 10.1038/ajg.2010.447]
44 **Schoefl R**, Haefner M, Wrba F, Pfeffel F, Stain C, Poetzi R, Gangl A. Forceps biopsy and brush cytology during endoscopic retrograde cholangiopancreatography for the diagnosis of biliary stenoses. *Scand J Gastroenterol* 1997; **32**: 363-368 [PMID: 9140159 DOI: 10.3109/00365529709007685]
45 **Kubota Y**, Takaoka M, Tani K, Ogura M, Kin H, Fujimura K, Mizuno T, Inoue K. Endoscopic transpapillary biopsy for diagnosis of patients with pancreaticobiliary ductal strictures. *Am J Gastroenterol* 1993; **88**: 1700-1704 [PMID: 8213710]
46 **Yoon WJ**, Lee JK, Lee KH, Lee WJ, Ryu JK, Kim YT, Yoon YB. A comparison of covered and uncovered Wallstents for the management of distal malignant biliary obstruction. *Gastrointest Endosc* 2006; **63**: 996-1000 [PMID: 16733115 DOI: 10.1016/j.gie.2005.11.054]
47 **Tanaka H**, Matsusaki S, Baba Y, Isono Y, Sase T, Okano H, Saito T, Mukai K, Murata T, Taoka H. Usefulness of Endoscopic Transpapillary Tissue Sampling for Malignant Biliary Strictures and Predictive Factors of Diagnostic Accuracy. *Clin Endosc* 2018; **51**: 174-180 [PMID: 28854772 DOI: 10.5946/ce.2017.082]
48 **Naitoh I**, Nakazawa T, Kato A, Hayashi K, Miyabe K, Shimizu S, Kondo H, Nishi Y, Yoshida M, Umemura S, Hori Y, Kuno T, Takahashi S, Ohara H, Joh T. Predictive factors for positive diagnosis of malignant biliary strictures by transpapillary brush cytology and forceps biopsy. *J Dig Dis* 2016; **17**: 44-51 [PMID: 26717051 DOI: 10.1111/1751-2980.12311]
49 **Chen WM**, Wei KL, Chen YS, Chang PJ, Tung SY, Chang TS, Huang HC, Shen CH, Hsieh YY, Wu CS. Transpapillary biliary biopsy for malignant biliary strictures: comparison between cholangiocarcinoma and pancreatic cancer. *World J Surg Oncol* 2016; **14**: 140 [PMID: 27142076 DOI: 10.1186/s12957-016-0883-8]
50 **Nishikawa T**, Tsuyuguchi T, Sakai Y, Sugiyama H, Tawada K, Mikata R, Tada M, Ishihara T, Miyazaki M, Yokosuka O. Factors affecting the accuracy of endoscopic transpapillary sampling methods for bile duct cancer. *Dig Endosc* 2014; **26**: 276-281 [PMID: 23826684 DOI: 10.1111/den.12140]
51 **Kawashima H**, Itoh A, Ohno E, Goto H, Hirooka Y. Transpapillary biliary forceps biopsy to distinguish benign biliary stricture from malignancy: how many tissue samples should be obtained? *Dig Endosc* 2012; **24** Suppl 1: 22-27 [PMID: 22533747 DOI: 10.1111/j.1443-1661.2012.01253.x]
52 **Navaneethan U**, Njei B, Lourdusamy V, Konjeti R, Vargo JJ, Parsi MA. Comparative effectiveness of biliary brush cytology and intraductal biopsy for detection of malignant biliary strictures: a systematic review and meta-analysis. *Gastrointest Endosc* 2015; **81**: 168-176 [PMID: 25440678 DOI: 10.1016/j.gie.2014.09.017]
53 **Seo DW**, Lee SK, Yoo KS, Kang GH, Kim MH, Suh DJ, Min YI. Cholangioscopic findings in bile duct tumors. *Gastrointest Endosc* 2000; **52**: 630-634 [PMID: 11060187 DOI: 10.1067/mge.2000.108667]
54 **Woo YS**, Lee JK, Oh SH, Kim MJ, Jung JG, Lee KH, Lee KT. Role of SpyGlass peroral cholangioscopy in the evaluation of indeterminate biliary lesions. *Dig Dis Sci* 2014; **59**: 2565-2570 [PMID: 24788322 DOI: 10.1007/s10620-014-3171-x]
55 **Parsi MA**, Jang S, Sanaka M, Stevens T, Vargo JJ. Diagnostic and therapeutic cholangiopancreatoscopy: performance of a new digital cholangioscope. *Gastrointest Endosc* 2014; **79**: 936-942 [PMID: 24287279 DOI: 10.1016/j.gie.2013.10.029]
56 **Hara T**, Yamaguchi T, Ishihara T, Tsuyuguchi T, Kondo F, Kato K, Asano T, Saisho H. Diagnosis and patient management of intraductal papillary-mucinous tumor of the pancreas by using peroral pancreatoscopy and intraductal ultrasonography. *Gastroenterology* 2002; **122**: 34-43 [PMID: 11781278 DOI: 10.1053/gast.2002.30337]
57 **Yamao K**, Ohashi K, Nakamura T, Suzuki T, Sawaki A, Hara K, Fukutomi A, Baba T, Okubo K, Tanaka K, Moriyama I, Fukuda K, Matsumoto K, Shimizu Y. Efficacy of peroral pancreatoscopy in the diagnosis of pancreatic diseases. *Gastrointest Endosc* 2003; **57**: 205-209 [PMID: 12556785 DOI: 10.1067/mge.2003.72]
58 **Chen YK**, Pleskow DK. SpyGlass single-operator peroral cholangiopancreatoscopy system for the diagnosis and therapy of bile-duct disorders: a clinical feasibility study (with video). *Gastrointest Endosc* 2007; **65**: 832-841 [PMID: 17466202 DOI: 10.1016/j.gie.2007.01.025]
59 **Shah RJ**, Langer DA, Antillon MR, Chen YK. Cholangioscopy and cholangioscopic forceps biopsy in patients with indeterminate pancreaticobiliary pathology. *Clin Gastroenterol Hepatol* 2006; **4**: 219-225 [PMID: 16469683 DOI: 10.1016/s1542-3565(05)00979-1]
60 **Fukuda Y**, Tsuyuguchi T, Sakai Y, Tsuchiya S, Saisyo H. Diagnostic utility of peroral cholangioscopy for various bile-duct lesions. *Gastrointest Endosc* 2005; **62**: 374-382 [PMID: 16111955 DOI: 10.1016/j.gie.2005.04.032]
61 **Nishikawa T**, Tsuyuguchi T, Sakai Y, Sugiyama H, Miyazaki M, Yokosuka O. Comparison of the diagnostic accuracy of peroral video-cholangioscopic visual findings and cholangioscopy-guided forceps biopsy findings for indeterminate biliary lesions: a prospective study. *Gastrointest Endosc* 2013; **77**: 219-226 [PMID: 23231758 DOI: 10.1016/j.gie.2012.10.011]
62 **Tieu AH**, Kumbhari V, Jakhete N, Onyimba F, Patel Y, Shin EJ, Li Z. Diagnostic and therapeutic utility of SpyGlass(®) peroral cholangioscopy in intraductal biliary disease: single-center, retrospective, cohort

study. *Dig Endosc* 2015; **27**: 479-485 [PMID: 25394296 DOI: 10.1111/den.12405]
63 **Sethi A**, Chen YK, Austin GL, Brown WR, Brauer BC, Fukami NN, Khan AH, Shah RJ. ERCP with cholangiopancreatoscopy may be associated with higher rates of complications than ERCP alone: a single-center experience. *Gastrointest Endosc* 2011; **73**: 251-256 [PMID: 21106195 DOI: 10.1016/j.gie.2010.08.058]
64 **Endo Y**, Morii T, Tamura H, Okuda S. Cytodiagnosis of pancreatic malignant tumors by aspiration, under direct vision, using a duodenal fiberscope. *Gastroenterology* 1974; **67**: 944-951 [PMID: 4372126 DOI: 10.1016/S0016-5085(19)32748-9]
65 **Takeda Y**, Matsumoto K, Kurumi H, Koda H, Yamashita T, Onoyama T, Kawata S, Horie Y, Isomoto H. Efficacy and safety of pancreatic juice cytology by using synthetic secretin in the diagnosis of pancreatic ductal adenocarcinoma. *Dig Endosc* 2018; **30**: 771-776 [PMID: 29873113 DOI: 10.1111/den.13203]
66 **Mikata R**, Ishihara T, Tada M, Tawada K, Saito M, Kurosawa J, Sugiyama H, Sakai Y, Tsuyuguchi T, Miyazaki M, Yokosuka O. Clinical usefulness of repeated pancreatic juice cytology *via* endoscopic naso-pancreatic drainage tube in patients with pancreatic cancer. *J Gastroenterol* 2013; **48**: 866-873 [PMID: 23053424 DOI: 10.1007/s00535-012-0684-y]
67 **Iiboshi T**, Hanada K, Fukuda T, Yonehara S, Sasaki T, Chayama K. Value of cytodiagnosis using endoscopic nasopancreatic drainage for early diagnosis of pancreatic cancer: establishing a new method for the early detection of pancreatic carcinoma in situ. *Pancreas* 2012; **41**: 523-529 [PMID: 22504379 DOI: 10.1097/MPA.0b013e31823c0b05]
68 **Hanada K**, Minami T, Shimizu A, Fukuhara M, Yano S, Sasaki K, Koda M, Sugiyama K, Yonehara S, Yanagisawa A. Roles of ERCP in the Early Diagnosis of Pancreatic Cancer. *Diagnostics (Basel)* 2019; 9 [PMID: 30866585 DOI: 10.3390/diagnostics9010030]
69 **Kanno A**, Masamune A, Hanada K, Maguchi H, Shimizu Y, Ueki T, Hasebe O, Ohtsuka T, Nakamura M, Takenaka M, Kitano M, Kikuyama M, Gabata T, Yoshida K, Sasaki T, Serikawa M, Furukawa T, Yanagisawa A, Shimosegawa T; Japan Study Group on the Early Detection of Pancreatic Cancer (JEDPAC). Multicenter study of early pancreatic cancer in Japan. *Pancreatology* 2018; **18**: 61-67 [PMID: 29170051 DOI: 10.1016/j.pan.2017.11.007]
70 **Glazer ES**, Hornbrook MC, Krouse RS. A meta-analysis of randomized trials: immediate stent placement *vs*. surgical bypass in the palliative management of malignant biliary obstruction. *J Pain Symptom Manage* 2014; **47**: 307-314 [PMID: 23830531 DOI: 10.1016/j.jpainsymman.2013.03.013]
71 **Moss AC**, Morris E, Leyden J, MacMathuna P. Malignant distal biliary obstruction: a systematic review and meta-analysis of endoscopic and surgical bypass results. *Cancer Treat Rev* 2007; **33**: 213-221 [PMID: 17157990 DOI: 10.1016/j.ctrv.2006.10.006]
72 **Domínguez-Muñoz JE**, Lariño-Noia J, Iglesias-Garcia J. Biliary drainage in pancreatic cancer: The endoscopic retrograde cholangiopancreatography perspective. *Endosc Ultrasound* 2017; **6**: S119-S121 [PMID: 29387707 DOI: 10.4103/eus.eus_79_17]
73 **Clarke DL**, Pillay Y, Anderson F, Thomson SR. The current standard of care in the periprocedural management of the patient with obstructive jaundice. *Ann R Coll Surg Engl* 2006; **88**: 610-616 [PMID: 17132306 DOI: 10.1308/003588406X149327]
74 **Isla AM**, Worthington T, Kakkar AK, Williamson RC. A continuing role for surgical bypass in the palliative treatment of pancreatic carcinoma. *Dig Surg* 2000; **17**: 143-146 [PMID: 10781977 DOI: 10.1159/000018817]
75 **Kozarek R**. Role of preoperative palliation of jaundice in pancreatic cancer. *J Hepatobiliary Pancreat Sci* 2013; **20**: 567-572 [PMID: 23595581 DOI: 10.1007/s00534-013-0612-4]
76 **Lee PJ**, Podugu A, Wu D, Lee AC, Stevens T, Windsor JA. Preoperative biliary drainage in resectable pancreatic cancer: a systematic review and network meta-analysis. *HPB (Oxford)* 2018; **20**: 477-486 [PMID: 29526466 DOI: 10.1016/j.hpb.2017.12.007]
77 **Andersen JR**, Sørensen SM, Kruse A, Rokkjaer M, Matzen P. Randomised trial of endoscopic endoprosthesis versus operative bypass in malignant obstructive jaundice. *Gut* 1989; **30**: 1132-1135 [PMID: 2475392 DOI: 10.1136/gut.30.8.1132]
78 **Saleem A**, Leggett CL, Murad MH, Baron TH. Meta-analysis of randomized trials comparing the patency of covered and uncovered self-expandable metal stents for palliation of distal malignant bile duct obstruction. *Gastrointest Endosc* 2011; **74**: 321-327.e1-3 [PMID: 21683354 DOI: 10.1016/j.gie.2011.03.1249]
79 **Maire F**, Sauvanet A. Palliation of biliary and duodenal obstruction in patients with unresectable pancreatic cancer: endoscopy or surgery? *J Visc Surg* 2013; **150**: S27-S31 [PMID: 23597937 DOI: 10.1016/j.jviscsurg.2013.03.005]
80 **Peng C**, Nietert PJ, Cotton PB, Lackland DT, Romagnuolo J. Predicting native papilla biliary cannulation success using a multinational Endoscopic Retrograde Cholangiopancreatography (ERCP) Quality Network. *BMC Gastroenterol* 2013; **13**: 147 [PMID: 24112846 DOI: 10.1186/1471-230X-13-147]
81 **Cortas GA**, Mehta SN, Abraham NS, Barkun AN. Selective cannulation of the common bile duct: a prospective randomized trial comparing standard catheters with sphincterotomes. *Gastrointest Endosc* 1999; **50**: 775-779 [PMID: 10570335 DOI: 10.1016/s0016-5107(99)70157-4]
82 **Grimm IS**, Baron TH. Biliary Stents for Palliation of Obstructive Jaundice: Choosing the Superior Endoscopic Management Strategy. *Gastroenterology* 2015; **149**: 20-22 [PMID: 26021235 DOI: 10.1053/j.gastro.2015.05.028]
83 **Zorrón Pu L**, de Moura EG, Bernardo WM, Baracat FI, Mendonça EQ, Kondo A, Luz GO, Furuya Júnior CK, Artifon EL. Endoscopic stenting for inoperable malignant biliary obstruction: A systematic review and meta-analysis. *World J Gastroenterol* 2015; **21**: 13374-13385 [PMID: 26715823 DOI: 10.3748/wjg.v21.i47.13374]
84 **Han SY**, Kim SO, So H, Shin E, Kim DU, Park DH. EUS-guided biliary drainage versus ERCP for first-line palliation of malignant distal biliary obstruction: A systematic review and meta-analysis. *Sci Rep* 2019; **9**: 16551 [PMID: 31719562 DOI: 10.1038/s41598-019-52993-x]
85 **Moss AC**, Morris E, Leyden J, MacMathuna P. Do the benefits of metal stents justify the costs? A

systematic review and meta-analysis of trials comparing endoscopic stents for malignant biliary obstruction. *Eur J Gastroenterol Hepatol* 2007; **19**: 1119-1124 [PMID: 17998839 DOI: 10.1097/MEG.0b013e3282f16206]

86 **Webb K**, Saunders M. Endoscopic management of malignant bile duct strictures. *Gastrointest Endosc Clin N Am* 2013; **23**: 313-331 [PMID: 23540963 DOI: 10.1016/j.giec.2012.12.009]

87 **Walter D**, van Boeckel PG, Groenen MJ, Weusten BL, Witteman BJ, Tan G, Brink MA, Nicolai J, Tan AC, Alderliesten J, Venneman NG, Laleman W, Jansen JM, Bodelier A, Wolters FL, van der Waaij LA, Breumelhof R, Peters FT, Scheffer RC, Leenders M, Hirdes MM, Steyerberg EW, Vleggaar FP, Siersema PD. Cost Efficacy of Metal Stents for Palliation of Extrahepatic Bile Duct Obstruction in a Randomized Controlled Trial. *Gastroenterology* 2015; **149**: 130-138 [PMID: 25790742 DOI: 10.1053/j.gastro.2015.03.012]

88 **Conio M**, Mangiavillano B, Caruso A, Filiberti RA, Baron TH, De Luca L, Signorelli S, Crespi M, Marini M, Ravelli P, Conigliaro R, De Ceglie A. Covered versus uncovered self-expandable metal stent for palliation of primary malignant extrahepatic biliary strictures: a randomized multicenter study. *Gastrointest Endosc* 2018; **88**: 283-291.e3 [PMID: 29653120 DOI: 10.1016/j.gie.2018.03.029]

89 **Flores Carmona DY**, Alonso Lárraga JO, Hernández Guerrero A, Ramírez Solís ME. Comparison of covered and uncovered self-expandable stents in the treatment of malignant biliary obstruction. *Rev Esp Enferm Dig* 2016; **108**: 246-249 [PMID: 26999335 DOI: 10.17235/reed.2016.4161/2015]

90 **Mangiavillano B**, De Luca L, Caruso A, Signorelli S, Marini M, Ravelli P, Bastardini R, Conigliaro R, Conio M. Self-conformable covered *vs* self-conformable uncovered metallic stents in the palliative treatment of malignant extra-hepatic biliary stricture: A multicentric randomized study-preliminary results. *Digest Liver Dis* 2015; **47**: e-105

91 **Lee SJ**, Kim MD, Lee MS, Kim IJ, Park SI, Won JY, Lee DY. Comparison of the efficacy of covered versus uncovered metallic stents in treating inoperable malignant common bile duct obstruction: a randomized trial. *J Vasc Interv Radiol* 2014; **25**: 1912-1920 [PMID: 25085230 DOI: 10.1016/j.jvir.2014.05.021]

92 **Ung KA**, Stotzer PO, Nilsson A, Gustavsson ML, Johnsson E. Covered and uncovered self-expandable metallic Hanarostents are equally efficacious in the drainage of extrahepatic malignant strictures. Results of a double-blind randomized study. *Scand J Gastroenterol* 2013; **48**: 459-465 [PMID: 23373541 DOI: 10.3109/00365521.2012.758766]

93 **Kitano M**, Yamashita Y, Tanaka K, Konishi H, Yazumi S, Nakai Y, Nishiyama O, Uehara H, Mitoro A, Sanuki T, Takaoka M, Koshitani T, Arisaka Y, Shiba M, Hoki N, Sato H, Sasaki Y, Sato M, Hasegawa K, Kawabata H, Okabe Y, Mukai H. Covered self-expandable metal stents with an anti-migration system improve patency duration without increased complications compared with uncovered stents for distal biliary obstruction caused by pancreatic carcinoma: a randomized multicenter trial. *Am J Gastroenterol* 2013; **108**: 1713-1722 [PMID: 24042190 DOI: 10.1038/ajg.2013.305]

94 **Fukuda W KH**, Kamada K, Kitano M, Yamashita Y, Tanaka K, *et al*. A randomized multicenter study comparing covered and uncovered self-expandable metal stents for malignant distal biliary obstruction-Kansai EDS study group. *J Gastroen Hepatol* 2012; **27**: 54-55

95 **Krokidis M**, Fanelli F, Orgera G, Tsetis D, Mouzas I, Bezzi M, Kouroumalis E, Pasariello R, Hatzidakis A. Percutaneous palliation of pancreatic head cancer: randomized comparison of ePTFE/FEP-covered versus uncovered nitinol biliary stents. *Cardiovasc Intervent Radiol* 2011; **34**: 352-361 [PMID: 20467870 DOI: 10.1007/s00270-010-9880-4]

96 **Krokidis M**, Fanelli F, Orgera G, Bezzi M, Passariello R, Hatzidakis A. Percutaneous treatment of malignant jaundice due to extrahepatic cholangiocarcinoma: covered Viabil stent versus uncovered Wallstents. *Cardiovasc Intervent Radiol* 2010; **33**: 97-106 [PMID: 19495871 DOI: 10.1007/s00270-009-9604-9]

97 **Kullman E**, Frozanpor F, Söderlund C, Linder S, Sandström P, Lindhoff-Larsson A, Toth E, Lindell G, Jonas E, Freedman J, Ljungman M, Rudberg C, Ohlin B, Zacharias R, Leijonmarck CE, Teder K, Ringman A, Persson G, Gözen M, Eriksson O. Covered versus uncovered self-expandable nitinol stents in the palliative treatment of malignant distal biliary obstruction: results from a randomized, multicenter study. *Gastrointest Endosc* 2010; **72**: 915-923 [PMID: 21034892 DOI: 10.1016/j.gie.2010.07.036]

98 **Telford JJ**, Carr-Locke DL, Baron TH, Poneros JM, Bounds BC, Kelsey PB, Schapiro RH, Huang CS, Lichtenstein DR, Jacobson BC, Saltzman JR, Thompson CC, Forcione DG, Gostout CJ, Brugge WR. A randomized trial comparing uncovered and partially covered self-expandable metal stents in the palliation of distal malignant biliary obstruction. *Gastrointest Endosc* 2010; **72**: 907-914 [PMID: 21034891 DOI: 10.1016/j.gie.2010.08.021]

99 **Cho YD**, Cheon YK, Yoo KS, Bang SJ, Kim CD, Kim JS, Roh MH, Kim HG. Uncovered Versus Covered Self-Expanding Metallic Stents for Inoperable Malignant Distal Biliary Obstruction: A Prospective Randomized Multicenter Study. *Gastrointest Endosc* 2009; **69**: AB137 [DOI: 10.1016/j.gie.2009.03.187]

100 **Gonzalez-Huix F**, Huertas C, Figa M, Igea F, Juzgado-Lucas D, Espinós JC, Abadia CD, Madrigal RE, Perez-Miranda M. A Randomized Controlled Trial Comparing the Covered (CSEMS) Versus Uncovered Self-Expandable Metal Stents (USEMS) for the Palliation of Malignant Distal Biliary Obstruction (MDBO): Interim Analysis. *Gastrointest Endosc* 2008; **67**: AB166 [DOI: 10.1016/j.gie.2008.03.379]

101 **Park DH**, Kim MH, Choi JS, Lee SS, Seo DW, Kim JH, Han J, Kim JC, Choi EK, Lee SK. Covered versus uncovered wallstent for malignant extrahepatic biliary obstruction: a cohort comparative analysis. *Clin Gastroenterol Hepatol* 2006; **4**: 790-796 [PMID: 16716757 DOI: 10.1016/j.cgh.2006.03.032]

102 **Isayama H**, Komatsu Y, Tsujino T, Sasahira N, Hirano K, Toda N, Nakai Y, Yamamoto N, Tada M, Yoshida H, Shiratori Y, Kawabe T, Omata M. A prospective randomised study of "covered" versus "uncovered" diamond stents for the management of distal malignant biliary obstruction. *Gut* 2004; **53**: 729-734 [PMID: 15082593 DOI: 10.1136/gut.2003.018945]

103 **Lee SH**, Cha SW, Cheon YK. Moon JH, Cho YD, Kim YS, Lee JS, Lee MS, Shim CS, Kim BS. A Randomized Controlled Comparative Study of Covered Versus Uncovered Self-Expandable Metal Stent for Malignant Biliary Obstruction. *Gastrointest Endosc* 2004; **59**: P188 [DOI:

10.1016/S0016-5107(04)00880-6]
104 **Isayama H**, Komatsu Y, Tsujino T, Toda N, Tada M, Yoshida H, Shiratori Y, Hamada T, Yamada H, Tagawa K, Kawabe T, Omata M. 4643 A prospective randomized study of "covered" vs "uncovered" metallic stent for distal malignant biliary obstruction. *Gastrointestinal Endoscopy* 2000; **51**: AB191 [DOI: 10.1016/S0016-5107(00)14490-6]
105 **Smits ME**, Rauws EAJ, Groen AK. Preliminary results of a prospective randomized study of partially covered wallstents *vs* noncovered wallstents. *Gastrointest Endosc* 1995; **41**: 416 [DOI: 10.1016/S0016-5107(05)80520-6]
106 **Seo DW**, Sherman S, Dua KS, Slivka A, Roy A, Costamagna G, Deviere J, Peetermans J, Rousseau M, Nakai Y, Isayama H, Kozarek R; Biliary SEMS During Neoadjuvant Therapy Study Group. Covered and uncovered biliary metal stents provide similar relief of biliary obstruction during neoadjuvant therapy in pancreatic cancer: a randomized trial. *Gastrointest Endosc* 2019; **90**: 602-612.e4 [PMID: 31276674 DOI: 10.1016/j.gie.2019.06.032]
107 **Silviera ML**, Seamon MJ, Porshinsky B, Prosciak MP, Doraiswamy VA, Wang CF, Lorenzo M, Truitt M, Biboa J, Jarvis AM, Narula VK, Steinberg SM, Stawicki SP. Complications related to endoscopic retrograde cholangiopancreatography: a comprehensive clinical review. *J Gastrointestin Liver Dis* 2009; **18**: 73-82 [PMID: 19337638]
108 **Froehlich F**, Gonvers JJ, Vader JP, Dubois RW, Burnand B. Appropriateness of gastrointestinal endoscopy: risk of complications. *Endoscopy* 1999; **31**: 684-686 [PMID: 10571143 DOI: 10.1055/s-1999-130]
109 **Miyatani H**, Mashima H, Sekine M, Matsumoto S. Post-ERCP biliary complications in patients with biliary type sphincter of Oddi dysfunction. *Sci Rep* 2018; **8**: 9951 [PMID: 29967373 DOI: 10.1038/s41598-018-28309-w]
110 **ASGE Standards of Practice Committee**, Chandrasekhara V, Khashab MA, Muthusamy VR, Acosta RD, Agrawal D, Bruining DH, Eloubeidi MA, Fanelli RD, Faulx AL, Gurudu SR, Kothari S, Lightdale JR, Qumseya BJ, Shaukat A, Wang A, Wani SB, Yang J, DeWitt JM. Adverse events associated with ERCP. *Gastrointest Endosc* 2017; **85**: 32-47 [PMID: 27546389 DOI: 10.1016/j.gie.2016.06.051]
111 **Coté GA**, Sherman S. Endoscopic palliation of pancreatic cancer. *Cancer J* 2012; **18**: 584-590 [PMID: 23187846 DOI: 10.1097/PPO.0b013e3182745ad4]
112 **Song TJ**, Lee JH, Lee SS, Jang JW, Kim JW, Ok TJ, Oh DW, Park DH, Seo DW, Lee SK, Kim MH, Kim SC, Kim CN, Yun SC. Metal versus plastic stents for drainage of malignant biliary obstruction before primary surgical resection. *Gastrointest Endosc* 2016; **84**: 814-821 [PMID: 27109456 DOI: 10.1016/j.gie.2016.04.018]
113 **Coates JM**, Beal SH, Russo JE, Vanderveen KA, Chen SL, Bold RJ, Canter RJ. Negligible effect of selective preoperative biliary drainage on perioperative resuscitation, morbidity, and mortality in patients undergoing pancreaticoduodenectomy. *Arch Surg* 2009; **144**: 841-847 [PMID: 19797109 DOI: 10.1001/archsurg.2009.152]
114 **Chen Y**, Ou G, Lian G, Luo H, Huang K, Huang Y. Effect of Preoperative Biliary Drainage on Complications Following Pancreatoduodenectomy: A Meta-Analysis. *Medicine (Baltimore)* 2015; **94**: e1199 [PMID: 26200634 DOI: 10.1097/MD.0000000000001199]
115 **Povoski SP**, Karpeh MS Jr, Conlon KC, Blumgart LH, Brennan MF. Association of preoperative biliary drainage with postoperative outcome following pancreaticoduodenectomy. *Ann Surg* 1999; **230**: 131-142 [PMID: 10450725 DOI: 10.1097/00000658-199908000-00001]
116 **Huang X**, Liang B, Zhao XQ, Zhang FB, Wang XT, Dong JH. The effects of different preoperative biliary drainage methods on complications following pancreaticoduodenectomy. *Medicine (Baltimore)* 2015; **94**: e723 [PMID: 25860221 DOI: 10.1097/MD.0000000000000723]
117 **Fang Y**, Gurusamy KS, Wang Q, Davidson BR, Lin H, Xie X, Wang C. Pre-operative biliary drainage for obstructive jaundice. *Cochrane Database Syst Rev* 2012; CD005444 [PMID: 22972086 DOI: 10.1002/14651858.CD005444.pub3]
118 **Zarzavadjian Le Bian A**, Fuks D, Dalla Valle R, Cesaretti M, Violi V, Costi R. Effectiveness and risk of biliary drainage prior to pancreatoduodenectomy: review of current status. *Surg Today* 2018; **48**: 371-379 [PMID: 28707170 DOI: 10.1007/s00595-017-1568-9]
119 **Scheufele F**, Schorn S, Demir IE, Sargut M, Tieftrunk E, Calavrezos L, Jäger C, Friess H, Ceyhan GO. Preoperative biliary stenting versus operation first in jaundiced patients due to malignant lesions in the pancreatic head: A meta-analysis of current literature. *Surgery* 2017; **161**: 939-950 [PMID: 28043693 DOI: 10.1016/j.surg.2016.11.001]
120 **Rustgi SD**, Amin S, Yang A, Kim MK, Nagula S, Kumta NA, DiMaio CJ, Boffetta P, Lucas AL. Preoperative Endoscopic Retrograde Cholangiopancreatography Is Not Associated With Increased Pancreatic Cancer Mortality. *Clin Gastroenterol Hepatol* 2019; **17**: 1580-1586.e4 [PMID: 30529734 DOI: 10.1016/j.cgh.2018.11.056]
121 **Gohil VB**, Klapman JB. Endoscopic Palliation of Pancreatic Cancer. *Curr Treat Options Gastroenterol* 2017; **15**: 333-348 [PMID: 28795293 DOI: 10.1007/s11938-017-0145-z]
122 **Nakai Y**, Hamada T, Isayama H, Itoi T, Koike K. Endoscopic management of combined malignant biliary and gastric outlet obstruction. *Dig Endosc* 2017; **29**: 16-25 [PMID: 27552727 DOI: 10.1111/den.12729]
123 **ASGE Standards of Practice Committee**; Fukami N, Anderson MA, Khan K, Harrison ME, Appalaneni V, Ben-Menachem T, Decker GA, Fanelli RD, Fisher L, Ikenberry SO, Jain R, Jue TL, Krinsky ML, Maple JT, Sharaf RN, Dominitz JA. The role of endoscopy in gastroduodenal obstruction and gastroparesis. *Gastrointest Endosc* 2011; **74**: 13-21 [PMID: 21704805 DOI: 10.1016/j.gie.2010.12.003]
124 **Dawod E**, Nieto JM. Endoscopic ultrasound guided gastrojejunostomy. *Transl Gastroenterol Hepatol* 2018; **3**: 93 [PMID: 30603729 DOI: 10.21037/tgh.2018.11.03]
125 **Jeurnink SM**, van Eijck CH, Steyerberg EW, Kuipers EJ, Siersema PD. Stent versus gastrojejunostomy for the palliation of gastric outlet obstruction: a systematic review. *BMC Gastroenterol* 2007; **7**: 18 [PMID: 17559659 DOI: 10.1186/1471-230X-7-18]
126 **Dormann A**, Meisner S, Verin N, Wenk Lang A. Self-expanding metal stents for gastroduodenal

malignancies: systematic review of their clinical effectiveness. *Endoscopy* 2004; **36**: 543-550 [PMID: 15202052 DOI: 10.1055/s-2004-814434]

127 **Graber I**, Dumas R, Filoche B, Boyer J, Coumaros D, Lamouliatte H, Legoux JL, Napoléon B, Ponchon T; Société Française d'Endoscopie Digestive (SFED). The efficacy and safety of duodenal stenting: a prospective multicenter study. *Endoscopy* 2007; **39**: 784-787 [PMID: 17703386 DOI: 10.1055/s-2007-966594]

128 **Kim JH**, Song HY, Shin JH, Choi E, Kim TW, Jung HY, Lee GH, Lee SK, Kim MH, Ryu MH, Kang YK, Kim BS, Yook JH. Metallic stent placement in the palliative treatment of malignant gastroduodenal obstructions: prospective evaluation of results and factors influencing outcome in 213 patients. *Gastrointest Endosc* 2007; **66**: 256-264 [PMID: 17643698 DOI: 10.1016/j.gie.2006.12.017]

129 **Maetani I**, Isayama H, Mizumoto Y. Palliation in patients with malignant gastric outlet obstruction with a newly designed enteral stent: a multicenter study. *Gastrointest Endosc* 2007; **66**: 355-360 [PMID: 17643712 DOI: 10.1016/j.gie.2006.11.060]

130 **Lowe AS**, Beckett CG, Jowett S, May J, Stephenson S, Scally A, Tam E, Kay CL. Self-expandable metal stent placement for the palliation of malignant gastroduodenal obstruction: experience in a large, single, UK centre. *Clin Radiol* 2007; **62**: 738-744 [PMID: 17604761 DOI: 10.1016/j.crad.2007.01.021]

131 **van Hooft JE**, Uitdehaag MJ, Bruno MJ, Timmer R, Siersema PD, Dijkgraaf MG, Fockens P. Efficacy and safety of the new WallFlex enteral stent in palliative treatment of malignant gastric outlet obstruction (DUOFLEX study): a prospective multicenter study. *Gastrointest Endosc* 2009; **69**: 1059-1066 [PMID: 19152912 DOI: 10.1016/j.gie.2008.07.026]

132 **Piesman M**, Kozarek RA, Brandabur JJ, Pleskow DK, Chuttani R, Eysselein VE, Silverman WB, Vargo JJ 2nd, Waxman I, Catalano MF, Baron TH, Parsons WG 3rd, Slivka A, Carr-Locke DL. Improved oral intake after palliative duodenal stenting for malignant obstruction: a prospective multicenter clinical trial. *Am J Gastroenterol* 2009; **104**: 2404-2411 [PMID: 19707192 DOI: 10.1038/ajg.2009.409]

133 **Havemann MC**, Adamsen S, Wøjdemann M. Malignant gastric outlet obstruction managed by endoscopic stenting: a prospective single-centre study. *Scand J Gastroenterol* 2009; **44**: 248-251 [PMID: 19016077 DOI: 10.1080/00365520802530820]

134 **Kim CG**, Choi IJ, Lee JY, Cho SJ, Park SR, Lee JH, Ryu KW, Kim YW, Park YI. Covered versus uncovered self-expandable metallic stents for palliation of malignant pyloric obstruction in gastric cancer patients: a randomized, prospective study. *Gastrointest Endosc* 2010; **72**: 25-32 [PMID: 20381802 DOI: 10.1016/j.gie.2010.01.039]

135 **Hamada T**, Hakuta R, Takahara N, Sasaki T, Nakai Y, Isayama H, Koike K. Covered versus uncovered metal stents for malignant gastric outlet obstruction: Systematic review and meta-analysis. *Dig Endosc* 2017; **29**: 259-271 [PMID: 27997723 DOI: 10.1111/den.12786]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com