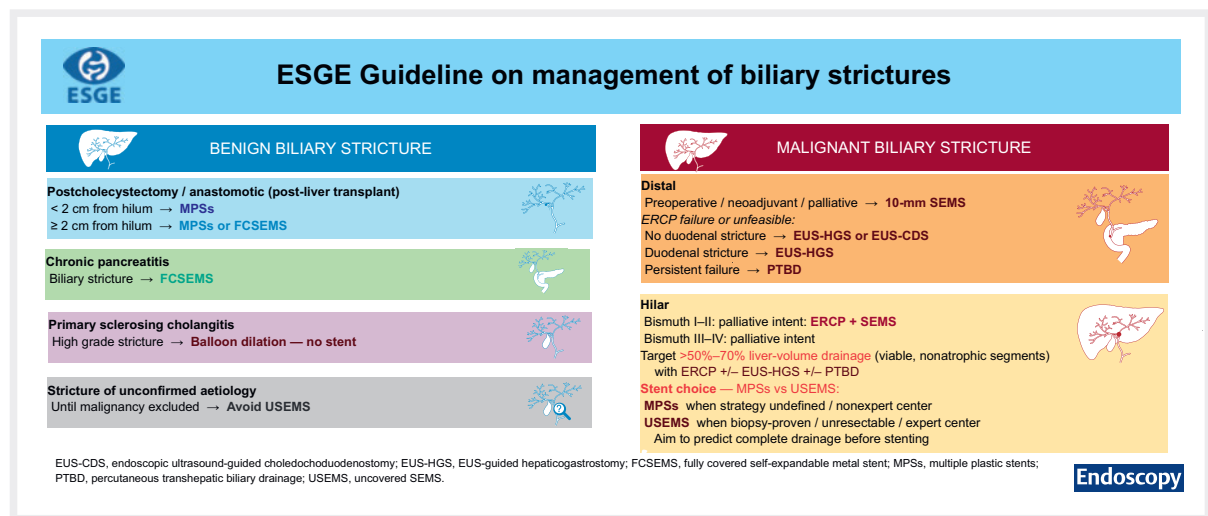


Biliary stricture management: European Society of Gastrointestinal Endoscopy (ESGE) Guideline



GRAPHICAL ABSTRACT



Authors

Arnaud Lemmers¹, Andrea Tringali², Sara Teles de Campos¹, Giuseppe Vanella³, Kin Seng Liem^{4,5}, Marianna Arvanitakis¹, Fabrice Caillol⁶, Christian Gerges⁷, Gavin Johnson⁸, Leena Kylänpää⁹, Enrique Perez-Cuadrado Robles¹⁰, Maria Chiara Petrone³, Mohan Ramchandani¹¹, Jeanin E. van Hooft⁴, Antonio Facciorusso¹², Tony C. Tham¹³, Konstantinos Triantafyllou¹⁴

Institutions

- Gastroenterology, Hepatopancreatology and Digestive Oncology Department, Erasme Hospital, HUB (Hôpital Universitaire de Bruxelles), Université Libre de Bruxelles (ULB), Brussels, Belgium
- Digestive Endoscopy Unit, Fondazione Policlinico Universitario Agostino Gemelli IRCCS, Rome, Italy
- Pancreatobiliary Endoscopy and Endosonography Division, IRCCS San Raffaele Institute and Vita-Salute University, Milan, Italy
- Department of Gastroenterology and Hepatology, Leiden University Medical Center, Leiden, The Netherlands
- Department of Gastroenterology and Hepatology, Erasmus Medical Center, Rotterdam, The Netherlands
- Department of Hepatogastroenterology, Paoli-Calmettes Institute, Marseille, France
- Department of Gastroenterology, Hepatology and Infectious Diseases, HM University Campus Helios Clinic Krefeld, Krefeld, Germany
- Pancreaticobiliary Unit, University College London Hospitals NHS Foundation Trust, London, United Kingdom
- Department of Gastrointestinal Surgery, Helsinki University Hospital and University of Helsinki, Helsinki, Finland
- Department of Hepatogastroenterology, Georges-Pompidou European Hospital, Paris, France
- AIG Hospitals, Asian Institute of Gastroenterology, Hyderabad, Telangana, India
- Department of Experimental Medicine, Università del Salento, Lecce, Italy
- Division of Gastroenterology, Ulster Hospital Belfast, Belfast, Northern Ireland
- Second Department of Gastroenterology, Medical School, National and Kapodistrian University of Athens, "Attikon" University General Hospital, Athens, Greece

published online 2026

Bibliography

Endoscopy

DOI 10.1055/a-2921-6492

ISSN 0013-726X

© 2026. European Society of Gastrointestinal Endoscopy.

All rights reserved.

This article is published by Thieme.

Georg Thieme Verlag KG, Oswald-Hesse-Straße 50,
70469 Stuttgart, Germany



Supplementary Material

Supplementary Material is available at

<https://doi.org/10.1055/a-2921-6492>

Corresponding author

Arnaud Lemmers, MD, PhD, Department of Gastroenterology, Hepatopancreatology and Digestive Oncology, Hôpital Universitaire de Bruxelles (H.U.B), CUB Hôpital Erasme, 808, route de Lennik, 1070 Brussels, Belgium
arnaud.lemmers@hubruxelles.be

MAIN RECOMMENDATIONS

Benign biliary strictures

1 ESGE suggests temporary insertion of multiple plastic stents (MPSs) to treat postcholecystectomy benign biliary strictures.

A fully covered self-expandable metal stent (FCSEMS) can be considered in these patients when the stricture is located >2 cm distally from the main hepatic confluence or for patients who are noncompliant with repeated endoscopic retrograde cholangiopancreatographies (ERCPs).

2 ESGE suggests treating anastomotic biliary strictures following liver transplantation with either MPSs or temporary insertion of an FCSEMS when located >2 cm distally from the main hepatic confluence.

3 ESGE suggests treating biliary strictures secondary to chronic pancreatitis with temporary insertion (6–12 months) of an FCSEMS.

4 ESGE suggests using balloon dilation alone for high grade biliary strictures secondary to primary sclerosing cholangitis. There is no added benefit of stenting following balloon dilation, and stenting may increase the risk of adverse events.

5 ESGE suggests avoiding the insertion of uncovered SEMSs (USEMSs) for the drainage of extrahepatic biliary obstruction of unconfirmed etiology.

Distal malignant biliary strictures

6 ESGE recommends the endoscopic placement of a 10-mm diameter SEMS for preoperative biliary drainage (PBD) of extrahepatic malignant biliary obstruction (MBO).

7 ESGE recommends the endoscopic placement of a 10-mm diameter SEMS for neoadjuvant biliary drainage of extrahepatic pathologically confirmed MBO.

8 ESGE recommends endoscopic over surgical or percutaneous biliary drainage for primary decompression of inoperable, extrahepatic MBO.

Hilar malignant biliary strictures

9 ESGE recommends ERCP over percutaneous transhepatic biliary drainage (PTBD) for PBD in hilar malignant obstruction.

10 ESGE suggests palliative drainage of malignant hilar strictures by means of ERCP for Bismuth types I–II. For Bismuth III–IV, ERCP or a combination of ERCP with endoscopic ultrasound-guided biliary drainage (EUS-BD) is preferable over primary PTBD. Complementary drainage using PTBD might be required in some cases.

11 ESGE suggests obtaining drainage of more than 50%, and ideally 70% or more, of the viable nonatrophic liver volume for palliative drainage of proven malignant Bismuth II–IV strictures, using a multimodal approach (EUS-BD/PTBD if needed, as complementary methods to ERCP).

12 ESGE suggests using either plastic stents or USEMSs for palliative drainage of proven malignant hilar obstruction. ESGE suggests a plastic stent when the optimal drainage strategy has not been defined. ESGE suggests using a USEMS in expert centers to reduce the need for revisional procedures based on the patient's expected survival and the likelihood of achieving complete biliary drainage.

Malignant biliary stricture in cases of failed or unfeasible ERCP

13 ESGE recommends EUS-BD over PTBD in cases of malignant biliary stricture following failed or unfeasible ERCP. In patients with distal stricture, ESGE suggests using EUS-guided hepaticogastrostomy (EUS-HGS) where a duodenal stricture is present, and either EUS-HGS or EUS-guided choledochoduodenostomy where there is no duodenal stricture.

ESGE suggests using PTBD when EUS-BD fails or is not feasible.

ABBREVIATIONS

ABS	anastomotic biliary stricture	EUS-RV	EUS-assisted rendezvous biliary drainage technique
AE	adverse event	FCSEMS	fully covered SEMS
BBS	benign biliary stricture	LAMS	lumen-apposing metal stent
CBD	common bile duct	LA-ERCP	laparoscopy-assisted ERCP
DBE	double-balloon enteroscopy	MBO	malignant biliary obstruction
DPPT	double-pigtail plastic stent	MPSSs	multiple plastic stents
EA-ERCP	enteroscopy-assisted ERCP	MRCP	magnetic resonance cholangiopancreatography
EBD	endoscopic balloon dilation	NBS	nonanastomotic biliary stricture
EDGE	endoscopic ultrasound-directed transgastric ERCP	PBD	preoperative biliary drainage
ERCP	endoscopic retrograde cholangiopancreatography	PCSEMS	partially covered SEMS
EUS	endoscopic ultrasound	PEP	post-ERCP pancreatitis
EUS-BD	EUS-guided biliary drainage	PSC	primary sclerosing cholangitis
EUS-CDS	EUS-guided choledochoduodenostomy	PTBD	percutaneous transhepatic biliary drainage
EUS-GBD	EUS-guided gallbladder drainage	RCT	randomized controlled trial
EUS-HGS	EUS-guided hepaticogastrostomy	RYGB	Roux-en-Y gastric bypass
EUS-HJS	EUS-guided hepaticojejunostomy	SBE	single-balloon enteroscopy
		SEMS	self-expandable metal stent
		USEMS	uncovered SEMS

SOURCE AND SCOPE

This guideline is an official statement of the European Society of Gastrointestinal Endoscopy (ESGE). ESGE guidelines represent a consensus of best practice based on the available evidence at the time of preparation. They are intended to be an educational tool to provide information that may support endoscopists in providing care to patients.

1 Introduction

Biliary strictures, defined as a narrowing of the intrahepatic or extrahepatic biliary system, with concomitant upstream biliary duct dilatation, are associated in most cases with symptoms (e.g. jaundice, pruritus, or sepsis secondary to cholangitis or liver abscesses) or with a risk of long-term complications such as secondary biliary cirrhosis, justifying the need for clinical intervention. Given the differences in their specific management, the required work-up to distinguish benign from malignant origins of a biliary stricture, appropriately adapted for its location and presentation, has been addressed by a previous guideline [1]. Several minimally invasive technical approaches have been developed over time to treat biliary strictures by dilation and/or stenting using endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic biliary drainage (PTBD), or, more recently, endoscopic ultrasound-guided biliary drainage (EUS-BD). These techniques have been demonstrated to be associated with lower morbidity compared with surgery, and should be tailored to the etiology, clinical situation, and anatomy of each patient.

The European Society of Gastrointestinal Endoscopy (ESGE) commissioned this guideline in 2025 to deal specifically with

biliary stricture management, updating the previous 2018 version of the biliary stenting guidelines [2] and harmonizing the clinical perspective with the therapeutic EUS guidelines published in 2022 [3]. The present work is independent of the biliary stricture diagnosis guideline (2025) [1], the chronic pancreatitis management guideline updated in 2018 [4], and the ERCP adverse event (AE) guidelines (2020) [5]. The goal of this guideline is to provide evidence-based recommendations (based on Grading of Recommendations Assessment, Development and Evaluation (GRADE) criteria [6]) focusing on the following sections: benign biliary stricture (BBS), malignant biliary stricture, surgically altered anatomy or inaccessible papilla, and second attempts after failure. Recommendations are issued focusing on the implications for patients.

2 Methods

The ESGE Guidelines Committee Chair (K.T.) appointed a leader (A.L.) who invited a list of authors (the panel) to participate in project development, and four task forces were created to deal with different aspects of the guideline. Task force members were allocated to different task forces (**Table 1s**, see online-only Supplementary material) and were asked to disclose any potential financial or intellectual conflicts of interest. The guideline was developed using the GRADE framework [6] (**Table 2s**). The relevant clinical questions were developed a priori, listed in the PICO (patient, intervention, control, outcome) format, and validated by the panel (**Table 3s**).

Each task force performed a systematic literature search using PubMed/MEDLINE, Embase, Scopus, and the Cochrane library, with the help of a professional librarian, and with added manual searches, to identify publications from 2017 to August 2024 (restricted to papers published in the English language), focusing on meta-analyses and published prospective studies,

particularly randomized controlled trials (RCTs), performed in humans. Further manual searches were performed up to 2025 at the time of final manuscript editing to ensure coherent updated discussion. Retrospective analyses and pilot studies were also included if they addressed topics not covered in the prospective studies. After further exploration of their content, all relevant articles were included and summarized in the literature tables for the key topics. Further details on the methodology of ESGE guideline development have been reported elsewhere [7].

In addition, various exchanges and an on-site meeting were held during ESGE Days 2025 with the guideline leader (A.L.) and the task force leaders to discuss and finalize the recommendations. When an adaptation of a recommendation and its quality of evidence was needed, decisions were taken after obtaining a consensus among involved authors, taking into account its implementation, feasibility, cost/resource use, need of specific expertise, and implications, and the justification was added in a specific paragraph at the end of the relevant section of the guideline.

By November 2025, a draft of all the recommendations was prepared. Following approval by the leader (A.L.), the draft was reviewed by two members of the ESGE Governing Board and by

external reviewers, and it was then sent for further comments to the ESGE National Societies and individual members. After agreement on a final version, the manuscript was submitted to the journal *Endoscopy* for publication. All authors agreed on the final version of the manuscript. The Guideline was issued in 2026 and will be considered for review if new and relevant evidence becomes available. Any updates to the Guideline in the interim period will be noted on the ESGE website: www.esge.com/esge-guidelines.html.

3 Recommendations

A summary of the main recommendations and comparison with the 2018 (stenting) and 2022 (therapeutic EUS) guidelines is presented in ► **Table 1**. An illustration of the new main recommendations is presented in ► **Fig. 1**.

► **Table 1** ESGE biliary stricture management guideline update 2025: summary of recommendations.

a) Benign biliary strictures	
2017 endoscopic biliary stenting guideline	2025 update on endoscopic biliary stricture management
Benign biliary strictures	
ESGE recommends temporary insertion of multiple plastic stents (MPSs) or of a fully covered SEMS for treatment of benign biliary strictures. Strong recommendation, moderate quality evidence. The choice between the two strategies depends on the etiology of the stricture, its location, the CBD diameter, and endoscopist experience.	Updated by pathology type.
ESGE suggests, for multiple plastic stenting, insertion of the maximum number of stents possible every 3–4 months for a total duration of 12 months and, for treatment with FCSEMS, insertion of an 8–10-mm diameter FCSEMS for a dwell stenting period of 6 months. Weak recommendation, low quality evidence.	Updated by pathology type.
Postcholecystectomy biliary stricture	
ESGE suggests temporary insertion of MPSs for the treatment of benign biliary strictures complicating cholecystectomy; an FCSEMS can be an alternative for strictures located >2 cm from the main hepatic confluence. Weak recommendation, moderate quality evidence.	ESGE suggests temporary insertion of MPSs to treat postcholecystectomy benign biliary strictures. An FCSEMS can be considered in these patients when the stricture is located >2 cm distally from the main hepatic confluence or for patients who are noncompliant with repeated ERCPs. Conditional recommendation, very low quality of evidence.
Anastomotic stricture after liver transplantation	
ESGE suggests temporary insertion of MPSs for the treatment of benign anastomotic biliary strictures following orthotopic liver transplantation pending further evidence about FCSEMS. Weak recommendation, moderate quality evidence	ESGE suggests treating anastomotic biliary strictures following liver transplantation with either MPSs or temporary insertion of an FCSEMS when located >2 cm distally from the main hepatic confluence. Conditional recommendation, low quality of evidence.
Nonanastomotic stricture after liver transplantation	
	ESGE suggests managing nonanastomotic biliary strictures amenable to endoscopic treatment following liver transplantation with temporary insertion of MPSs together with balloon dilation if needed. Conditional recommendation, very low quality of evidence.

Chronic pancreatitis-associated biliary stricture	
ESGE suggests the temporary insertion of MPSs or of an FCSEMS for treating benign biliary strictures related to chronic pancreatitis. Weak recommendation, moderate quality evidence.	ESGE suggests treating biliary strictures secondary to chronic pancreatitis with temporary insertion (6–12 months) of an FCSEMS. Conditional recommendation, low quality of evidence.
Primary sclerosing cholangitis-associated biliary stricture	
<i>PSC guidelines 2017</i> ESGE/EASL suggest that the choice between stenting and balloon dilation should be left to the endoscopist's discretion. Weak recommendation, low quality evidence.	ESGE suggests using balloon dilation alone for high grade biliary strictures secondary to PSC. There is no added benefit of stenting following balloon dilation, and stenting may increase the risk of adverse events. Conditional recommendation, low quality of evidence.
b) Malignant biliary strictures	
2017 endoscopic biliary stenting guideline	2025 update on endoscopic biliary stricture management
Suspected malignant biliary obstruction	
ESGE recommends against the insertion of USEMS for the drainage of extrahepatic biliary obstruction of unconfirmed etiology. Strong recommendation, low quality evidence.	ESGE suggests avoiding the insertion of USEMSs for the drainage of extrahepatic biliary obstruction of unconfirmed etiology. Conditional recommendation, low quality of evidence.
Extrahepatic malignant biliary stricture: preoperative	
ESGE recommends against routine preoperative biliary drainage in patients with malignant extrahepatic biliary obstruction; preoperative biliary drainage should be reserved for patients with cholangitis, severe symptomatic jaundice (e.g. intense pruritus), or delayed surgery, or for before neoadjuvant chemotherapy in jaundiced patients. Strong recommendation, moderate quality evidence.	ESGE suggests offering preoperative biliary drainage to patients with extrahepatic malignant biliary obstruction (MBO) with cholangitis, severe symptomatic jaundice (e.g. intense pruritus), or delayed surgery after 2 weeks, or before neoadjuvant chemotherapy in jaundiced patients. Routine preoperative biliary drainage may be avoidable in patients with extrahepatic MBO when upfront surgery is planned within 1–2 weeks. Conditional recommendation, low quality of evidence.
ESGE recommends the endoscopic placement of a 10-mm diameter SEMS for preoperative biliary drainage of extrahepatic MBO. Strong recommendation, moderate quality evidence.	ESGE recommends the endoscopic placement of a 10-mm diameter SEMS for preoperative biliary drainage of extrahepatic MBO. Strong recommendation, moderate quality of evidence.
	Extrahepatic MBO: neoadjuvant
	ESGE recommends the endoscopic placement of a 10-mm diameter SEMS for neoadjuvant biliary drainage of extrahepatic pathologically confirmed MBO. Strong recommendation, moderate quality of evidence.
Extrahepatic MBO: palliative	
ESGE recommends that decompression of extrahepatic MBO be performed via ERCP rather than by surgery or percutaneously. Strong recommendation, moderate quality evidence.	ESGE recommends endoscopic over surgical or percutaneous biliary drainage for primary decompression of inoperable, extrahepatic MBO. Strong recommendation, moderate quality of evidence.
ESGE recommends SEMS insertion for palliative drainage of extrahepatic MBO. Strong recommendation, high quality evidence. ESGE recommends restricting the use of EUS-BD to cases where biliary drainage using standard ERCP techniques has failed. Strong recommendation, low quality evidence.	ESGE recommends SEMS insertion for palliative drainage of extrahepatic MBO of confirmed etiology. Strong recommendation, high quality evidence.
<i>2021 therapeutic EUS guideline</i> ESGE recommends ERCP for primary drainage of distal MBO, but EUS-BD could also be used in this setting for inoperable patients at high volume expert centers. Strong recommendation, moderate quality evidence.	ESGE suggests favoring ERCP for primary drainage of distal MBO, but EUS-BD could also be used as an alternative to primary ERCP for palliative biliary drainage in selected patients with distal MBO, in expert centers. Conditional recommendation, low quality of evidence.
Malignant bilioduodenal obstruction	
ESGE suggests endoscopic insertion of a biliary SEMS and an uncovered duodenal SEMS in patients with both biliary and duodenal malignant obstruction. Weak recommendation, low quality evidence.	See final entry in section d of this table.

Stent dysfunction	
ESGE suggests that in a patient with a distal malignant biliary stricture and a nonfunctioning stent, a plastic stent should be replaced by a SEMS and, in the case of a SEMS, a plastic stent or a new SEMS should be inserted within the original SEMS. Weak recommendation, moderate quality evidence.	No recommendation or suggestion.
Malignant hilar strictures	
ESGE recommends performing drainage of malignant hilar strictures in high volume centers with a hepatobiliary MDT. Strong recommendation, moderate quality evidence.	ESGE recommends performing drainage of malignant hilar strictures in high volume centers with a hepatobiliary MDT. Strong recommendation, moderate quality evidence.
Hilar stricture: preoperative	
ESGE suggests against routine preoperative biliary drainage in patients with malignant hilar obstruction. The indication and route for pre-operative biliary drainage should be decided by an MDT based on patient characteristics and institutional experience. Weak recommendation, low quality evidence.	ESGE suggests against routine preoperative biliary drainage in patients with malignant hilar obstruction. Indications and routes of drainage must be determined following an MDT discussion based on patient characteristics and institutional experience. Conditional recommendation, low quality of evidence. ESGE recommends ERCP over PTBD for preoperative biliary drainage in hilar malignant obstruction. Strong recommendation, moderate quality of evidence.
Hilar stricture: palliative	
ESGE suggests palliative drainage of malignant hilar strictures by means of ERCP for Bismuth types I and II, and PTBD or a combination of PTBD and ERCP for Bismuth types III and IV, to be modulated according to local expertise. Weak recommendation, low quality evidence.	ESGE suggests palliative drainage of malignant hilar strictures by means of ERCP for Bismuth types I–II. For Bismuth III–IV, ERCP or a combination of ERCP with EUS-BD is preferable over primary PTBD. Complementary drainage using PTBD might be required in some cases. Conditional recommendation, very low quality of evidence.
ESGE suggests, for palliative endoscopic drainage of Bismuth types II–IV strictures, drainage of $\geq 50\%$ of the liver volume and avoidance of the opacification of biliary ducts that will not be drained. Weak recommendation, low quality evidence.	ESGE suggests obtaining drainage of more than 50%, and ideally 70% or more, of the viable nonatrophic liver volume for palliative drainage of proven malignant Bismuth III–V strictures, using a multimodal approach (EUS-BD/PTBD if needed, as complementary methods to ERCP). Conditional recommendation, low quality of evidence.
ESGE recommends USEMSs for palliative drainage of malignant hilar obstruction. Strong recommendation, moderate quality evidence.	ESGE suggests using either plastic stents or USEMSs for palliative drainage of proven malignant hilar obstruction. ESGE suggests a plastic stent when the optimal drainage strategy has not been defined. ESGE suggests using a USEMS in expert centers to reduce the need for revisional procedures based on the patient's expected survival and the likelihood of achieving complete biliary drainage. Conditional recommendation, moderate quality of evidence.
c) Surgically altered anatomy/inaccessible papilla	
2021 therapeutic EUS guideline (nothing in 2017 biliary stenting guideline)	2025 update on endoscopic biliary stricture management
All postsurgical conditions	ERCP in Billroth II anatomy
ESGE suggests EUS-BD only after failed enteroscopy-assisted ERCP (EA-ERCP) in the management of benign postsurgical biliary obstruction or CBD stones. Weak recommendation, low quality evidence. ESGE suggests EUS-BD in postsurgical MBO and a long biliary limb with dilated intrahepatic bile ducts. Weak recommendation, low quality evidence.	ESGE suggests that in cases of Billroth II postsurgical anatomy, ERCP with front- or side-viewing endoscopes can be considered. Depending on local expertise, EUS-assisted or EUS-guided techniques can be undertaken when ERCP is unsuccessful. Conditional recommendation, moderate quality of evidence.
	Biliary drainage after pancreaticoduodenectomy
	ESGE suggests that, in patients with previous pancreaticoduodenectomy, EA-ERCP, EUS, and PTBD may be considered. For benign biliary strictures, EA-ERCP should be considered as the first-line option. EUS-BD may be proposed in selected cases, particularly when multiple biliary interventions are expected or if the index EA-ERCP was difficult. PTBD, including percutaneous cholangioscopy, may be considered in specific cases, such as right-sided hepatolithiasis or when other techniques have failed.

	For malignant biliary strictures, EA-ERCP or EUS-BD (either antegrade or EUS-HGS / EUS-HJS) is recommended as first-line therapy, according to anatomical constraints and local expertise. PTBD is recommended as the second-line option. EUS-directed transenteric ERCP requires further evaluation. Conditional recommendation, low quality of evidence.
	Biliary drainage after RYGB
	ESGE suggests that in patients with previous RYGB, EDGE or EA-ERCP may be considered. - For benign biliary strictures, EDGE is suggested as the first-line approach, unless there is specific expertise in EA-ERCP. - For malignant biliary strictures, EUS-BD (either antegrade stenting or EUS-HGS / EUS-HJS) is often the preferred option, although EDGE, EA-ERCP, and PTBD may also be considered based on anatomical constraints and local expertise. Conditional recommendation, low quality of evidence.
	Biliary drainage after partial/total gastrectomy (Roux-en-Y jejunojejunal anastomosis)
	ESGE suggests that in patients with partial or total gastrectomy with a Roux-en-Y jejunojejunal anastomosis, EA-ERCP, EUS-BD, and PTBD can be considered. - For benign biliary strictures, EA-ERCP should be considered as first-line option. EUS-BD may be proposed in selected cases, particularly when multiple biliary interventions are expected. PTBD, including percutaneous cholangioscopy, may be considered in specific indications, such as CBD or intrahepatic stones, or in cases where other techniques have failed. - For malignant biliary strictures, EUS-BD (either antegrade or EUS-HGS / EUS-HJS) or PTBD are suggested as first-line approaches in expert centers. Conditional recommendation, low quality of evidence.
	Biliary drainage after Roux-en-Y hepaticojejunostomy
	ESGE suggests endoscopic over percutaneous biliary drainage in patients with Roux-en-Y hepaticojejunostomy, owing to its safer profile. - For benign biliary stricture, EA-ERCP or EUS-BD techniques, such as antegrade drainage or EUS-HGS, are viable options. Additionally, EUS-directed transenteric ERCP may be considered in selected cases, particularly for postsurgical complications of hepaticojejunostomy. - For malignant biliary strictures, EUS-BD, with antegrade drainage or EUS-HGS, is recommended as a first-line approach. - PTBD can be considered as a second-line approach for benign and malignant indications. Conditional recommendation, low quality of evidence.
	Inaccessible papilla
	ESGE recommends EUS-BD over PTBD in cases of malignant biliary stricture following failed or unfeasible ERCP. In patients with distal stricture, ESGE suggests using EUS-HGS where a duodenal stricture is present, and either EUS-HGS or EUS-CDS where there is no duodenal stricture. ESGE suggests using PTBD when EUS-BD fails or is not feasible. Strong recommendation, moderate quality of evidence.
d) ERCP failure: second attempt	
2017 endoscopic biliary stenting guideline/ 2021 therapeutic EUS guideline	2025 update on endoscopic biliary stricture management
	Benign biliary stricture: accessible papilla, ERCP failure (failed cannulation/stricture passage)
ESGE suggests an EUS-RV technique after a second failed ERCP in benign biliary disease and normal gastrointestinal anatomy in high volume expert centers. Weak recommendation, low quality evidence.	ESGE suggests using rendezvous over transmural drainage where ERCP has failed for benign biliary strictures. Conditional recommendation, low quality of evidence.

ESGE recommends the use of EUS-BD over PTBD after failed ERCP in distal MBO when local expertise is available. Strong recommendation, moderate quality evidence. ESGE suggests EUS-BD with hepaticogastrostomy only for inoperable hilar MBO with a dilated left hepatic duct when inadequately drained by ERCP and/or PTBD in high volume expert centers. Weak recommendation, moderate quality evidence. ESGE recommends the use of EUS-BD over PTBD after failed ERCP in distal MBO when local expertise is available. Strong recommendation, moderate quality evidence.	Malignant biliary stricture: accessible papilla, ERCP failure, no duodenal stricture ESGE suggests EUS-guided transmural drainage over PTBD for MBO after failed ERCP. Conditional recommendation, low quality of evidence.
ESGE suggests endoscopic insertion of a biliary SEMS and an uncovered duodenal SEMS in patients with both biliary and duodenal malignant obstruction. Weak recommendation, low quality evidence.	Malignant biliary stricture: accessible papilla, ERCP failure, with duodenal stricture ESGE suggests EUS-BD over surgical bypass or percutaneous drainage in the setting of double malignant biliary and gastric outlet obstruction, where expertise is available. In this scenario, EUS-HGS is associated with reduced risk of recurrent biliary obstruction compared with EUS-CDS. Conditional recommendation, very low quality of evidence.

CBD, common bile duct; EA-ERCP, enteroscopy-assisted ERCP; EASL, European Association for the Study of the Liver; EDGE, endoscopic ultrasound-directed trans-gastric ERCP; ERCP, endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound; EUS-BD, EUS-guided biliary drainage; EUS-CDS, EUS-guided choledochoduodenostomy; EUS-HGS, EUS-guided hepaticogastrostomy; EUS-HJS, EUS-guided hepaticojunostomy; EUS-RV, EUS-assisted rendezvous biliary drainage technique; FCSEMS, fully covered self-expandable metal stent; MBO, malignant biliary obstruction; MDT, multidisciplinary team; MPSS, multiple plastic stents; PSC, primary sclerosing cholangitis; PTBD, percutaneous transhepatic biliary drainage; RYGB, Roux-en-Y gastric bypass; SEMS, self-expandable metal stent; USEMS, uncovered SEMS.

3.1 Benign biliary stricture

The natural evolution of BBSs with a sustained rise in liver function test (LFT) values has been associated with the development of long-term infective complications (e.g. cholangitis, liver abscess) and liver function deterioration (e.g. liver fibrosis, secondary biliary cirrhosis – 7.3% in chronic pancreatitis-related BBS) [4, 8, 9, 10]. Regression of liver fibrosis has been documented in surgical series after drainage of BBS (secondary to chronic pancreatitis and cholecystectomy), but no studies have evaluated the results of endoscopic treatment with multiple plastic stents (MPSS) or fully covered self-expandable metal stents (FCSEMSs) (**Table 4.1s**). It can be assumed that surgical or endoscopic biliary drainage resulting in normalization of LFTs can prevent the liver function deterioration that is observed in the case of untreated BBS. Since 2017, no major novel evidence has suggested changing the practice of starting endotherapy for the treatment of BBS with persistent increase in the LFTs for more than a month and/or the presence of cholangitis. The choice between MPSS and an FCSEMS depends on the etiology of the stricture, its location, common bile duct (CBD) diameter, and the endoscopist's experience. Practically, the following treatments can be suggested: MPSS, insertion of the maximum number of stents, with stent exchange every 3–4 months over a total period of 12 months; FCSEMS, insertion of an 8–10-mm diameter FCSEMS for a stent indwell period of 6–12 months.

3.1.1 Benign biliary stricture after cholecystectomy

RECOMMENDATION

ESGE suggests temporary insertion of multiple plastic stents to treat postcholecystectomy benign biliary strictures.

An FCSEMS can be considered in these patients when the stricture is located >2 cm distally from the main hepatic confluence or for patients who are noncompliant with repeated ERCPs.

Conditional recommendation, very low quality of evidence.

Postcholecystectomy BBSs are rare (<1%) and occur close to the main hepatic confluence in almost half of cases [11], especially in the era of laparoscopic surgery. The choice between MPSS and an FCSEMS depends on the involvement or not of the main hepatic confluence, patient compliance with repeated ERCPs, and evaluation of stricture recurrence rate and AEs during long-term follow-up (**Table 4.2s**).

A recent meta-analysis [12] comparing MPSS and covered SEMSs to manage BBS showed similar results in terms of stricture resolution, AEs, and stricture recurrence. Covered SEMSs had a higher migration rate, but required significantly fewer ERCPs, which can be translated into lower healthcare costs overall. These results do not necessarily apply to postcholecystectomy BBSs owing to the paucity of available data and the particular anatomy of postcholecystectomy BBS, involving the hilum in almost half of the cases [11]. In fact, only one RCT



► **Fig. 1** An illustration of the new main recommendations for: **a** benign biliary strictures; **b** malignant biliary strictures. ERCP, endoscopic retrograde cholangiopancreatography; EUS-CDS, EUS-guided choledochoduodenostomy; EUS-HGS, EUS-guided hepaticogastrostomy; FCSEMS, fully covered metal stent; MPSs, multiple plastic stents; PTBD, percutaneous transhepatic biliary drainage; SEMS, self-expandable metal stent; USEMS, uncovered SEMS.

[13], which included 31 patients, has compared MPSs and partially covered SEMs (PCSEMs) to dilate BBSs, which were mostly secondary to cholecystectomy. Based on magnetic resonance cholangiopancreatography (MRCP) findings, the long-term (5-year) biliary patency rate was higher for PCSEMs compared with MPSs (81.7% vs. 71.9%; $P = 0.02$), but AEs were numerically more frequent with SEMs (40% vs. 25%; $P = 0.37$). However, this study raised several concerns owing to the small number of patients enrolled, lack of detail in the study protocol, and the infrequent use of PCSEMs, raising concerns about stent removability. A large retrospective series [11], which included 154 patients with postcholecystectomy BBS treated with MPSs, described a low stricture recurrence rate (9.4%) after a mean follow-up of 11 years from stent removal. Unscheduled stent exchange due to AEs (e.g. cholangitis, jaundice, pain) was necessary in 7.4% of the MPS patients and one patient had ileal perforation due to stent migration and required urgent surgery.

One small prospective multicenter series [14] enrolled 18 patients with postcholecystectomy BBS located >2 cm from the main hepatic confluence who were treated with an FCSEMS; the stent indwelling period was 10–12 months. After a mean follow-up of 5 years from stent removal, only 61% of the patients had not required further treatments. The FCSEMS migration rate was 16.7%, and the AE rate (e.g. cholangitis, pancreatitis) was 38.9%. Interestingly, endoscopic retreatment was always possible after failure of MPSs or FCSEMs, not precluding a surgical approach if needed.

MPSs have shown sustained results during long-term follow-up compared with FCSEMs in the setting of postcholecystectomy BBS. MPSs can be adapted for strictures involving the main hepatic confluence and should be suggested as the first-line treatment for patients with postcholecystectomy BBS.

FCSEMs can be considered for strictures located >2 cm from the hepatic hilum, especially in patients who are noncompliant with repeated ERCPs (**Fig. 1s**)

Given the lack of comparative studies and systematic reviews and meta-analyses in this field, the task force issued a conditional recommendation with very low quality of evidence in favor of the temporary insertion of MPSs compared with an FCSEMS, which is mainly based on expert consensus extrapolated from indirect evidence.

3.1.2 Benign biliary stricture after liver transplantation: anastomotic stricture

RECOMMENDATION

ESGE suggests treating anastomotic biliary strictures following liver transplantation with either MPSs or temporary insertion of an FCSEMS when located >2 cm distally from the main hepatic confluence.

Conditional recommendation, low quality of evidence.

Biliary strictures after orthotopic liver transplantation are reported with an overall incidence of 4%–20% and are divided into anastomotic biliary strictures (ABSs) and nonanastomotic bili-

ary strictures (NBSs), with ABSs occurring more frequently than NBSs [15, 16].

Two treatment options are available to obtain permanent dilation of ABSs with endoscopic drainage:

- temporary insertion (usually 6-month indwelling period) of an FCSEMS, via transpapillary or intraductal route, is associated with fewer interventions and lower overall cost
- insertion, every 3–4 months, of an increasing number of plastic stents, for 1 year (MPSs), is associated with improved long-term results (**Table 4.3s**)

The main advantage of FCSEMs over MPSs is the need for two ERCPs to obtain ABS resolution with MPSs. Fewer ERCPs is associated with reduced overall cost and improved patient compliance. According to recent meta-analyses [17, 18], FCSEMs offer similar ABS resolution and AE rates to MPSs. The diameter of an FCSEMS is commonly 10 mm (8 mm can be considered according to the patient's anatomy) and the stent is usually left in place for 6 months. The main issue with FCSEMs is the risk of migration (proximal or distal partial/complete), resulting in an increased incidence of ABS recurrence compared with MPSs during a follow-up of 1–2 years. Three studies reported a mean 5-year follow-up [19, 20, 21]: one RCT [19] using transpapillary FCSEMs showed 36% ABS recurrence compared with 7% with MPSs; another single-arm, prospective, multicenter study [20] reported a 51% recurrence rate using transpapillary FCSEMs; the third study, which was comparative but retrospective, had a similar ABS recurrence rate for FCSEMs and MPSs (33.3% vs. 28.6%, respectively) after a 5-year mean follow-up – notably, the authors used an intraductal FCSEMS with antimigration properties [21].

FCSEMs with antimigration flaps were developed to improve ABS dilation. Two retrospective studies [22, 23] have compared transpapillary FCSEMs and antimigration FCSEMs: one study [23] had a significantly higher ABS resolution rate and fewer recurrences with antimigration FCSEMs, while the other [22] reported similar results, but also included patients with refractory ABSs.

Although it is more expensive and associated with a longer treatment period, treatment with MPSs is very effective, considering their low ABS recurrence rate (3%–6%) during a follow-up of longer than 5 years [24, 25].

FCSEMS treatment for ABSs is well standardized: once the stent is correctly deployed, it reaches the maximum diameter in almost all cases, as long as migration does not occur.

MPS placement is technically demanding and ABS dilation depends on operator experience in inserting the maximum number of plastic stents at each ERCP. The complexity of MPSs is also related to the need to remove and replace plastic stents at each treatment. A recent study [25] proposed a simplified MPS protocol: plastic stents were added at each ERCP, without their removal, and this protocol was compared retrospectively with conventional stent exchange. ABS resolution, ABS recurrence, and AEs were similar, without an increase in infective complications (e.g. cholangitis) during treatment. The sequential stent addition MPS protocol significantly reduced procedure time, fluoroscopy time, and costs (fewer devices were

needed for each procedure), maintaining excellent long-term results [26].

MPSs with the stent addition protocol represents a valuable alternative stenting technique, especially when intraductal FCSEMSs or antimigration FCSEMSs are not available.

Endoscopic sphincterotomy is needed to apply the MPS protocol, to place and remove an intraductal FCSEMS, and to reduce the risk of pancreatitis related to transpapillary FCSEMS insertion [27,28]. In the specific setting of living donor transplantation, biliary stricture has been reported in up to 40% of cases, with lower success rates in treating strictures by an endoscopic approach depending on the angulation of the stricture [29].

In summary, a recent meta-analysis demonstrated that FCSEMS placement is associated with similar ABS resolution and AEs to MPSs. Patient and societal advantages of using FCSEMSs include a reduced number of ERCPs and overall costs. Anatomical constraints (>2 cm from the hilum) and the risk of migration of FCSEMSs keep MPSs as a valid option.

The task force downgraded the quality of evidence to low owing to the high risk of inconsistency and imprecision (**Table 5.1s**). Therefore, the task force agreed on a conditional recommendation supporting either the use of MPSs or temporary insertion of an FCSEMS in post-liver transplantation anastomotic strictures.

3.1.3 Benign biliary stricture after liver transplantation: nonanastomotic stricture

RECOMMENDATION

ESGE suggests managing nonanastomotic biliary strictures amenable to endoscopic treatment following liver transplantation with temporary insertion of MPSs together with balloon dilation if needed. Conditional recommendation, very low quality of evidence.

Seven risk factors for nonanastomotic biliary stricture (NBS) development after liver transplantation were identified in a recent meta-analysis [30], including deceased cardiac death donor; primary sclerosing cholangitis (PSC) as an indication for orthotopic liver transplantation; Roux-en-Y bile duct reconstruction; hepatic artery thrombosis; longer cold and warm ischemia time; and total operative times. NBS develops secondary to ischemic cholangiopathy, involving the bile ducts within the graft, while the biliary anastomosis is not usually stenotic, resulting in a complex and chronic disease with limited possibilities for definitive treatment, leaving redo liver transplantation as the only therapeutic possibility in many cases.

Biliary cast syndrome can be associated with NBS, representing the evolution of the disease, as shown from cholangiographic evaluations [31].

Four types of ischemic cholangiopathy have been described [32]: the “confluence dominant type,” involving the hilum, can be successfully managed with MPSs; the “minor form,” which rarely needs stent insertion and redo liver transplantation; and

the “diffuse necrosis” and “multifocal progressive” patterns, which are largely stent dependent, and in which redo liver transplantation is almost universally required. An NBS amenable to endoscopic treatment commonly extends to the hilum and segmental/subsegmental intrahepatic bile ducts.

ERCP can be used to treat NBS by extraction of biliary casts, balloon dilation, and stenting of hilar/intrahepatic strictures, prolonging graft function and reducing the need for redo liver transplantation in some cases. Drainage in those with NBS is challenging, requiring selective cannulation of the intrahepatic radicles, balloon dilation of the strictures (commonly up to 4–6 mm), and insertion of MPSs to achieve dilation and complete drainage of the intrahepatic ducts to reduce the risk of cholangitis. Stent exchange is planned every 3–4 months over 1 year, but a recent paper [15] proposed continuing the dilation treatment until stricture resolution without an established timeframe. This strategy reflects the nature of NBS, which can evolve and recur over time. Endoscopic management of NBS can be considered a “bridge to redo liver transplantation,” especially when the stricture did not respond to dilation with MPSs [33].

No studies have compared the results of using ERCP with dilation and/or stenting to drain and dilate NBSs versus no ERCP (**Table 4.4s**). One prospective [32] and five retrospective studies [15,31,33,34,35], which included a total of 162 patients, evaluated endoscopic stenting of NBS with MPSs or a single plastic stent; balloon dilation of the strictures was performed before stenting, if needed. The NBS resolution rate was between 41% and 60% in the retrospective studies, whereas the long-term (1–8 years) success rates dropped to 21%. Cholangitis during the stent program was the most common AE, reported in up to 74% of cases [35].

Given the lack of comparative studies and systematic reviews and meta-analyses in this field, the task force issued a conditional recommendation with very low quality of evidence in favor of the temporary insertion of MPSs together with balloon dilation if needed.

3.1.4 Benign biliary stricture secondary to chronic pancreatitis

RECOMMENDATION

ESGE suggests treating biliary strictures secondary to chronic pancreatitis with temporary insertion (6–12 months) of an FCSEMS. Conditional recommendation, low quality of evidence.

BBSs due to chronic pancreatitis generally arise from chronic inflammation and fibrosis in the pancreas, leading to external compression or fibrotic stricture formation within the bile duct [36]. The biliary stricture involves the distal intrapancreatic bile duct, resulting in a longer stenosis compared with postoperative BBSs. These anatomical considerations explain the 60%–70% stricture resolution rate after endotherapy on long-term follow-up [37].

Key indications for intervention include jaundice, cholangitis (to prevent progression to sepsis), and prolonged cholestasis (elevated alkaline phosphatase for over a month), to prevent the development of secondary biliary cirrhosis [38]. Endoscopic therapy is the preferred initial intervention for most patients, with surgery reserved for those cases where endotherapy fails [39,40].

The following treatment options have been evaluated in studies.

- **ERCP with MPSS:** Starting with one or two 10-Fr plastic stents, stents are exchanged every 3–4 months, with gradual dilation and placement of MPSS over a 12-month period – the goal being to achieve maximal dilation of the biliary stricture [38] – with reported success rates for stricture resolution ranging from 60% to 92% [38,41] and a reported up to 17% rate of recurrence, often necessitating further intervention [36]. The main disadvantages of MPSS are the need for multiple ERCP sessions, the risk of stent occlusion, and patient noncompliance with repeated procedures.
- **ERCP with an FCSEMS:** An FCSEMS is placed across the stricture during ERCP and is generally left in place for 6–12 months before its removal [37]. An FCSEMS can achieve similar or superior dilation compared with MPSS owing to its larger caliber, corresponding to the diameter achieved with six or more plastic stents [41]. Studies have shown FCSEMSs to be comparable to MPSS in terms of stricture resolution (90%–92%) [37,38,42]. Additionally, the use of an FCSEMS is associated with fewer ERCP sessions, reducing the need for frequent procedures [39,40].

The major concerns with FCSEMSs include stent migration (reported in 7%–25% of cases), which can be resolved with anti-migration mechanisms like anchoring flaps, and rare cases of cholecystitis [40,42]; however, overall complications such as cholangitis or pancreatitis appear comparable to MPSS placement [40]. An important consideration is the careful positioning of the FCSEMS to avoid obstruction of the cystic duct [36,40].

FCSEMS indwell time is an open issue in chronic pancreatitis-related BBS. Some authors proposed a longer (10–12 months) stenting period to consolidate the dilation [43,44]. The risk of hyperplastic tissue ingrowth/overgrowth and FCSEMS embedding is rare (near 3%–4%) but, when present, complex procedures like the “SEMS-in-SEMS” technique are needed [45]. A 6-month FCSEMS indwell time seems safer [38,42,46]; however, no direct comparisons between 6 months or 10–12 months of FCSEMS indwell have been conducted.

Comparative outcomes (Table 4.5s) In a recent RCT by Ramchandani et al. [44], involving 164 patients with chronic pancreatitis-related strictures, 84 patients received MPSS while 80 received a single FCSEMS over a 12-month period. After 2 years of follow-up, stricture resolution rates were similar between the two groups: 75.8% in the FCSEMS arm and 77.1% in the MPSS arm. However, the FCSEMS group required significantly fewer ERCP procedures on average to achieve stricture resolution (2.6 vs. 3.9; $P<0.001$), suggesting a potential reduction in procedural burden for patients treated with an FCSEMS.

Another RCT by Haapamäki et al. [38] reported comparable 2-year stricture-free success rates of 90% in the MPSS group and 92% in the FCSEMS group after 6 months of stenting, with no significant difference between the groups ($P=0.41$). This suggests that both approaches offer similar long-term outcomes, with FCSEMSs providing a more streamlined treatment option for some patients.

Additionally, a third RCT by Coté et al. [46] included 112 patients with BBSs, of whom 35 had chronic pancreatitis. Patients were randomized to receive either MPSS (replaced every 3 months) or a single FCSEMS for 6 months. This study also demonstrated noninferior stricture resolution rates for FCSEMSs (92.6%) compared with MPSS (85.4%), with FCSEMSs requiring fewer ERCP procedures ($P<0.001$). A 12-month follow-up confirmed the durability of these outcomes.

No significant differences were observed in these studies in terms of stricture recurrence, migration, or moderate-to-severe AEs between the two groups.

Concerning long-term outcomes, a single-arm prospective study [37] reported a 5-year follow-up after FCSEMS removal in 118 patients with chronic pancreatitis-related biliary strictures: 61.6% of the patients remained stent free, increasing to 77.4% in those patients who had had initial stricture resolution.

A recent meta-analysis based on these three RCTs concluded there were no differences between FCSEMSs and MPSS in rates of stricture resolution (odds ratio [OR] 0.59, 95%CI 0.19 to 1.81; $I^2=50.6\%$), time to stricture resolution (MPSS vs. FCSEMS: median [interquartile range] 199.5 [95] days vs. 184 [38] days; $P=0.15$), procedural time (mean difference 8.26, 95%CI –6.24 to 22.76; $I^2=83\%$), AEs (OR 0.67, 95%CI 0.35 to 1.30; $I^2=0\%$), or mortality. MPSS use was associated with more ERCPs (mean difference 1.42, 95%CI 1.50 to 1.70; $P<0.01$), and a higher number of stents were used (7.0 vs. 4.4 vs. 1.3; $P<0.001$) [47].

Summary With similar efficacy and safety, FCSEMSs for treating BBSs related to chronic pancreatitis have the advantage of requiring fewer ERCPs than MPSS.

The task force downgraded the quality of evidence owing to the high risk of inconsistency and imprecision (Table 5.2s). Therefore, a conditional recommendation supporting the temporary insertion (6–12 months) of an FCSEMS was issued.

3.1.5 Benign biliary stricture secondary to primary sclerosing cholangitis

RECOMMENDATION

ESGE suggests using balloon dilation alone for high grade biliary strictures secondary to primary sclerosing cholangitis. There is no added benefit of stenting following balloon dilation, and stenting may increase the risk of adverse events (mainly cholangitis).

Conditional recommendation, low quality of evidence.

PSC is a chronic cholestatic liver disease characterized by inflammation and fibrosis with subsequent development of multiple biliary strictures and dilatations. Patients with more

advanced disease can benefit from endotherapy for the management of “dominant” or “high grade” strictures [48]. The new definition of a high grade stricture diagnosed during MRCP is a stricture causing 75% reduction in the duct diameter in the CBD or hepatic ducts. High grade biliary strictures in PSC are also associated with an increased risk of cholangiocarcinoma, requiring brush cytology or biopsy during ERCP, with or without cholangioscopy. High grade biliary strictures in the setting of PSC are amenable to endoscopic dilation after evaluation of the biliary anatomy with MRCP. ERCP can obtain relief of jaundice/cholestasis in PSC via stricture dilation with balloons (**Table 4.6s**). When placed in selected rare cases, stents in the setting of PSC should be removed within 1–2 weeks to avoid infectious complications.

IgG4-related cholangitis is a separate rare disorder mimicking PSC and cholangiocarcinoma. The diagnosis relies on the HISORT criteria (histology, imaging [MRCP], serology [serum IgG4 levels], organ involvement [associated autoimmune pancreatitis, sialadenitis], and response to steroid treatment). When there is clinical suspicion, immunosuppressive therapy is the key to management, confirming the diagnosis when a response occurs. Endoscopic biliary drainage is reserved for septic cholangitis or long-lasting fibrotic phenotype strictures, preferably using just balloon dilation, with short-course stenting only in cases that are refractory to endoscopic balloon dilation (EBD) [48].

Therapeutic options evaluated in PSC The following are the possible therapeutic options available.

- **ERCP with balloon dilation** Gotthardt et al. [49] conducted a long-term study evaluating the outcomes of repeated EBD in 96 PSC patients with high grade strictures. Over a 20-year period, patients underwent repeated dilations. There was an 81% transplant-free survival rate at 5 years and transplant-free survival was 52% at 10 years. This study demonstrates that EBD of high grade strictures can effectively preserve liver function in PSC patients over extended periods. According to a meta-analysis of 10 studies, which included 456 patients and assessed outcomes of EBD alone vs. EBD and stenting [50], EBD has a clinical success rate of 86.5% compared with 70.8% with stenting ($P < 0.001$) and a technical success rate of 96.8%. The recurrence-free rate varies, but generally ranges from 9–12 months, which may necessitate repeated dilations in patients with progressive disease. A multicenter RCT found no significant difference in recurrence rates between short-term stenting and EBD for high grade strictures in PSC [51].
- **ERCP with plastic stenting** A study by van Milligen de Witt et al. [52] reviewed the effects of endoscopic stent therapy in 25 PSC patients with high grade strictures. Technical success was achieved in 84% of cases, and 57% of patients maintained stable liver function, without symptoms, at a mean follow-up of 29 months post-stent removal. Additionally, 19% of patients who relapsed responded to further endoscopic therapy, while early complications were reported in 14% of patients. This study concluded that endoscopic stent therapy is safe and effective, particularly for managing acute disease exacerbations due to extrahepatic strictures in PSC.
- **ERCP with FCSEMSs** In terms of refractory, high grade strictures, a retrospective study by Sbeit et al. [53] evaluated the use of FCSEMSs in patients unresponsive to EBD or plastic stents. In this study of 20 PSC patients with resistant strictures, FCSEMSs were placed for 3 months. At 1 month, 80% of patients showed improvement in weakness and 35% in pruritus, with similar improvements noted at 6 months post-stent removal. Cholangiographic resolution of the high grade stricture was achieved in 65% of patients after stent removal, although 30% experienced recurrence within 12 months. The study concluded that temporary placement of an FCSEMS is a feasible, safe, and effective option for managing refractory PSC-related strictures.

Comparative outcomes Ponsioen et al. [51] conducted a multicenter, open-label, randomized trial comparing EBD versus short-term stenting in PSC patients with high grade strictures. Among 65 randomized patients, the cumulative recurrence-free rate of the primary high grade strictures was equal in both groups. The overall median recurrence-free rate and initial failure rate were equal in both groups (EBD 52% vs. stenting 44%; $P = 0.89$); however, procedure-related severe AEs were significantly higher in the stent group (6.7% vs. 45.4%; $P = 0.01$).

A retrospective study by Kaya et al. [54] compared the outcomes of EBD alone with EBD followed by stenting in 71 PSC patients with high grade strictures. While cholestasis improvement was similar in the two groups, stenting was linked to a higher complication rate (30% vs. 6%; $P = 0.001$) and incidence of acute cholangitis ($P = 0.004$).

In a retrospective study by Han et al. [55], 169 PSC patients with high grade strictures were treated either with EBD and stenting (115 patients) or EBD alone (54 patients). After 1 year of follow-up, transplant-free survival rates were similar between the two groups; however, patients who received both stenting and dilation had more advanced PSC and experienced a significantly higher rate of complications compared with the EBD-alone group (33% vs. 21.8%).

Two meta-analyses [50, 56] compared the results of EBD vs. EBD plus stenting in PSC high grade strictures. In the first one, nine studies were included (one RCT, four prospective, four retrospective studies), with a total of 458 patients. EBD alone was found to be superior to dilation plus stenting in terms of technical (96.8% vs. 91.9%) and clinical (86.5% vs. 70.8%) success, with a lower AE rate (11.2% vs. 26.9%), including cholangitis. In the second meta-analysis, seven studies were included (one RCT and six retrospective studies), totaling 660 patients. The clinical efficacy was similar for EBD and stenting (85% vs. 84.9%), with fewer interventions needed in the EBD group (2.7 vs. 6.5; $P < 0.001$) and there being fewer AEs (15% vs. 44%), particularly cholangitis (3.2% vs. 16.8%).

In conclusion Recent data from an RCT [51] and two meta-analyses [50, 56] support the role of EBD alone in obtaining better clinical success with a reduction of infectious complications in the management of PSC patients with high grade strictures. When stenting is needed in patients with PSC, plastic stents are preferred, with their early removal within 1–2 weeks, to avoid cholangitis secondary to stent occlusion from debris. The role

of FCSEMSs in PSC is still under evaluation, but they might be an option for selected refractory cases [53].

The task force issued a conditional recommendation with a low quality of evidence because of the high risk of indirectness and imprecision (**Table 5.3s**).

3.2 Malignant biliary strictures

RECOMMENDATION

ESGE suggests avoiding the insertion of uncovered SEMSs for the drainage of extrahepatic biliary obstruction of unconfirmed etiology.

Conditional recommendation, low quality of evidence.

In large series, 5%–10% of patients undergoing surgery for pancreatic cancer prove to have benign disease at surgery [57]. Uncovered SEMSs (USEMSs) are difficult or impossible to remove and, if misplaced in indeterminate biliary strictures, may jeopardize the possibility of adequately assessing the etiology of a stricture by magnetic resonance imaging or by EUS owing to artefacts, sampling tissue with an intraductal brush or biopsy forceps, and assessing its cholangioscopic appearance [1]. In patients who subsequently survive long term with a benign condition, the misplacement of a USEMS could be associated with increased numbers of required reinterventions and the associated risks of biliary obstruction.

3.2.1 Distal malignant biliary stricture: preoperative and neoadjuvant biliary drainage

RECOMMENDATION

ESGE suggests offering preoperative biliary drainage (PBD) to patients with extrahepatic malignant biliary obstruction and cholangitis, severe symptomatic jaundice (e.g. intense pruritus), or delayed surgery after 2 weeks, or before neoadjuvant chemotherapy in jaundiced patients.

Routine PBD may be avoidable in patients with extrahepatic malignant biliary obstruction when upfront surgery is planned within 1–2 weeks.

Conditional recommendation, low quality of evidence.

A landmark RCT [58] comparing upfront surgery within 1 week (96 patients) with preoperative biliary drainage (PBD) using plastic stents followed by surgery 4–6 weeks later (106 patients) reported that PBD prior to surgery for pancreatic head carcinoma increased the severe AE rate (74% vs. 39%; relative risk 0.54, 95%CI 0.41 to 0.71; $P<0.001$), but was not associated with differences in surgical complications between the groups (47% vs. 37%; nonsignificant). Interestingly, in the PBD group, the 46% AE rate included 30% stent dysfunction and 26% cholangitis. This study was limited by the exclusion of patients with bilirubin values exceeding 250 $\mu\text{mol/L}$ (14 mg/dL),

the specific design of the surgical timings in the two groups, and the choice of plastic stents, which are now known to be associated with more dysfunction than the recently recommended SEMSs for use in this setting.

Several meta-analyses published before the last ESGE guidelines suggested that PBD did not influence mortality rates, but might worsen morbidity compared with direct surgery. More recent retrospective studies have reported varying postoperative complication rates that either support PBD [59,60,61] or favor direct surgery [62,63]. These differences can be explained by differences in the population characteristics and methods (e.g. percutaneous or endoscopic drainage), and confounding bias (**Table 6.1s**). Taken together, the lower stent dysfunction rates observed in the studies using SEMSs in the preoperative setting and the expanding use of neoadjuvant chemotherapy before surgery argue in favor of more frequently offering patients preoperative biliary drainage using a SEMS.

The evidence supporting this statement was based on a single RCT (**Table 7s**). Therefore, given the impossibility of assessing the risk of inconsistency and indirectness, and the need for further RCTs in this field, the task force issued a conditional recommendation with a low quality of evidence.

RECOMMENDATION

ESGE recommends the endoscopic placement of a 10-mm diameter SEMS for preoperative biliary drainage of extrahepatic malignant biliary obstruction.

Strong recommendation, moderate quality of evidence.

The endoscopic approach to biliary drainage remains preferable over percutaneous management. The preference for an endoscopic approach is based on increased overall survival and a decreased incidence of liver metastasis associated with this approach, as demonstrated recently for distal cholangiocarcinoma [64], and by two meta-analyses for different types of malignancies [65,66].

Adding the accumulating evidence to the previous ESGE guidelines [2], a recent systematic review and meta-analysis aggregated 12 studies involving 683 patients, comprising two RCTs, one prospective study, and nine retrospective cohorts [67]. Compared with plastic stents, the use of a SEMS was associated with longer stent patency and fewer endoscopic reinterventions, but more post-ERCP AEs (post-ERCP pancreatitis [PEP] 10.7% vs. 4.7%) and a comparable rate of complications after surgery. Of note, mainly PCSEMSs or FCSEMSs were used in this study, involving 8/12 studies offering neoadjuvant therapy to patients, with no data about the use of sphincterotomy before covered SEMS placement, an intervention that is known to increase the risk of PEP. A recent matched prospective trial compared the use of a modified FCSEMS to plastic stents for PBD, demonstrating reduced AE rates (6.9% vs. 27%; $P=0.04$) and reduced need for reintervention (0% vs. 20.7%) with the use of the modified FCSEMS [68] (**Table 6.1s**).

The quality of evidence was downgraded to moderate owing to the risk of indirectness (**Table 7s**). Therefore, the task force issued a strong recommendation, with a moderate quality of evidence.

RECOMMENDATION

ESGE recommends the endoscopic placement of a 10-mm diameter SEMS for neoadjuvant biliary drainage of extrahepatic pathologically confirmed malignant biliary obstruction.
Strong recommendation, moderate quality of evidence.

For neoadjuvant biliary drainage, one new RCT reported results that are concordant with the ESGE 2018 statement. The RCT evaluated FCSEMSs against plastic stents in 67 patients and observed less stent dysfunction (18.2% vs. 72.8%; $P=0.02$), fewer reinterventions, and a lower risk of AEs with SEMSs [69] (**Table 6.2s**).

Another RCT in 119 patients, who were randomized to receive an FCSEMS or a USEMS for preoperative biliary drainage in the setting of neoadjuvant therapy, observed similar rates of biliary drainage, reintervention, and AEs [70]. Interestingly, the use of a 4-cm stent was predictive of the need for reintervention, arguing the insertion of a 6-cm SEMS may be preferable.

The quality of evidence was downgraded to moderate owing to the risk of indirectness (**Table 7s**), and a strong recommendation, with moderate quality of evidence, was issued.

3.2.2 Distal malignant biliary stricture: palliative drainage

RECOMMENDATION

ESGE recommends endoscopic over surgical or percutaneous biliary drainage for primary decompression of inoperable, extrahepatic malignant biliary obstruction.
Strong recommendation, moderate quality of evidence.

RECOMMENDATION

ESGE recommends SEMS insertion for palliative drainage of extrahepatic malignant biliary obstruction of confirmed etiology.
Strong recommendation, high quality of evidence.

RECOMMENDATION

ESGE suggests favoring ERCP for primary drainage of distal malignant biliary obstruction, but EUS-guided biliary drainage (EUS-BD) could also be used as an alternative to primary ERCP for palliative biliary drainage in selected patients with distal malignant biliary obstruction, in expert centers.
Conditional recommendation, low quality of evidence.

Type of SEMS for ERCP For palliative drainage, multiple meta-analyses were cited in the ESGE guideline in 2018 that demonstrated the advantages of SEMSs over plastic stents in terms of patient survival, stent dysfunction, and the need for reintervention/cholangitis.

Recently, several prospective and retrospective studies have confirmed these data, with longer stent patency observed with USEMSs compared with plastic stents (**Table 6.3s**).

The theoretical advantage of covered SEMSs is the reduced risk of tumor ingrowth but covered SEMSs also carry higher risks of stent migration, tumor overgrowth, and sludge formation. A recent RCT [71] and previous meta-analyses comparing covered SEMSs (FCSEMS and PCSEMS) and USEMSs in this setting did not report any differences in stent dysfunction, reintervention rates, or survival [2].

Innovative tricks to decrease migration or ingrowth have recently been described.

- A recent RCT showed that, when associated with coaxial double-pigtail stent insertion, FCSEMS migration is reduced from 40% to 15% ($P=0.02$) and stent patency prolonged from 173 days to 237 days ($P=0.048$) [72] (**Table 6.5s**)
- The use of a newly designed multihole SEMS, where multiple small side holes are present in the stent membrane, was associated with less recurrent biliary obstruction (21%), less ingrowth (13%), and less migration (2.6%) compared with USEMSs and FCSEMSs, respectively [73]
- A prospective study on modified FCSEMSs with antimigration features observed a significantly lower risk of stent migration and longer patency compared with conventional FCSEMSs [74].

Interestingly, a recent meta-analysis [75] that specifically compared PCSEMSs to FCSEMSs, including 62 studies (3327 patients treated with FCSEMSs, 2322 with PCSEMSs), reported a significantly longer time to recurrent biliary obstruction with PCSEMSs (369 days, 95%CI 290 to 449 days) than with FCSEMSs (238 days, 95%CI 191 to 268 days) in a subanalysis of a prospective trial of unresectable distal MBO, while the rate of AEs was not different.

The task force decided to keep the first two statements, given the absence of new evidence challenging them in the recent literature. The quality of evidence on type of SEMS was downgraded to low owing to the risk of indirectness and imprecision (**Table 7s**), and the task force issued a conditional recommendation, with low quality of evidence, in favor of using PCSEMSs.

EUS-BD Two meta-analyses of RCTs comparing EUS-BD to ERCP for primary palliative biliary drainage [76, 77] showed that EUS-BD and ERCP had similar rates of technical success, clinical success, safety, and stent patency. The technical success of EUS-BD using lumen-apposing metal stents (LAMSs) was reported to be superior to ERCP in both meta-analyses, mainly due to one of the included RCTs [78], which reported a surprising low (76%) technical success rate in the ERCP group. In one of the meta-analyses, only studies of EUS-BD using SEMSs had lower reintervention rates compared with ERCP, this long-term outcome difference being mainly due to one of the studies where a significant proportion of the included procedures were hepaticogastrotomies [79]. Of note, there was heterogeneity of the type of SEMS (USEMS, PCSEMS, or FCSEMS) used in the ERCP group as comparison. With regard to the similar safety observed with ERCP and EUS-BD, careful examination of the included studies revealed that rectal nonsteroidal anti-inflammatories (NSAIDs) were not delivered in one of the studies [79], which reported a 14.8% rate of PEP, and were delivered to only 57% of the patients treated by ERCP in a second study [80] (**Table 6.4s**).

Potential publication biases have been discussed regarding these data [76], reported mainly by expert centers in therapeutic EUS, with potential under-reporting of bad outcome data using EUS-BD, as revealed by recently published real-life data. Real-world data have reported that 7% of the procedures are associated with technical failures (risk factors being CBD diameter ≤ 15 mm and low operator experience [≤ 10 LAMS placements]), with a mortality rate as high as 12% at 30 days [81]. For EUS-BD, LAMS misdeployment was recently studied in a cohort of 152 patients where, on multivariate analysis, CBD diameter ≤ 15 mm was associated with increased odds of misdeployment and technical failure [82]. Recent evidence is clear about the bad outcomes associated with EUS-BD using choledochoduodenostomy (EUS-CDS) in patients with duodenal stricture [83], due to increased risk of food impaction, and about the high long-term dysfunction rate of EUS-BD using LAMSs if no FCSEMS or coaxial double-pigtail plastic stent (DPPT) is inserted through the LAMS [84, 85, 86, 87, 88], with a reported 10% pooled rate of dysfunction and 12% reintervention rate in a large meta-analysis [89]. Of note, a recent study from a high volume expert center demonstrated that the need for EUS-BD using a LAMS for primary biliary drainage of distal MBO is present in only a minority of cases (6.6%) [90].

Taken together, recent data suggest that, in expert hands, EUS-BD as a primary biliary drainage method might be an alternative to ERCP with SEMS placement for palliative drainage of distal MBO when the CBD diameter is ≥ 12 mm, but more unbiased quality data are needed to eventually generalize and change a paradigm based on massive worldwide experience with ERCP in this setting.

The task force downgraded the quality of evidence owing to the moderate risk of bias in the literature and the high risk of indirectness (**Table 7s**). Therefore, the task force issued a conditional recommendation, with a low quality of evidence.

3.2.3 Hilar/intrahepatic malignant biliary stricture: preoperative drainage

RECOMMENDATION

ESGE recommends performing drainage of malignant hilar strictures in high volume centers with a hepatobiliary multidisciplinary team.
Strong recommendation, moderate quality evidence.

RECOMMENDATION

ESGE suggests against routine preoperative biliary drainage in patients with malignant hilar obstruction. Indications and routes of drainage must be determined following a multidisciplinary team discussion based on patient characteristics and institutional experience.
Conditional recommendation, low quality evidence.

RECOMMENDATION

ESGE recommends ERCP over percutaneous transhepatic biliary drainage (PTBD) for preoperative biliary drainage in hilar malignant obstruction.
Strong recommendation, moderate quality of evidence.

As stated in the previous ESGE guidelines [2], assessment and drainage of malignant hilar biliary strictures should be performed in high volume centers with a dedicated multidisciplinary team, to ensure better outcomes. The indication for drainage should be discussed, based on resectability and the clinical situation of the patient, and various therapeutic modalities considered (e.g. portal embolization and extension of required surgery) [91, 92].

For patients with resectable disease and an indication for biliary drainage (e.g. severe jaundice, cholangitis, predicted future liver remnant volume of $\leq 30\%$ following surgery), both ERCP and PTBD are available modalities. A recent RCT including 54 patients with potentially resectable perihilar cholangiocarcinoma and biliary obstruction of the future liver remnant compared endoscopic biliary drainage with ERCP ($n=27$) to PTBD ($n=27$). The study reported comparable severe preoperative drainage-related AEs (67% vs. 63%), but a higher overall mortality rate in the PTBD group (41% vs. 11%), leading to a premature termination of the study [93]. Seeding, with potential metastasis found at the laparotomy scar can be a concern for both routes, but appears to be higher for PTBD [94]. A recent meta-analysis focused on the rate of implantation metastases, including 10 studies and 1085 patients who had undergone endoscopic or percutaneous drainage for MBO, confirmed that PTBD was related to a higher risk of implantation metastases (OR 0.35, 95%CI 0.23 to 0.53; $P<0.001$) [65] (**Table 6.6s**).

The task force decided to keep the two first statements in light of the absence of new evidence challenging their validity in the recent literature.

The quality of evidence informing the comparison between ERCP and PTBD was downgraded to moderate because the risk of inconsistency could not be assessed (evidence based on a single RCT) (**Table 8s**).

3.2.4 Hilar/intrahepatic malignant biliary stricture: palliative drainage

RECOMMENDATION

ESGE suggests palliative drainage of malignant hilar strictures by means of ERCP for Bismuth types I–II. For Bismuth III–IV, ERCP or a combination of ERCP with EUS-BD is preferable over primary PTBD. Complementary drainage using PTBD might be required in some cases. Conditional recommendation, very low quality of evidence.

The goals of obtaining qualitative palliative drainage for hilar MBO are to solve obstructive symptoms and prevent or treat cholangitis, to ensure access to oncological treatment and reduce the need for revision and readmission as much as possible. The difficulty of hilar strictures relates to their anatomical complexity and the need to adequately drain dilated biliary ducts from nonatrophic liver segments [95]. The previous version of the ESGE biliary stenting guidelines published in 2018 proposed ERCP for Bismuth I and II, and PTBD or combining ERCP and PTBD for Bismuth III–IV, following local expertise. Recent data associated with the development of EUS-guided hepaticogastrostomy (EUS-HGS) and procedure-related mortality associated with PTBD challenge the statement from 2018.

ERCP vs. PTBD A recently published meta-analysis comparing ERCP and PTBD for the drainage of hilar malignant stricture, mixing preoperative and palliative settings, showed superior therapeutic success in the PTBD group (OR 3.5, 95%CI 2.1 to 6.0), with higher cholangitis (OR 1.7, 95%CI 0.9 to 3.1) and re-intervention rates (OR 11.5, 95%CI 3.5 to 37.7) in the ERCP group [96]. The main limits of this study were that only one of the 11 studies included in the meta-analysis was an RCT, all the other studies were retrospective. A majority of the lesion types included were Bismuth III–IV (74% of the cohort), with only 30% of the cohort having been treated with bilateral drainage (only 23% bilateral drainage in the ERCP group for 68% of Bismuth III–IV in the ERCP group).

Among the studies included in the meta-analysis, the only study published after 2017, the end date of the literature search for the previous ESGE guideline on biliary stenting, is an RCT from Coelen et al. [93]. Although designed in a preoperative setting, this RCT compared PTBD to ERCP for hilar malignant biliary drainage and was closed prematurely owing to higher mortality in the PTBD group (41% vs. 11%; RR 3.7, 95% CI 1.2 to 11.7; $P=0.03$), with a trend toward a higher cholangitis rate in the PTBD group (59% vs. 37%; $P>0.05$).

More recent data, from a bicenter retrospective study reported by Lubbe et al. [97] on palliative hilar biliary drainage by ERCP (153 patients) and PTBD (140 patients), reported similar rates of technical (98% vs. 99%; $P=0.8$) and therapeutic success (81.7 vs. 73%; $P=0.2$). ERCP had more sustained drainage success compared with PTBD, with a 3-month gain in the duration of therapeutic success after ERCP drainage (95%CI 26 to 160 days; $P=0.006$). AE analysis demonstrated equivalent cholangitis rates (21% vs. 24%), more pancreatitis in the ERCP group (9.4% vs. 0%), and increased procedure-related death in the PTBD group (6.0% vs. 15.8%; $P<0.001$) (**Table 6.7s**).

EUS-HGS Recent developments in EUS-BD have been applied to palliative treatment of hilar MBO, using mainly EUS-HGS, sometimes using the bridging technique when left-to-right SEMSs are implanted, or with complementary hepaticoduodenostomy to drain the right segments. Hepaticogastrostomy is generally performed using the placement of dedicated partially covered stents to avoid bile leakage and stent migration.

Specific data on the use of these techniques for malignant hilar stricture drainage have been reported in a review by Nakai et al., reporting on 88 cases, with a technical success rate of 98%, high clinical success (75%), and a low rate of AEs (8%) [98].

Further retrospective studies have reported experience with using EUS-HGS for hilar malignant biliary drainage in 20, 34, and 41 cases, with high rates of technical success (91%–100%), clinical success ranging from 65% to 100%, and AE rates of 13%–35%, depending on definitions [99,100,101]. In the study by Schoch et al., clinical success and access to chemotherapy after EUS-HGS were both associated with improved survival [100] (**Table 6.7s**).

EUS-HGS vs. PTBD In a propensity score-matched analysis comparing EUS-HGS to PTBD, Koutlas et al. demonstrated a better clinical success rate (100% vs. 75%) and a better safety profile (AEs 13% vs. 58%), with fewer reinterventions, shorter hospital stay, and shorter procedure times with EUS-HGS compared with PTBD [101] (**Table 6.7s**).

Conclusion Limitations of the available evidence in palliative hilar MBO drainage concern PTBD, where the majority of evidence of its increased morbidity compared with endoscopic drainage comes from good quality RCTs dedicated to preoperative drainage (and not palliative drainage).

The task force downgraded the quality of evidence to very low owing to the high risk of bias in the literature, imprecision, and publication bias (**Table 8s**). Therefore, a conditional recommendation with very low quality of evidence was issued.

RECOMMENDATION

ESGE suggests obtaining drainage of more than 50%, and ideally 70% or more, of the viable nonatrophic liver volume for palliative drainage of proven malignant Bismuth II–IV strictures, using a multimodal approach (EUS-BD/PTBD if needed, as complementary methods to ERCP). Conditional recommendation, low quality of evidence.

One RCT assessed the question of whether to drain palliative hilar malignant stricture using unilateral ($n = 66$) or bilateral SEMS ($n = 67$) insertion. Although the technical success rates were similar (95.5% vs. 100%), the rates of clinical success (95.3% vs. 84.9%; $P = 0.047$) and primary reintervention (42.6% vs. 60.3%; $P = 0.049$), and the median cumulative stent patency duration (252 days vs. 139 days) were all in favor of bilateral SEMS insertion [102].

Two systematic reviews, mainly based on retrospective series, were published on this topic, both demonstrating a reduction in the need for reintervention and prolonged stent patency with bilateral drainage [103, 104].

A recent large multicenter retrospective study on 236 patients with hilar MBO compared unilateral to bilateral stenting using SEMSs. Although technical success was higher using unilateral stenting 98.8% vs. 82.5%; $P < 0.001$), clinical success was higher in the bilateral SEMS group (85.7% vs. 70.5%; $P = 0.03$), with reduced postprocedure mortality (hazard ratio [HR] 0.36; $P < 0.01$), and prolonged survival (median 828 vs. 202 days; $P < 0.01$) [105].

Of note, unilateral vs. bilateral liver drainage is not applicable to all cases (i.e. post-hepatectomy, massive neoplastic infiltration of one liver lobe, atrophic segments) and caution must be taken not to attempt to intubate atrophic segments as this is associated with an increased post-ERCP cholangitis rate [106]. In 2010, a study demonstrated that clinical success is better when more than 50% of the liver is drained (OR 4.5; $P = 0.001$), with improved survival (119 days vs. 59 days; $P = 0.005$) [106].

More recent studies are challenging the cutoff of 50% of the liver volume as a target for liver drainage. A single-center, retrospective study systematically collected a cohort of 60 patients and demonstrated that patients with $\geq 80\%$ of the liver drained for palliation of hilar MBO (Bismuth type II 29%, III 34%, IV 37%) had better survival (8.5 months vs. 3.5 months; $P < 0.001$), whatever the technique (ERCP +/- EUS-BD +/- PTBD) used for biliary drainage [107]. A receiver operating characteristic (ROC) curve was used to predict the possibility of administering chemotherapy to the patient, the threshold being 71% of the liver drained (92% vs. 44%; OR 0.06, 95%CI 0.01 to 0.32; $P = 0.008$).

Similarly, another retrospective single-center study demonstrated, in 90 patients with hilar MBO receiving palliative chemotherapy, that draining more than 80% of the liver, assessed by a 3D image volume analyzer, was associated with improved survival (450 days vs. 224 days; $P = 0.003$), but no difference in time to recurrent biliary obstruction (median 201 days, 95%CI 155 to 317 days) [108]. In multivariate analysis, the presence of cholangiocarcinoma (HR 0.3, 95%CI 0.2 to 0.5; $P < 0.001$) and drainage of more than 80% of the liver (HR 0.35, 95%CI 0.2 to 0.6; $P = 0.003$) were both independent predictive factors of survival.

Lastly, a recent retrospective, single-center study on 82 patients with Bismuth II, III, or IV hilar strictures treated with ERCP for palliative drainage assessed the preoperative liver volumetry and ERCP drained segments, with clinical success defined by a 50% decrease in bilirubinemia or normalization

within 2 weeks [109]. The study showed a correlation between clinical success and $>50\%$ of the liver drained (OR 4.15, 95%CI 1.4 to 12.5; $P = 0.02$) and >2 liver sectors drained (OR 8.5, 95%CI 2.7 to 26.7%; $P < 0.001$), independently of the presence of unilateral or bilateral drainage (Tables 6.7s and 8s).

Practically, preprocedural drainage imaging is required to assess potential segments to drain, excluding the ones that are atrophic or massively infiltrated by the tumor. Classically, clinicians should recognize the main sectors as right anterior (V–VIII), right posterior (VI–VII), and specify whether they are separated by tumor infiltration; left segments II and III and also specify whether they are separated by tumor infiltration. MRCP will provide the relevant information to define the strategy adequately. The percentage of liver drained is obtained by dividing the segments drained by the nonatrophic/non-resected segments in place. Liver volumetry obtained by 3D computed tomography reconstructions prior to drainage has also been described as a valuable tool for response to drainage prediction [108].

The task force downgraded the quality of evidence to low owing to the indirectness in the unilateral vs. bilateral stenting meta-analysis, and owing to the absence of meta-analyses or comparative trials assessing the percentage of liver drained (Table 8s). Therefore, a consensus for conditional recommendation, with a low quality of evidence, was issued.

RECOMMENDATION

ESGE suggests using either plastic stents or uncovered SEMSs for palliative drainage of proven malignant hilar obstruction. ESGE suggests a plastic stent when the optimal drainage strategy has not been defined. ESGE suggests using an uncovered SEMS in expert centers to reduce the need for revisional procedures based on the patient's expected survival and the likelihood of achieving complete biliary drainage. Conditional recommendation, moderate quality of evidence.

Not much new evidence has been published on the use of USEMSs compared with plastic stents for palliative drainage of hilar MBO since the last ESGE biliary stenting guidelines, with the recommendations made then proposed on the basis of three meta-analyses that demonstrated the advantage of USEMSs in terms of stent dysfunction, need for reintervention, and improved survival, compared with plastic stents [2].

Improvements in oncological therapy, with some patients experiencing prolonged survival and/or remissions, have led to the need to address the question of using FCSEMSs for drainage of hilar MBO, with the aim of providing benefit from the long-term patency of SEMSs, while being able to remove them when needed.

A recent RCT compared the use of a 7-Fr plastic stent versus a 6-mm FCSEMS for drainage of 50 patients with non-resectable hilar MBO. Although the migration rate was higher with FCSEMSs (48% vs. 16%; $P = 0.02$), the mean time to recurrent

biliary obstruction was higher in the FCSEMS group (190 days vs. 96 days; $P=0.02$), with a higher reintervention rate in the plastic stent group (40% vs. 16%; $P=0.04$) and no difference in AEs [110]. Two recent retrospective studies, which included 54 and 22 patients with non-resectable hilar MBO, reported the experience of using a slim (6-mm) FCSEMS for palliative drainage: the median times to recurrent biliary obstruction were 181 days and 113 days, respectively, with 100% reintervention success (stent removal and replacement of new ones) in both series, but with an interesting safety profile (1.8% cholangitis and no liver abscesses in the first series; 3.1% cholecystitis and 6.3% delayed complications [e.g. liver abscess] in the second series) [111,112]. Up until now, no RCTs have compared USEMSs with FCSEMSs for non-resectable hilar MBO to determine whether replacement of FCSEMSs in long survivors would be a better option.

In light of the massive amount of evidence in favor of the use of USEMSs for drainage of non-resectable hilar MBO, and the need for more safety and comparative data on the use of FCSEMSs in this context, ESGE recommends the use of USEMSs for this indication (**Table 6.7s**).

Despite this evidence, the task force acknowledged that many of these studies analyzed the time to first stent dysfunction and did not fully capture long-term outcomes. Moreover, systematic plastic stent exchange, as is done as the standard of care for benign strictures, was not proposed. Although mostly associated with the insertion of SEMS in SEMS, a technique that precludes easy revision, emerging evidence suggests that, over time, USEMSs may be associated with an increased and earlier need for percutaneous drainage compared with plastic stents [113]. In addition, a USEMS represents a definitive intervention, and suboptimal initial drainage may limit the possibility of further endoscopic optimization. Therefore, the task force emphasized that the choice of stent should be further individualized based on disease stage, expected survival, the likelihood of achieving complete biliary drainage, and the feasibility of future endoscopic interventions.

The task force consensus was therefore in favor of a conditional recommendation, with a moderate quality of evidence.

3.2.5 How to solve stent dysfunction in malignant stricture

When stent dysfunction occurs in a SEMS in a patient with distal MBO, insertion of either an uncovered or covered SEMS appears to be equally effective with regard to stent patency, according to an RCT by Lee et al. [114] and reconfirmed by a more recent retrospective study [115].

With regard to SEMS dysfunction in patients with proximal MBO, the data are conflicting: one retrospective study showed no difference regarding reobstruction, whether plastic or metal stents were placed into the initial SEMS, while another retrospective study reported a significant difference in favor of SEMS insertion [116,117] (**Table 6.8s**).

EUS-BD with a LAMS is an emerging technique in distal MBO. Various prospective studies have revealed a dysfunction rate ranging from 16% to 55% within 6 months [84,86,87]. A recent meta-analysis including 21 studies and 1435 patients reported a dysfunction rate of 10%, requiring a reintervention in 12% of

cases [89]. The dysfunction appears to be mitigated by placing an FCSEMS or a coaxial DPPT through the LAMS [85] (**Table 6.9s**).

3.3 Biliary stricture management in surgically altered anatomy or inaccessible papilla

While ERCP is the standard treatment for biliary disorders in normal anatomic conditions, biliary drainage in patients with surgically altered anatomy (summarized in **Fig. 2s**) presents unique challenges [118,119], driven by both anatomical and technical factors. First, intubating an anastomosis can be difficult owing to altered pathways and adhesions. Second, the length of the afferent jejunal limb significantly impacts intubation success. Third, cannulating an intact papilla from a distal approach is more challenging than accessing a bilioenteric or pancreatoenteric anastomosis. Finally, the absence of an elevator in certain endoscopes and the use of nonspecialized accessory catheters can further hinder cannulation and therapeutic interventions. These factors may warrant the use of other advanced endoscopic techniques that require specialized training and equipment.

ERCP is a high risk procedure [5], with surgically altered anatomy further elevating the risk of complications, which range from 0% to 19.5% in this patient population [120]. Perforation is the most common and potentially fatal AE, followed by bleeding, cholangitis, mucosal tears, and PEP. Perforations can occur at various levels, often due to difficult intubation across sharp angulations or excessive looping. Barotrauma is a unique risk, especially in closed-loop systems, and can lead to severe complications such as intestinal rupture. Detailed information on these AEs can be found in other ESGE Guidelines [5, 120, 121, 122, 123].

The alternative drainage approaches, including enteroscopy-assisted ERCP, therapeutic EUS, and PTBD, are also not without complications.

Taken together, endoscopists performing biliary drainage in patients with surgically altered anatomy must obtain all available details on the anatomy of the patient, and must be familiar with potential AEs. It is recommended that such procedures are performed in units fully equipped to diagnose and manage any complications that may arise, and in centers where all drainage techniques and complication management expertise is available if required.

3.3.1 ERCP in patients with Billroth II anatomy

RECOMMENDATION

ESGE suggests that in cases of Billroth II postsurgical anatomy, ERCP with front- or side-viewing endoscopes can be considered. Depending on local expertise, EUS-assisted or EUS-guided techniques can be undertaken when ERCP is unsuccessful.

Conditional recommendation, moderate quality of evidence.

ERCP in patients with Billroth II gastrectomy has been considered a challenging procedure, related to afferent limb intubation, identification and biliary cannulation, and performance of the sphincterotomy in the inverted papilla. An ERCP has however been considered an acceptable approach for Billroth II for many years [124]. The efficacy and safety of using a duodenoscope or a front-viewing scope with a cap in Billroth II anatomy appear to be equivalent, based on two recent systematic reviews, plus one prospective and two retrospective series [125, 126, 127, 128, 129] (**Tables 9s and 10s**).

If an ERCP is unsuccessful in patients with a biliary stricture, EUS-assisted or EUS-guided techniques can be undertaken depending on local expertise (e.g. EUS-assisted rendezvous [EUS-RV], EUS-guided antegrade stenting, EUS-guided transmural drainage) [3].

3.3.2 Biliary drainage in patients with previous pancreaticoduodenectomy

RECOMMENDATION

ESGE suggests that, in patients with previous pancreaticoduodenectomy, enteroscopy-assisted ERCP (EA-ERCP), EUS, and PTBD may be considered.

For benign biliary strictures, EA-ERCP should be considered as the first-line option. EUS-BD may be proposed in selected cases, particularly when multiple biliary interventions are expected or if the index EA-ERCP was difficult. PTBD, including percutaneous cholangioscopy, may be considered in specific cases, such as right-sided hepatolithiasis or when other techniques have failed.

For malignant biliary strictures, EA-ERCP or EUS-BD (either antegrade or EUS-guided hepaticogastrostomy [EUS-HGS]/EUS-guided hepaticojejunostomy [EUS-HJS]) is recommended as first-line therapy, according to anatomical constraints and local expertise. PTBD is recommended as the second-line option. EUS-directed transenteric ERCP requires further evaluation.

Conditional recommendation, low quality of evidence.

EA-ERCP has acceptable rates of success and, although inferior to EUS-BD, it has a more favorable AE rate. The evidence supporting the success of EA-ERCP or EUS-BD in patients with a prior Whipple procedure is primarily derived from systematic reviews and meta-analyses, mixing the types of surgically altered anatomy, with only one cohort study examining both EUS-BD and EA-ERCP [130, 131, 132, 133, 134]. No randomized trials have compared the two techniques.

In a comparative cohort reported by Khashab et al. [134], where 15/98 patients had undergone a Whipple procedure, 49 patients were treated with EUS-BD and 49 with EA-ERCP. The clinical success rate for EUS-BD was 88%, compared with 59.1% for EA-ERCP (mostly via double-balloon enteroscopy [DBE]). The AE rate was 20.4% for EUS-BD and 4% for EA-ERCP.

EA-ERCP is been reported in several meta-analyses to have a procedural success rate of 61.7%–75.8% and an AE rate of 6.6% with single-balloon enteroscopy (SBE)-assisted ERCP in surgi-

cally altered anatomy [135, 136], although DBE-assisted ERCP has been reported to have a procedural success rate of 93%, with a 4% rate of AEs, in a cohort of 1323 patient with surgically altered anatomy, which included 312 patients who had undergone a Whipple procedure [137]. Better success was reported with short DBE scopes (<200 cm), which allow for the use of standard ERCP accessories, compared with long DBE scopes (>200 cm).

A meta-analysis reported that EUS-BD has a technical success rate of 97.8%, and a clinical success rate of 94.9%, with a 12.8% AE rate in a large (n = 409) cohort of patients with surgically altered anatomy, including 70 cases with previous Whipple surgery [138].

Finally, EUS-directed transenteric ERCP is a technique in which a gastroenteric or entero-enteric anastomosis is created between the proximal gastrointestinal tract and the small-bowel loop containing the ampulla/bilioenteric anastomosis, using a LAMS. This facilitates standard ERCP via the anastomosis and offers the additional benefit of enabling complex treatments such as cholangioscopy-directed lithotripsy for large stones. This procedure has been described in multiple case reports, with the largest series coming from Mutignani et al. [139] (**Table 9s**).

The task force issued a conditional recommendation, with a low quality of evidence owing to the high risk of indirectness and imprecision (**Table 10s**).

3.3.3 Biliary drainage in patients with previous Roux-en-Y gastric bypass

RECOMMENDATION

ESGE suggests that in patients with previous Roux-en-Y gastric bypass (RYGB), EUS-directed transgastric ERCP (EDGE) or EA-ERCP may be considered.

For benign biliary strictures, EDGE is suggested as the first-line approach, unless there is specific expertise in EA-ERCP.

For malignant biliary strictures, EUS-BD (either antegrade stenting or EUS-HGS/EUS-HJS) is often the preferred option, although EDGE, EA-ERCP, and PTBD may also be considered based on anatomical constraints and local expertise.

Conditional recommendation, low quality of evidence.

EUS-directed transgastric ERCP (EDGE) is an advanced endoscopic procedure involving the creation of a temporary EUS-guided anastomosis between the gastric pouch and the excluded stomach, that is subsequently used to perform a standard ERCP. The procedure should only be performed in centers with expertise in advanced EUS techniques. One of the advantages of EDGE is that it retains access to the bile duct for ERCP after the procedure, which can be crucial in the event of complications, such as sphincterotomy bleeding or when further interventions are required (e.g. large-stone lithotripsy, BBS management). However, it typically involves at least two endoscopic

procedures (EDGE as the first step, ERCP as the second step, and final LAMS removal). The routine use of a 20-mm LAMS, along with techniques for anchoring the LAMS, has made single-session EDGE possible (i.e. LAMS placement and ERCP in the same procedure). Further procedures will be needed to remove the LAMS at a later time to avoid weight regain.

For EA-ERCP, Roux-en-Y gastric bypass (RYGB) requires the enteroscope to traverse a significantly longer segment of the small bowel, with potentially sharp angulations and adhesions, especially at the entero-enteral anastomosis. If a long double-balloon enteroscope is used, it limits the range of accessories available for cannulation and the completion of endoscopic therapy. DBE is more effective than SBE, and advanced enteroscopic skills are necessary to achieve the same efficacy as EDGE or laparoscopy-assisted ERCP (LA-ERCP), which may limit the availability of EA-ERCP.

In the context of palliative care for malignancy, the priority is to achieve biliary drainage as efficiently as possible, with a focus on obtaining long-lasting stent patency. While EUS-BD remains an option, the postsurgical anatomy may make it difficult to access the left side of the liver from the gastric pouch, which could hinder either EUS-HGS or antegrade stenting via EUS. In such cases, EDGE and PTBD remain viable options, depending on the patient's functional status and local expertise. PTBD remains a viable option in expert centers to treat malignant stricture in a single session with direct SEMS placement.

EA-ERCP in RYGB Three significant systematic reviews and meta-analyses have been published that examined EA-ERCP in RYGB patients [135, 136, 137]. Unfortunately, as all of them included other types of surgically altered anatomy, only one of them [136] specifically broke down success rates for RYGB. The success rate for EA-ERCP was reported to be 61.7%–76.4% with SBE in RYGB, with an AE rate of 6.5%–6.6% [135, 136], and 90%–94% with DBE-ERCP, with an AE rate of 4% [137].

Although infrequently used for biliary stricture management, LA-ERCP has been extensively studied in RYGB, with four systematic reviews and meta-analyses focusing solely on LA-ERCP, with stone extraction as the main indication: reported cannulation success rates were 95.3%–98.5%, whereas AE rates were reported to be up to 20.6%, with a majority of these related to the laparoscopy [140, 141, 142, 143].

Technical comparison was reported in a meta-analysis including LA-ERCP (403 patients), SBE-ERCP (166 patients), and DBE-ERCP (71 patients). Native papilla cannulation rates were 95.7%, 62.2%, and 82.2%, respectively, with AE rates of 18%, 9.9%, and 2%, respectively [144].

EDGE in RYGB There have been two meta-analyses that focused solely on EDGE: Prakash et al. [145] and Su et al. [146] reported on 169 and 585 procedures, respectively, with 94%–98% ERCP success rates and AE rates of 14%–18%, including stent malposition or dislodgement (4%), pain (2%), bleeding (2%), persistent fistula (1%), and perforation (1%). Of note, LAMS dislodgement was lower for the 20-mm LAMS compared with the 15-mm LAMS. Data from two meta-analyses [97, 98] comparing EDGE with EA-ERCP concluded that EDGE had superior efficacy (94.8%–100%) over EA-ERCP (66%–66.3%), and superior safety (AE rate, 9.6%–14.9% vs. 14.7%–16%, respectively), with a fas-

ter procedure rate (61 vs. 169 minutes) and shorter length of stay (1.8 vs. 6.9 days).

EUS-BD in RYGB Tanisaka et al. published a meta-analysis on EUS-BD in 409 patients with surgically altered anatomy, primarily for malignant indications [138]. The clinical success rate was 94%, with an AE rate of 12.8%; however, the study showed significant heterogeneity, making it difficult to derive efficacy analysis for RYGB specifically (**Table 9s**).

The task force issued a conditional recommendation, with a low quality of evidence owing to the high risk of indirectness and imprecision (**Table 10s**).

3.3.4 Biliary drainage in patients with previous gastrectomy with a Roux-en-Y jejunojunal anastomosis

RECOMMENDATION

ESGE suggests that in patients with a partial or total gastrectomy with a Roux-en-Y jejunojunal anastomosis, EA-ERCP, EUS-BD, and PTBD can be considered.

For benign biliary strictures, EA-ERCP should be considered as the first-line option. EUS-BD may be proposed in selected cases, particularly when multiple biliary interventions are expected. PTBD, including percutaneous cholangioscopy, may be considered in specific indications, such as CBD or intrahepatic stones, or in cases where other techniques have failed.

For malignant biliary strictures, EUS-BD (either antegrade or EUS-HGS/EUS-HJS) or PTBD are suggested as first-line approaches in expert centers.

Conditional recommendation, low quality of evidence.

Most studies evaluating biliary drainage techniques in cases with benign indications and partial or total gastrectomy with a Roux-en-Y jejunojunal anastomosis have focused on colonoscopy-assisted ERCP or EA-ERCP. The success rate for accessing the papilla using an adult or pediatric colonoscope has been reported to be 68%, with biliary cannulation rates ranging from 72.7% to 85.4% [147, 148]. The use of a cap-assisted scope progression has also proven beneficial [149]. EA-ERCP using SBE or DBE techniques has demonstrated biliary cannulation rates of 78.8%–90.9% and clinical success rates of 78.1%–100% [150, 151, 152, 153, 154, 155, 156]. A meta-analysis of 403 patients with Roux-en-Y gastrectomy reported a biliary cannulation rate of 88.1% and procedural success rate of 76.4% [136], both lower compared with other anatomical configurations [152].

EUS-BD has been primarily assessed in patients with malignant indications [138]. Regarding benign indications, particularly in stone removal, EUS-guided antegrade drainage and EUS-HGS or EUS-HJS [157, 158, 159, 160, 161, 162] have been described in small series [157], showing comparable outcomes to EA-ERCP [151]. Notably, a multicenter study involving 21 patients who underwent EUS-HJS reported a clinical success rate of 80%, with an AE rate of 33% [163].

EUS-directed transenteric ERCP may be another option in highly selected cases; however, outcomes have been less often reported compared with EDGE, and technical variables make this procedure less standardized [164].

PTBD has also demonstrated acceptable outcomes, better than EA-ERCP in these scenarios [165], and comparative representative studies specific to the Roux-en-Y jejunojejunal anastomosis anatomy are lacking compared with EUS-BD [166]. Recently, percutaneous-assisted cholangioscopy has been shown to be particularly useful in cases of hepatolithiasis and large CBD stones, with an AE rate of 19.6% [167, 168, 169], a scenario that might occur above a biliary stricture (**Tables 9s**).

The task force issued a conditional recommendation with low quality of evidence owing to the high risk of indirectness and imprecision (**Table 10s**).

3.3.5 Biliary drainage in patients with previous Roux-en-Y hepaticojejunostomy

RECOMMENDATION

ESGE suggests endoscopic over percutaneous biliary drainage in patients with Roux-en-Y hepaticojejunostomy, owing to its better safety profile.

For benign biliary strictures, EA-ERCP or EUS-BD techniques, such as antegrade drainage or EUS-HGS, are viable options. Additionally, EUS-directed transenteric ERCP may be considered in selected cases, particularly for postsurgical complications of hepaticojejunostomy.

For malignant biliary strictures, EUS-BD, with antegrade drainage or EUS-HGS, is recommended as a first-line approach.

PTBD can be considered as a second-line approach for benign and malignant indications.

Conditional recommendation, low quality of evidence.

Roux-en-Y hepaticojejunostomy is a surgical technique performed for biliary reconstruction. Endoscopic access has similar success, but lower AE rates than PTBD.

EA-ERCP has reported technical success rates of 86%–93% [152, 156, 170], although total procedural success rates were lower, at 60.6%, in a cohort of 221 patients [152].

EUS-guided hepaticocenterostomy [171], with or without transhepatic cholangioscopy [172] and/or antegrade drainage [173], can be considered in benign conditions. Additionally, EUS-directed transenteric ERCP, through an EUS-guided anastomosis made using a LAMS, may be proposed in selected cases [174, 175, 176, 177], particularly for postsurgical complications of hepaticojejunostomy [177].

For malignant conditions, EUS-BD has demonstrated higher technical and clinical success rates compared with EA-ERCP [178]. Techniques such as EUS-guided transmural stenting alone, antegrade stenting, or a combination of these have been successfully used in cases of distal MBO [160].

PTBD has been evaluated in small series [179, 180, 181, 182]. While PTBD achieves similar complete stone removal rates to

EA-ERCP, it is associated with higher AE rates in patients with hepatolithiasis [183, 184], and requires more frequent interventions in post-liver transplantation patients [185]. Specifically, percutaneous cholangioscopy [186] has proven feasible and effective, but might be associated with a significantly higher AE rate (45% vs. 10%) compared with EA-ERCP, as reported in a retrospective study of 40 patients [184] (**Table 9s**).

The task force issued a conditional recommendation with low quality of evidence owing to the high risk of indirectness and imprecision (**Table 10s**).

3.3.6 Biliary drainage in patients with inaccessible papilla

RECOMMENDATION

ESGE recommends EUS-BD over PTBD in cases of malignant biliary stricture following failed or unfeasible ERCP. In patients with distal stricture, ESGE suggests using EUS-HGS where a duodenal stricture is present, and either EUS-HGS or EUS-guided choledochoduodenostomy (EUS-CDS) where there is no duodenal stricture.

ESGE suggests using PTBD when EUS-BD fails or is not feasible.

Strong recommendation, moderate quality of evidence.

PTBD may achieve comparable technical and clinical success rates to EUS-BD; however, it is associated with a higher incidence of AEs.

In patients where ERCP has failed or is not feasible, EUS-BD, including EUS antegrade drainage, EUS-CDS, EUS-HGS, and EUS-guided gallbladder drainage (EUS-GBD), has been described as an effective alternative.

Several meta-analyses have evaluated EUS-CDS and EUS-HGS, reporting comparable technical and clinical success rates [187, 188, 189]. While some studies have reported higher AE rates with EUS-HGS [190, 191], a recent meta-analysis reported an acceptable AE rate of 12% [192]. For EUS-CDS, using either a LAMS [193, 194, 195, 196] or a SEMS [197], the reported AE rate is 9.3% and the reintervention rate is 8.3% [198]. However, duodenal stenosis has been described as a risk factor for long-term obstruction following EUS-CDS [87, 199]. In this context, EUS-CDS has demonstrated higher rates of postprocedural AEs (42.9% vs. 7.7%) and biliary dysfunction (71.4% vs. 16.7%) compared with EUS-HGS [83].

Although much less established than other EUS-BD techniques, EUS-GBD has also been proposed as a rescue therapy when the cystic duct is patent. A multicenter study reported a clinical success rate of 81.3% [200], with results comparable with EUS-CDS in another observational series [201], but data on follow-up of patients with more than 4 months of survival are missing.

PTBD has demonstrated a trend toward higher AEs in a systematic review, with no significant differences in clinical success when compared with EUS-HGS and EUS-CDS [202]. Retrospective studies comparing PTBD and EUS-CDS also reported similar results, with PTBD associated with higher rates of AEs

[203,204,205] and reintervention [204]. An RCT comparing PTBD and EUS-HGS further confirmed higher AE and reintervention rates in the PTBD group [206] (**Tables 9s**).

The task force issued a strong recommendation with moderate quality of evidence owing to the risk of publication bias reported in the meta-analyses supporting this statement [183, 184, 185] (**Table 10s**).

3.4 Biliary stricture management after failure: second attempt

ERCP may fail in up to 10%–20% of patients [207], with a limit not exceeding 5% in expert centers proposed by the ESGE performance measures initiative [208], which recommends referring patients to a more experienced colleague or center in cases of failure. Reasons for failure may involve neoplastic infiltration, unnegotiable biliary stenosis, surgically altered anatomy and/or duodenal stenosis, and also difficult cannulation.

In such instances, a repeat attempt at ERCP has been reported to be successful in up to 82% of cases [2], by waiting at least 2 days and optimizing patient sedation, team preparation, availability of ancillary material, and referral to a more expert endoscopist or institution. A general algorithm is proposed in **Fig. 3s**.

3.4.1 Second attempt for benign biliary stricture (accessible papilla)

RECOMMENDATION

ESGE suggests using rendezvous over transmural drainage where ERCP has failed for benign biliary strictures. Conditional recommendation, low quality of evidence.

As an alternative to repeat ERCP after 2–4 days, as proposed in the last ESGE therapeutic EUS guidelines, the EUS-RV technique has been suggested in cases of ERCP failure for benign stenosis [3]. Knowing the expected long-term survival in such cases, surgical hepaticojejunostomy might be discussed in some situations, but this is associated with long-term complications (e.g. stricture in 9%–15%, cholangitis), and surgical choledochoduodenostomy has also been reported to be associated with long-term complications [209,210,211].

As a consequence, the goal of management of benign stenosis after ERCP failure is to allow ERCP management (ERCP repeated by an expert or rendezvous technique) with the aim of preserving the anatomy.

EUS-RV First described by Mallory et al. [212], EUS-RV is a challenging technique with a relatively high rate of failure. Although technical success has been reported to reach 77%–86.1%, with a 14% AE rate, in a meta-analysis [213], a recent retrospective series [166] from two tertiary centers reported a 25% technical failure rate, attenuating the encouraging data from the meta-analysis. Recent prospective and retrospectives series of EUS-RV for benign stricture have reported better results (92% technical success) and fewer AEs for benign strictures [214,215].

Percutaneous rendezvous The available data come from retrospective series. A French cohort of 84 patients treated using the percutaneous rendezvous technique reported a success rate of 95.2%, but with important morbidity (19.5% [9.5% related specifically to the rendezvous]) and mortality of 3.5% [216]. A German study on 244 patients, including 28.7% with benign strictures and 50.8% with altered anatomy, comparing PTBD to the percutaneous rendezvous technique, demonstrated decreased morbidity in the rendezvous group (16.6% vs. 26.4%), with a technical success rate of 80.4% [217].

Comparative outcomes (EUS-RV vs. percutaneous rendezvous) A recent meta-analysis [218] compared EUS-RV to percutaneous rendezvous, comparing 524 patients in 19 studies treated with EUS-RV with 591 patients in 13 studies treated with percutaneous rendezvous. Technical success was similar (89.2% vs. 95.8%) in the subgroup with benign stenosis for EUS-RV (7 studies, 84 patients) and percutaneous rendezvous (7 studies, 180 patients), and in the subgroup with normal anatomy (90.7% vs. 95.5%; 16 studies, 413 patients, and 9 studies, 340 patients). Overall AEs were similar for EUS-RV (9.8%) and for percutaneous rendezvous (13.4%). Pancreatitis and bile leakage were higher with EUS-RV (2.5% vs. 0.8% and 3% vs. 0.6%). Both techniques had similar technical success and AE rates in this meta-analysis. Limitations of the study were the considerable heterogeneity in the technical success rate, the absence of studies directly comparing EUS-RV and percutaneous rendezvous, and the retrospective aspect of the series. There is therefore insufficient data to recommend EUS-RV over percutaneous rendezvous (**Table 11s**).

EUS-BD using retrievable stents with EUS-guided antegrade stenting or EUS-HGS have been reported anecdotally for benign strictures. Evidence is lacking regarding their safety and long-term outcomes [159,219,220,221].

The task force issued a conditional recommendation, with a low quality of evidence owing to the risk of indirectness and imprecision (**Table 12s**).

3.4.2 Second attempt for malignant biliary stricture without duodenal stricture (accessible papilla)

RECOMMENDATION

ESGE suggests EUS-guided transmural drainage over PTBD for malignant biliary obstruction after failed ERCP. Conditional recommendation, low quality of evidence.

PTBD has been considered the standard alternative for ERCP failure. It may however be contraindicated in some situations (e.g. ascites) and is burdened by a non-negligible rate of morbidity and an intrinsic discomfort related to the percutaneous drain [222,223]. EUS-BD offers different routes of drainage by rendezvous, antegrade stenting, or transmural drainage using EUS-CDS and EUS-HGS [3]. There are insufficient data to recommend the extrahepatic versus the intrahepatic approach.

In the setting of MBO and failed ERCP with an accessible papilla:

- there is no direct evidence comparing repeat ERCP with EUS-BD
- based on four meta-analyses [202, 224, 225, 226] and three RCTs [206, 224, 225], there is low quality evidence to support the argument that EUS-BD has similar technical and clinical success compared with PTBD, but with a reduced risk of AEs (OR 0.25, 95%CI 0.10 to 0.61; $I^2=0\%$) and recurrent biliary obstruction (OR 0.05, 95%CI 0.01 to 0.25; $I^2=0\%$); of note, no RCTs have included EUS-CDS performed with a LAMS
- for EUS-BD, based on two meta-analyses [188, 202] and one RCT [225], there is very low quality of evidence supporting the argument that EUS-HGS and EUS-CDS with a SEMS have similar technical and clinical success; however, no RCTs have included EUS-CDS performed with a LAMS, which would potentially improve the ease and safety of the procedure
- EUS-BD demonstrates reduced total treatment costs when compared with PTBD, especially when also accounting for hospital stay and reinterventions [204, 205]
- EUS-GBD with a LAMS has recently emerged as a back-up strategy for failed ERCP and unfavorable EUS-CDS [201]
- one small RCT has reported comparable efficacy and safety of surgical hepaticojejunostomy and EUS-CDS with a SEMS [226] (**Table 13s**).

An international survey assessed patient perspectives by enrolling 327 patients scheduled to undergo ERCP for MBO. Based on simulated scenarios, more than 80% of patients preferred EUS-BD to PTBD for ERCP failure because of the absence of a percutaneous drain and the possibility of a one-stage procedure to achieve clinical success [227]. This rate increased where EUS-BD expertise was available and decreased in line with an increasing rate of AEs [228], supporting the need to improve proficiency and safety as a driver for EUS-BD adoption.

In distal MBO with adequate biliary dilatation, EUS-CDS with a LAMS can further increase the simplicity of EUS-BD, by allowing single-step, free-hand advancement of an electrocautery-enhanced LAMS without any device exchange. This is strictly dependent on adequate biliary dilatation, usually >15 mm [82].

The most recent meta-analysis [89] reported >90% technical and clinical success, with a roughly 10% rate of early AEs (mostly mild or moderate) and a roughly 10% rate of reintervention. However, EUS-CDS with a LAMS is unfavorable in cases involving pyloroduodenal invasion [87, 229], gastric outlet obstruction [83], and mildly dilated CBD, as well as in proximal/hilar malignant stenosis, where EUS-HGS should be preferred [3]. EUS-GBD can be used as an acceptable rescue drainage modality in distal MBO, provided that the cystic duct is patent [201]. Caution must be taken with EUS-CDS, as demonstrated by recently published real-world data on technical complications, which reported a 12% rate of 30-day mortality [81].

There is insufficient evidence to restrict the use of EUS-CDS in patients with potentially resectable disease, but follow-up data from two cohorts (one prospective and one retrospective) have demonstrated LAMS dysfunction in 32%–55% of cases after EUS-CDS [84, 229]. Case series have demonstrated no increased rate of postsurgical AEs [230], with the presumed

advantage of a reduced rate of PEP for early or even upfront adoption for preoperative EBD. Limited evidence is available for EUS-HGS [231]. These data suggest multidisciplinary discussion should be undertaken in patients where EUS-BD is foreseen in the preoperative setting, taking into account also the advantages of EUS-BD in terms of safety, potentially translating into higher and faster access to neoadjuvant treatment and/or surgery.

The task force issued a conditional recommendation with low quality of evidence owing to the risk of indirectness and imprecision (**Table 14s**).

3.4.3 Second attempt for malignant biliary stricture with duodenal stricture (accessible papilla)

RECOMMENDATION

ESGE suggests EUS-BD over surgical bypass or percutaneous drainage in the setting of double malignant biliary and gastric outlet obstruction, where expertise is available.

In this scenario, EUS-HGS is associated with reduced risk of recurrent biliary obstruction compared with EUS-CDS. Conditional recommendation, very low quality of evidence.

The performance of ERCP is suboptimal in patients with duodenal stricture and/or indwelling duodenal stents, achieving variable technical success in tertiary referral centers [232, 233, 234, 235]. Inconsistent results have been reported, suggesting that EUS-BD might be associated with higher rates of technical success than ERCP in this scenario. Yamao et al. have reported a significantly higher rate of technical success (95% vs. 56%) in this setting [236]; however, in an older study, EUS-BD was associated with increased AEs, but this study involved transmural drainage with plastic stents, a clinical technique that has now been abandoned [237]. More consistently, the rate of recurrent biliary obstruction appears to be lower and time to recurrent biliary obstruction longer in cases of EUS-HGS, as the drainage is far from the tumor site. These results add to the body of literature supporting the advantage of EUS-BD over PTBD [202, 238].

Although more technically challenging, recent data have provided more evidence to support EUS-HGS over EUS-CDS in this specific setting, owing to longer drainage patency with EUS-HGS, being far from the tumor location, and increased risk of ascending cholangitis or stent dysfunction using EUS-CDS, especially with the use of a LAMS, with the risk of stent obstruction due to food impaction above the duodenal stricture [83, 87, 229].

In the setting of MBO and duodenal stenosis, after failed ERCP:

- there is no direct evidence comparing repeat ERCP with EUS-BD
- there is no direct evidence comparing EUS-BD with PTBD in the specific scenario of duodenal stenosis

- based on a pooled analysis of available data from four small observational studies (three retrospective [199, 239, 240] and one prospective [83]) in the setting of combined biliary and gastric outlet obstruction, EUS-CDS is associated with an increased risk of recurrent biliary obstruction (RR 5.04, 95%CI 2.09 to 12.14; $I^2 = 0\%$) compared with EUS-HGS, with similar risk of AEs. Two studies included EUS-CDS performed with a LAMS, and one with a SEMS; two studies included gastric outlet obstruction treated with EUS-guided gastroenterostomy and one with duodenal SEMS
- EUS-guided double bypass (EUS-guided gastroenterostomy + EUS-BD) compared with surgical double bypass demonstrates similar technical and clinical success, with significantly reduced rates of AEs (especially severe) and shorter hospitalization in one retrospective study [241] (**Table 15s**).

Finally, intubating a previously placed gastroenteric LAMS to retrogradely reach the papilla is one additional reported strategy to achieve biliary drainage in the setting of double obstruction [242]. When these EUS-BD possibilities are paired with the increasingly reported advantages of EUS-guided gastroenterostomy over duodenal stenting or surgical bypass in treating gastric outlet obstruction [243, 244, 245, 246, 247], this may call for centralization of patients with double obstruction in centers where advanced interventional EUS expertise is available.

Management of patients of this complexity should be performed after multidisciplinary discussion, accounting for extensive radiological evaluation of the specific anatomy, resectability status, oncological perspective on presumed life expectancy, and frailty of the patient.

The task force issued a conditional recommendation with very low quality of evidence because of the risk of indirectness, imprecision and the moderate risk of bias in the literature (**Table 16s**).

3.5 Periprocedural and technical aspects of biliary stenting

3.5.1 Antibiotic prophylaxis

For some procedures (e.g. predicted incomplete biliary drainage, hilar stricture management, those in immunocompromised patients or with PSC, cholangioscopy), antibiotics should be administered before ERCP. These recommendations have been described in great detail in the ESGE ERCP-related AEs guidelines and must be followed [5].

3.5.2 Post-ERCP pancreatitis prophylaxis

For ERCPs, rectal administration of 100 mg diclofenac or indomethacin in all patients without contraindication, hyperhydration, and use of a prophylactic pancreatic stent should be properly applied following ESGE guidelines [5].

3.5.3 Stent registry

Maintaining a registry for patients with biliary stents, in particular for patients with BBS, and recalling these patients for stent removal/exchange has been recommended in the ESGE biliary

stenting guidelines in 2017 [2], because forgotten stents may be extremely difficult to remove and scheduled stent exchange/removal has been demonstrated to reduce septic complications. No major new data have been published on this topic, which remains a critically important aspect of the management of patients with biliary strictures and must be applied.

3.6 Environmental impact

The environmental impact of endoscopic management of biliary strictures using ERCP and EUS (including stenting and dilation) is driven mainly by single-use devices, energy for intensive imaging, cautery, and long-lasting procedures, extensive sterilization processes, also taking into consideration that sometimes more than one endoscope is used (back-to-back use of the echoendoscope and the duodenoscope) for interventional procedures in the biliary tract, and waste disposal (the waste from therapeutic procedures is more than double that of diagnostic endoscopies) [248], with cumulative effects influenced by disease type (benign vs. malignant) and the need for repeat interventions. While no specific evidence has been derived from disease-specific biliary studies, most evidence comes from life-cycle assessments, waste audits, and sustainability analyses, and scientific society guidance documents [249].

The most relevant evidence to this guideline comes from a prospective study conducted at the Asian Institute of Gastroenterology Hospitals that comprehensively assessed greenhouse gas emissions and waste generation of gastrointestinal procedures, the majority of which were ERCPs [248]. Although the results of this study cannot be directly generalized, one of the key drivers of the environmental impact of endoscopy, detected also in a European study that included non-ERCP procedures only [250], is the greenhouse gas emissions related to patients travelling to and from the hospital, which ranges from 45% of the total procedure-related carbon footprint in France to more than 80% in India. This is of paramount importance as repeated regular plastic stent replacements are recommended for the management of BBSs, and a direct comparison with the SEMS placement strategy's environmental impact is not yet available.

The authors also highlighted the positive impact of recycling hospital waste in India – 25.7% of the total waste in India compared to 9%–20% in US centers [251, 252] – as demonstrated by substantial CO₂ emission reduction. In comparison to evidence from the USA, direct landfill disposal accounted for 9.5% of the generated waste, while the US centers reported 61%–63% [251, 252]. While this comparison should be interpreted cautiously owing to the difference in procedure mix, among other factors, it highlights the beneficial effects of structured waste recycling.

Another barrier to reducing the carbon footprint of interventional biliary endoscopy is the avoidance of reprocessed ERCP and reusable EUS devices [253]. This topic was recently reintroduced by the ESGE Position Statement on reducing the environmental footprint of gastrointestinal endoscopy [249], as so far no infectious outbreaks have been reported with reusable devices and past outbreaks were linked to inadequate reprocessing of duodenoscopes. Currently, European Union legislation states

that the reprocessing of devices is allowed only when permitted by national law, primarily for reusable devices. Therefore, this matter should be addressed locally, on a case-by-case basis.

3.7 Unmet needs and evidence gaps

As is evident above, most of the recommendations in this Guideline are based on low quality evidence. Even if it is not feasible for all the questions, there is a clinical need for further high quality prospective studies and RCTs, given the constant technical evolution of therapeutic endoscopy. Various identified unmet needs include: updated trials on preoperative biliary drainage with SEMSs compared with upfront pancreaticoduodenectomy, because the use of plastic stents in this scenario is outdated; high quality comparative trials on the use of newly designed FCSEMSs with antimigration systems for BBS; RCTs comparing the insertion of MPSS with FCSEMSs in benign post-cholecystectomy biliary stricture management; prospective extended experience in maximum biliary drainage and prospective evaluation of liver volumetry for palliative hilar MBO with survival and access to chemotherapy as the main outcomes; RCTs comparing PCSEMSs with USEMSs in palliative drainage of distal MBO; comparative trials on the route of drainage in patients with surgically altered anatomy; reported cohorts on the route of drainage in cases of ERCP failure for BBS. Another major gap in the literature is the required number of EUS or ERCP procedures and their associated cost and environmental impact to achieve clinical success as recognized outcomes when comparing procedures. Further research in this field should align with defined criteria from the ESGE E-SPARE framework [254].

Disclaimer

ESGE Guidelines represent a consensus of best practice based on the available evidence at the time of preparation. They may not apply to all situations and should be interpreted in the setting of specific clinical scenarios and resource availability. They are intended to be an educational tool to provide information that may support endoscopists in providing care to patients. They are not rules and should not be used either to replace clinical judgement or to establish a legal standard of care. Healthcare organizations that are practicing advanced procedures (e.g. complex ERCP, therapeutic EUS, PTBD, EA-ERCP) require dedicated training programs [255], annual case volume exposure, and knowledge of each clinician's own limits, with regional organization of expert center referral systems.

Acknowledgement

ESGE wish to thank Prof. Michael Bretthauer, Prof. Nageshwar Reddy, and Dr. Katarzyna M. Pawlak for their meticulous review of the draft of the manuscript. The authors are also grateful for the valuable comments received from Erkan Parlak on behalf of the Turkish Gastroenterology Association, and all other comments received, which helped to improve this guideline. The authors also thank Tarjei Fiskergård Werner, senior librarian at the University of Oslo Library, for assistance with the literature

search. We acknowledge the contribution of a medical writer, Sandy Field, PhD, for English language editing of the manuscript.

Contributors' Statement

Arnaud Lemmers: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing. Andrea Tringali: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Sara Teles de Campos: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Giuseppe Vanella: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Kin Seng Liem: Data curation, Formal analysis, Validation, Writing - original draft. Marianna Arvanitakis: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Fabrice Caillol: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Christian Gerges: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Gavin Johnson: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Leena Kylänpää: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Enrique Perez-Cuadrado Robles: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Maria Chiara Petrone: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Mohan Ramchandani: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Jeanin E. van Hooft: Conceptualization, Formal analysis, Methodology, Validation, Writing - original draft, Writing - review & editing. Antonio Facciorusso: Conceptualization, Formal analysis, Methodology. Tony C. Tham: Supervision, Writing - review & editing. Konstantinos Triantafyllou: Conceptualization, Project administration, Supervision, Validation, Writing - review & editing.

Conflict of Interest

M. Arvanitakis has received lecture fees from Boston Scientific (2024 to present). G. Johnson is on the advisory board and has provided educational consultancy for Boston Scientific (2022 to present) and is on the advisory board of Olympus (2025 to present). E. Perez-Cuadrado Robles has provided consultancy to Boston Scientific (2024 to present). G. Vanella has provided consultancy to Boston Scientific (2022 to present). J. van Hooft has received consultancy fees from Olympus and lecture fees from Fujifilm and Cook Medical (all 2024 to present). F. Caillol, A. Facciorusso, C. Gerges, L. Kylänpää, A. Lemmers, K.S. Liem, M. Petrone, M. Ramchandani, S. Teles de Campos, T. C. Tham, K. Triantafyllou, and A. Tringali declare that they have no conflict of interest.

Funding Information

The present project is internally funded by the European Society of Gastrointestinal Endoscopy (ESGE).

References

- [1] Facciorusso A, Crino SF, Gkolfakis P et al. Diagnostic work-up of bile duct strictures: European Society of Gastrointestinal Endoscopy (ESGE) Guideline. *Endoscopy* 2025; 57: 166–185 doi:10.1055/a-2481-7048
- [2] Dumonceau JM, Tringali A, Papanikolaou IS et al. Endoscopic biliary stenting: indications, choice of stents, and results: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline – Updated October 2017. *Endoscopy* 2018; 50: 910–930 doi:10.1055/a-0659-9864
- [3] van der Merwe SW, van Wanrooij RLJ, Bronswijk M et al. Therapeutic endoscopic ultrasound: European Society of Gastrointestinal Endoscopy (ESGE) Guideline. *Endoscopy* 2022; 54: 185–205 doi:10.1055/a-1717-1391
- [4] Dumonceau JM, Delhaye M, Tringali A et al. Endoscopic treatment of chronic pancreatitis: European Society of Gastrointestinal Endoscopy (ESGE) Guideline – Updated August 2018. *Endoscopy* 2019; 51: 179–193 doi:10.1055/a-0822-0832
- [5] Dumonceau JM, Kapral C, Aabakken L et al. ERCP-related adverse events: European Society of Gastrointestinal Endoscopy (ESGE) Guideline. *Endoscopy* 2020; 52: 127–149 doi:10.1055/a-1075-4080
- [6] Guyatt G, Oxman AD, Akl EA et al. GRADE guidelines: 1. Introduction-GRADE evidence profiles and summary of findings tables. *J Clin Epidemiol* 2011; 64: 383–394 doi:10.1016/j.jclinepi.2010.04.026
- [7] Dumonceau JM, Hassan C, Riphaus A et al. European Society of Gastrointestinal Endoscopy (ESGE) guideline development policy. *Endoscopy* 2012; 44: 626–629 doi:10.1055/s-0031-1291747
- [8] Hammel P, Couvelard A, O'Toole D et al. Regression of liver fibrosis after biliary drainage in patients with chronic pancreatitis and stenosis of the common bile duct. *NEJM* 2001; 344: 418–423
- [9] Sikora SS, Srikanth G, Agrawal V et al. Liver histology in benign biliary stricture: fibrosis to cirrhosis ... and reversal? *J Gastroenterol Hepatol* 2008; 23: 1879–1884 doi:10.1111/j.1440-1746.2007.04901.x
- [10] Rajendran J, Irrinki S, Gupta V et al. Elastography for evaluation of regression in liver fibrosis after surgical biliary drainage for benign biliary strictures: a practical possibility? *J Clin Gastroenterol* 2024; 58: 502–506 doi:10.1097/MCG.0000000000001895
- [11] Costamagna G, Tringali A, Perri V et al. Endotherapy of postcholecystectomy biliary strictures with multiple plastic stents: long-term results in a large cohort of patients. *Gastrointest Endosc* 2020; 91: 81–89
- [12] Kamal F, Ali Khan M, Lee-Smith W et al. Metal versus plastic stents in the management of benign biliary strictures: systematic review and meta-analysis of randomized controlled trials. *Eur J Gastroenterol Hepatol* 2022; 34: 478–487
- [13] Artifon EL, Coelho F, Frazao M et al. A prospective randomized study comparing partially covered metal stent versus plastic multistent in the endoscopic management of patients with postoperative benign bile duct strictures: a follow-up above 5 years. *Rev Gastroenterol Peru* 2012; 32: 26–31
- [14] Tringali A, Reddy DN, Ponchon T et al. Treatment of post-cholecystectomy biliary strictures with fully-covered self-expanding metal stents – results after 5 years of follow-up. *BMC Gastroenterol* 2019; 19: 214
- [15] Zhang CC, Rupp C, Exarchos X et al. Scheduled endoscopic treatment of biliary anastomotic and nonanastomotic strictures after orthotopic liver transplantation. *Gastrointest Endosc* 2023; 97: 42–49 doi:10.1016/j.gie.2022.08.034
- [16] Buis CI, Hoekstra H, Verdonk RC et al. Causes and consequences of ischemic-type biliary lesions after liver transplantation. *J Hepatobiliary Pancreat Surg* 2006; 13: 517–524 doi:10.1007/s00534-005-1080-2
- [17] Baraldo S, Meine GC, Santo PAE et al. Fully covered self-expandable metal stents versus multiple plastic stents for the treatment of post-orthotopic liver transplant anastomotic biliary strictures: An updated systematic review and meta-analysis of randomized controlled trials. *Surg Endosc* 2025; 39: 721–729 doi:10.1007/s00464-024-11467-6
- [18] Papaefthymiou A, Ramai D, Maida M et al. Efficacy of different stent types in post-liver-transplant anastomotic biliary strictures: a systematic review and meta-analysis. *Ann Gastroenterol* 2024; 37: 485–492 doi:10.20524/aog.2024.0886
- [19] Cantu P, Santi G, Rosa R et al. Cost analysis of a long-term randomized controlled study in biliary duct-to-duct anastomotic stricture after liver transplantation. *Transpl Int* 2021; 34: 825–834 doi:10.1111/tri.13867
- [20] Poley JW, Ponchon T, Poespoek A et al. Fully covered self-expanding metal stents for benign biliary stricture after orthotopic liver transplant: 5-year outcomes. *Gastrointest Endosc* 2020; 92: 1216–1224 doi:10.1016/j.gie.2020.04.078
- [21] Sissingh NJ, de Vries BA, Inderson A et al. Intraductal fully covered self-expandable metal stent versus multiple plastic stents for treating biliary anastomotic strictures after liver transplantation. *Gastrointest Endosc* 2023; 97: 704–712 e2 doi:10.1016/j.gie.2022.11.018
- [22] Bordacahar B, Perdigo F, Leblanc S et al. Clinical efficacy of anti-migration features in fully covered metallic stents for anastomotic biliary strictures after liver transplantation: comparison of conventional and anti-migration stents. *Gastrointest Endosc* 2018; 88: 655–664 doi:10.1016/j.gie.2018.06.035
- [23] Fuentes-Valenzuela E, de Benito Sanz M, Garcia-Pajares F et al. Anti-migration versus conventional fully covered metal stents in the endoscopic treatment of anastomotic biliary strictures after deceased-donor liver transplantation. *Surg Endosc* 2023; 37: 6975–6982
- [24] Tringali A, Barbaro F, Pizzicannella M et al. Endoscopic management with multiple plastic stents of anastomotic biliary stricture following liver transplantation: long-term results. *Endoscopy* 2016; 48: 546–551
- [25] Barakat MT, Huang RJ, Thosani NC et al. Liver transplant-related anastomotic biliary strictures: a novel, rapid, safe, radiation-sparing, and cost-effective management approach. *Gastrointest Endosc* 2018; 87: 501–508 doi:10.1016/j.gie.2017.07.025
- [26] Tarantino I, Amata M, Cicchese N et al. Sequential multistenting protocol in biliary stenosis after liver transplantation: a prospective analysis. *Endoscopy* 2019; 51: 1130–1135 doi:10.1055/a-0977-3158
- [27] Martins FP, De Paulo GA, Contini MLC et al. Metal versus plastic stents for anastomotic biliary strictures after liver transplantation: a randomized controlled trial. *Gastrointest Endosc* 2018; 87: 131 e1–e13 doi:10.1016/j.gie.2017.04.013
- [28] Yang H, Yang Z, Hong J. Post-ERCP pancreatitis occurs more frequently in self-expandable metallic stents than multiple plastic stents on benign biliary strictures: a meta-analysis. *Ann Med* 2022; 54: 2439–2449
- [29] Parlak E, Simsek C, Koksas AS et al. The classification of biliary strictures in patients with right-lobe liver transplant recipients and its relation to traversing the stricture with a guidewire. *Transplantation* 2022; 106: 328–336
- [30] Fasullo M, Ghazaleh S, Sayeh W et al. Prognostic factors for non-anastomotic biliary strictures following adult liver transplantation: a systematic review and meta-analysis. *Dig Dis Sci* 2023; 68: 2683–2694 doi:10.1007/s10620-023-07861-0
- [31] Lemmers A, Pezzullo M, Hadeifi A et al. Biliary cast syndrome after liver transplantation: A cholangiographic evolution study. *J Gastroenterol Hepatol* 2021; 36: 1366–1377 doi:10.1111/jgh.15318

- [32] Graziadei IW, Schwaighofer H, Koch R et al. Long-term outcome of endoscopic treatment of biliary strictures after liver transplantation. *Liver Transpl* 2006; 12: 718–725 doi:10.1002/lt.20644
- [33] Barbaro F, Tringali A, Larghi A et al. Endoscopic management of non-anastomotic biliary strictures following liver transplantation: Long-term results from a single-center experience. *Dig Endosc* 2021; 33: 849–857
- [34] Tabibian JH, Asham EH, Goldstein L et al. Endoscopic treatment with multiple stents for post-liver-transplantation nonanastomotic biliary strictures. *Gastrointest Endosc* 2009; 69: 1236–1243
- [35] Michael FA, Friedrich-Rust M, Erasmus HP et al. Treatment of non-anastomotic biliary strictures after liver transplantation: how effective is our current treatment strategy? *J Clin Med* 2023; 12: 3491 doi:10.3390/jcm12103491
- [36] ASGE Standards of Practice Committee. Sheth SG, Machicado JD et al. American Society for Gastrointestinal Endoscopy guideline on the role of endoscopy in the management of chronic pancreatitis: summary and recommendations. *Gastrointest Endosc* 2024; 100: 584–594
- [37] Lakhtakia S, Reddy N, Dolak W et al. Long-term outcomes after temporary placement of a self-expanding fully covered metal stent for benign biliary strictures secondary to chronic pancreatitis. *Gastrointest Endosc* 2020; 91: 361–369 e3 doi:10.1016/j.gie.2019.08.037
- [38] Haapamäki C, Kylanpää L, Udd M et al. Randomized multicenter study of multiple plastic stents vs. covered self-expandable metallic stent in the treatment of biliary stricture in chronic pancreatitis. *Endoscopy* 2015; 47: 605–610 doi:10.1055/s-0034-1391331
- [39] Ramchandani M, Pal P, Costamagna G. Management of benign biliary stricture in chronic pancreatitis. *Gastrointest Endosc Clin N Am* 2023; 33: 831–844 doi:10.1016/j.giec.2023.04.002
- [40] Giri S, Jearth V, Sundaram S. Covered self-expanding metal stents versus multiple plastic stents for benign biliary strictures: an updated meta-analysis of randomized controlled trials. *Cureus* 2022; 14: e24588 doi:10.7759/cureus.24588
- [41] Dumonceau JM, Delhay M, Charette N et al. Challenging biliary strictures: pathophysiological features, differential diagnosis, diagnostic algorithms, and new clinically relevant biomarkers – part 1. *Therap Adv Gastroenterol* 2020; 13: 1756284820927292 doi:10.1177/1756284820927292
- [42] Chaput U, Vienne A, Audureau E et al. Temporary placement of fully covered self-expandable metal stents for the treatment of benign biliary strictures. *United European Gastroenterol J* 2016; 4: 403–412 doi:10.1177/2050640615606550
- [43] Deviere J, Nageshwar Reddy D, Puspok A et al. Successful management of benign biliary strictures with fully covered self-expanding metal stents. *Gastroenterology* 2014; 147: 385–395 quiz e15
- [44] Ramchandani M, Lakhtakia S, Costamagna G et al. Fully covered self-expanding metal stent vs multiple plastic stents to treat benign biliary strictures secondary to chronic pancreatitis: a multicenter randomized trial. *Gastroenterology* 2021; 161: 185–195 doi:10.1053/j.gastro.2021.03.015
- [45] Tringali A, Blero D, Boskoski I et al. Difficult removal of fully covered self expandable metal stents (SEMS) for benign biliary strictures: the "SEMS in SEMS" technique. *Dig Liver Dis* 2014; 46: 568–571 doi:10.1016/j.dld.2014.02.018
- [46] Cote GA, Slivka A, Tarnasky P et al. Effect of covered metallic stents compared with plastic stents on benign biliary stricture resolution: a randomized clinical trial. *JAMA* 2016; 315: 1250–1257
- [47] Sheth SG, Machicado JD, Chhoda A et al. American Society for Gastrointestinal Endoscopy guideline on the role of endoscopy in the management of chronic pancreatitis: methodology and review of evidence. *Gastrointest Endosc* 2025; 101: e1–e53 doi:10.1016/j.gie.2024.05.017
- [48] European Association for the Study of the Liver. EASL Clinical Practice Guidelines on sclerosing cholangitis. *J Hepatol* 2022; 77: 761–806
- [49] Gotthardt DN, Rudolph G, Kloters-Plachky P et al. Endoscopic dilation of dominant stenoses in primary sclerosing cholangitis: outcome after long-term treatment. *Gastrointest Endosc* 2010; 71: 527–534 doi:10.1016/j.gie.2009.10.041
- [50] Dhaliwal AS, Naga Y, Ramai D et al. A comparison of balloon- versus stent-based approach for dominant strictures in primary sclerosing cholangitis: a meta-analysis. *Ann Gastroenterol* 2022; 35: 307–316 doi:10.20524/aog.2022.0701
- [51] Ponsioen CY, Arnelo U, Bergquist A et al. No superiority of stents vs balloon dilatation for dominant strictures in patients with primary sclerosing cholangitis. *Gastroenterology* 2018; 155: 752–729 e5
- [52] van Milligen de Wit AW, van Bracht J, Rauws EA et al. Endoscopic stent therapy for dominant extrahepatic bile duct strictures in primary sclerosing cholangitis. *Gastrointest Endosc* 1996; 44: 293–299
- [53] Sbeiti W, Khoury T, Goldin E et al. Three-months duration of fully-covered metal stent for refractory dominant extra-hepatic biliary stricture among primary sclerosing cholangitis patients: efficacy and safety. *Surg Endosc* 2022; 36: 2412–2417 doi:10.1007/s00464-021-08522-x
- [54] Kaya M, Petersen BT, Angulo P et al. Balloon dilation compared to stenting of dominant strictures in primary sclerosing cholangitis. *Am J Gastroenterol* 2001; 96: 1059–1066 doi:10.1111/j.1572-0241.2001.03690.x
- [55] Han S, Shah RJ. Benefit of endoscopic stenting for dominant strictures in patients with primary sclerosing cholangitis. *Endosc Int Open* 2022; 10: E1163–E1168 doi:10.1055/a-1873-0961
- [56] Garg A, Moond V, Garg A et al. Endoscopic balloon dilation versus stent placement in the management of dominant strictures in primary sclerosing cholangitis: a systematic review and meta-analysis. *Gastrointest Endosc* 2026; 103: 461–468.e14
- [57] Wolfson D, Barkin JS, Chari ST et al. Management of pancreatic masses. *Pancreas* 2005; 31: 203–217 doi:10.1097/01.mpa.0000180613.07948.ca
- [58] van der Gaag NA, Rauws EA, van Eijck CH et al. Preoperative biliary drainage for cancer of the head of the pancreas. *NEJM* 2010; 362: 129–137 doi:10.1056/NEJMoa0903230
- [59] van Gils L, Verbeek R, Wellerdieck N et al. Preoperative biliary drainage in severely jaundiced patients with pancreatic head cancer: A retrospective cohort study. *HPB (Oxford)* 2022; 24: 1888–1897
- [60] Shen Z, Zhang J, Zhao S et al. Preoperative biliary drainage of severely obstructive jaundiced patients decreases overall postoperative complications after pancreaticoduodenectomy: A retrospective and propensity score-matched analysis. *Pancreatol* 2020; 20: 529–536
- [61] Kanani F, Messer N, Cohen B et al. Impact of preoperative biliary drainage on outcomes of pancreaticoduodenectomy in severe hyperbilirubinemia. *Surg Endosc* 2025; 39: 6504–6513 doi:10.1007/s00464-025-12027-2
- [62] Arkadopoulos N, Kyriazi MA, Papanikolaou IS et al. Erratum to: Pre-operative biliary drainage of severely jaundiced patients increases morbidity of pancreaticoduodenectomy: results of a case-control study. *World J Surg* 2015; 39: 554 doi:10.1007/s00268-014-2861-z
- [63] Bolm L, Petrova E, Woehrmann L et al. The impact of preoperative biliary stenting in pancreatic cancer: A case-matched study from the German nationwide pancreatic surgery registry (DGA V StuDoQ | Pancreas). *Pancreatol* 2019; 19: 985–993
- [64] Miura F, Sano K, Wada K et al. Prognostic impact of type of preoperative biliary drainage in patients with distal cholangiocarcinoma. *Am J Surg* 2017; 214: 256–261

- [65] Yang G, Xiong Y, Sun J et al. Effects of different preoperative biliary drainage methods for resected malignant obstruction jaundice on the incidence rate of implantation metastasis: A meta-analysis. *Oncol Lett* 2020; 20: 2217–2224 doi:10.3892/ol.2020.11767
- [66] Wang L, Lin N, Xin F et al. A systematic review of the comparison of the incidence of seeding metastasis between endoscopic biliary drainage and percutaneous transhepatic biliary drainage for resectable malignant biliary obstruction. *World J Surg Oncol* 2019; 17: 116
- [67] Endo Y, Tanaka M, Kitago M et al. Comparison between plastic and metallic biliary stent placement for preoperative patients with pancreatic head cancer: a systematic review and meta-analysis. *Ann Surg Oncol* 2024; 31: 1319–1327
- [68] Lee HW, Moon JH, Lee YN et al. Modified non-flared fully covered self-expandable metal stent versus plastic stent for preoperative biliary drainage in patients with resectable malignant biliary obstruction. *J Gastroenterol Hepatol* 2019; 34: 1590–1596
- [69] Tamura T, Itonaga M, Ashida R et al. Covered self-expandable metal stents versus plastic stents for preoperative biliary drainage in patient receiving neo-adjuvant chemotherapy for borderline resectable pancreatic cancer: Prospective randomized study. *Dig Endosc* 2021; 33: 1170–1178 doi:10.1111/den.13926
- [70] Seo DW, Sherman S, Dua KS et al. 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
- [71] Conio M, Mangiavillano B, Caruso A et al. 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 doi:10.1016/j.gie.2018.03.029
- [72] Paik WH, Woo SM, Chun JW et al. Efficacy of an internal anchoring plastic stent to prevent migration of a fully covered metal stent in malignant distal biliary strictures: a randomized controlled study. *Endoscopy* 2021; 53: 578–585 doi:10.1055/a-1256-0571
- [73] Kulpatcharapong S, Piyachaturawat P, Mekaroonkamol P et al. Efficacy of multi-hole self-expandable metal stent compared to fully covered and uncovered self-expandable metal stents in patients with unresectable malignant distal biliary obstruction: a propensity analysis. *Surg Endosc* 2024; 38: 212–221
- [74] Lee HW, Moon JH, Lee YN et al. Usefulness of newly modified fully covered metallic stent of 12 mm in diameter and anti-migration feature for periampullary malignant biliary strictures: Comparison with conventional standard metal stent. *J Gastroenterol Hepatol* 2019; 34: 1208–1213
- [75] Vanella G, Coluccio C, Cucchetti A et al. Fully covered versus partially covered self-expandable metal stents for palliation of distal malignant biliary obstruction: a systematic review and meta-analysis. *Gastrointest Endosc* 2024; 99: 314–322 e19 doi:10.1016/j.gie.2023.10.023
- [76] Khoury T, Sbeit W, Fumex F et al. Endoscopic ultrasound- versus ERCP-guided primary drainage of inoperable malignant distal biliary obstruction: systematic review and meta-analysis of randomized controlled trials. *Endoscopy* 2024; 56: 955–963 doi:10.1055/a-2340-0697
- [77] Lauri G, Archibugi L, Arcidiacono PG et al. Primary drainage of distal malignant biliary obstruction: A comparative network meta-analysis. *Dig Liver Dis* 2024; 56: 2004–2010 doi:10.1016/j.dld.2024.08.053
- [78] Teoh AYB, Napoleon B, Kunda R et al. EUS-guided choledochoduodenostomy using lumen apposing stent versus ERCP with covered metallic stents in patients with unresectable malignant distal biliary obstruction: a multicenter randomized controlled trial (DRA-MBO trial). *Gastroenterology* 2023; 165: 473–482 e2
- [79] Paik WH, Lee TH, Park DH et al. EUS-guided biliary drainage versus ERCP for the primary palliation of malignant biliary obstruction: a multicenter randomized clinical trial. *Am J Gastroenterol* 2018; 113: 987–997 doi:10.1038/s41395-018-0122-8
- [80] Chen YI, Sahai A, Donatelli G et al. Endoscopic ultrasound-guided biliary drainage of first intent with a lumen-apposing metal stent vs endoscopic retrograde cholangiopancreatography in malignant distal biliary obstruction: a multicenter randomized controlled study (ELEMENT trial). *Gastroenterology* 2023; 165: 1249–1261 e5
- [81] Beunon C, Debourdeau A, Schaefer M et al. Technical failure of endoscopic ultrasound-guided choledochoduodenostomy: multicenter study on rescue techniques, consequences, and risk factors. *Endoscopy* 2025; 57: 990–1000 doi:10.1055/a-2541-2973
- [82] Chen YI, Long C, Sahai AV et al. Stent misdeployment and factors associated with failure in endoscopic ultrasound-guided choledochoduodenostomy: analysis of the combined datasets from two randomized trials. *Endoscopy* 2025; 57: 330–338
- [83] Vanella G, Leone R, Frigo F et al. Endoscopic ultrasound-guided choledochoduodenostomy versus hepaticogastrostomy combined with gastroenterostomy in malignant double obstruction (CABRIO-LET_Pro): A prospective comparative study. *DEN Open* 2025; 5: e70024
- [84] Fritzsche JA, Fockens P, Besselink MG et al. Endoscopic ultrasound-guided choledochoduodenostomy using single-step lumen-apposing metal stents for primary drainage of malignant distal biliary obstruction (SCORPION-p): a prospective pilot study. *Endoscopy* 2024; 56: 47–52 doi:10.1055/a-2134-3537
- [85] Fritzsche JA, Fockens P, Besselink MG et al. Optimizing EUS-guided choledochoduodenostomy with lumen-apposing metal stents for primary drainage of malignant distal biliary obstruction (SCORPION-llp): a prospective pilot study. *Gastrointest Endosc* 2025; 101: 1009–1016
- [86] Vanella G, Dell'Aanna G, van Wanrooij RJ et al. Managing dysfunctions and reinterventions in endoscopic ultrasound-guided choledochoduodenostomy with lumen apposing metal stents: Illustrated technical review (with videos). *Dig Endosc* 2024; 36: 481–491
- [87] Geyl S, Redelsperger B, Yzet C et al. Risk factors for stent dysfunction during long-term follow-up after EUS-guided biliary drainage using lumen-apposing metal stents: A prospective study. *Endosc Ultrasound* 2023; 12: 237–244
- [88] Garcia-Sumalla A, Loras C, Sanchiz V et al. Multicenter study of lumen-apposing metal stents with or without pigtail in endoscopic ultrasound-guided biliary drainage for malignant obstruction-BAMPI TRIAL: an open-label, randomized controlled trial protocol. *Trials* 2022; 23: 181 doi:10.1186/s13063-022-06106-1
- [89] Li JS, Tang J, Fang J et al. Adverse events in endoscopic ultrasound-guided choledochoduodenostomy with lumen-apposing metal stents: A systematic review and meta-analysis. *J Gastroenterol Hepatol* 2024; 39: 1769–1779
- [90] Bang JY, Faraj Agha M, Hawes R et al. Rate of suitable cases for primary EUS-guided biliary drainage in distal malignant biliary obstruction. *Gut* 2025; 75: 6–9 doi:10.1136/gutjnl-2025-334979
- [91] Wiggers JK, Groot Koerkamp B, Cieslak KP et al. Postoperative mortality after liver resection for perihilar cholangiocarcinoma: development of a risk score and importance of biliary drainage of the future liver remnant. *J Am Coll Surg* 2016; 223: 321–331 e1
- [92] Olthof PB, Wiggers JK, Koerkamp BG et al. Postoperative liver failure risk score: identifying patients with resectable perihilar cholangiocarcinoma who can benefit from portal vein embolization. *J Am Coll Surg* 2017; 225: 387–394
- [93] Coelen RJS, Roos E, Wiggers JK et al. Endoscopic versus percutaneous biliary drainage in patients with resectable perihilar cholangiocarcinoma: a multicentre, randomised controlled trial. *Lancet Gastroenterol Hepatol* 2018; 3: 681–690

- [94] Komaya K, Ebata T, Yokoyama Y et al. Verification of the oncologic inferiority of percutaneous biliary drainage to endoscopic drainage: A propensity score matching analysis of resectable perihilar cholangiocarcinoma. *Surgery* 2017; 161: 394–404 doi:10.1016/j.surg.2016.08.008
- [95] Tringali A, Boskoski I, Costamagna G. Endoscopic stenting in hilar cholangiocarcinoma: when, how, and how much to drain? *Gastroenterol Res Pract* 2019; 2019: 5161350 doi:10.1155/2019/5161350
- [96] van Eecke E, Degroote H, Vanlander A et al. Outcome of primary ERCP versus primary PTC for biliary drainage in malignant hilar biliary strictures: a systematic review and meta-analysis. *Surg Endosc* 2022; 36: 7160–7170 doi:10.1007/s00464-022-09413-5
- [97] Lubbe J, Lindemann J, Gondo W et al. Endoscopic versus percutaneous intervention for palliation in malignant hilar bile duct obstruction – A comparative cohort study. *HPB (Oxford)* 2022; 24: 2145–2156 doi:10.1016/j.hpb.2022.09.005
- [98] Nakai Y, Kogure H, Isayama H et al. Endoscopic ultrasound-guided biliary drainage for unresectable hilar malignant biliary obstruction. *Clin Endosc* 2019; 52: 220–225 doi:10.5946/ce.2018.094
- [99] Winkler J, Caillol F, Ratone JP et al. Feasibility of EUS-guided hepaticogastrostomy for inoperable malignant hilar biliary strictures. *Endosc Ultrasound* 2021; 10: 51–56 doi:10.4103/eus.eus_68_20
- [100] Schoch A, Lisotti A, Walter T et al. Efficacy of EUS-guided hepaticogastrostomy in prolonging survival of patients with perihilar cholangiocarcinoma. *Endosc Ultrasound* 2022; 11: 487–494
- [101] Koutlas NJ, Pawa S, Russell G et al. EUS-guided hepaticogastrostomy versus percutaneous transhepatic biliary drainage after failed ERCP: A propensity score-matched analysis. *Endosc Int Open* 2024; 12: E108–E115 doi:10.1055/a-2220-2740
- [102] Lee TH, Kim TH, Moon JH et al. Bilateral versus unilateral placement of metal stents for inoperable high-grade malignant hilar biliary strictures: a multicenter, prospective, randomized study (with video). *Gastrointest Endosc* 2017; 86: 817–827
- [103] Ashat M, Arora S, Klair JS et al. Bilateral vs unilateral placement of metal stents for inoperable high-grade hilar biliary strictures: A systematic review and meta-analysis. *World J Gastroenterol* 2019; 25: 5210–5219 doi:10.3748/wjg.v25.i34.5210
- [104] Naitoh I, Inoue T. Optimal endoscopic drainage strategy for unresectable malignant hilar biliary obstruction. *Clin Endosc* 2023; 56: 135–142 doi:10.5946/ce.2022.150
- [105] Jo IH, Paik CN, Kim DB et al. Unilateral versus bilateral Y-type stent-in-stent metal stent insertions in inoperable malignant hilar biliary strictures: A multicenter retrospective study. *Hepatobiliary Pancreat Dis Int* 2021; 20: 561–567 doi:10.1016/j.hbpd.2021.08.002
- [106] Vienne A, Hobeika E, Gouya H et al. Prediction of drainage effectiveness during endoscopic stenting of malignant hilar strictures: the role of liver volume assessment. *Gastrointest Endosc* 2010; 72: 728–735
- [107] Caillol F, Bories E, Zemmour C et al. Palliative endoscopic drainage of malignant stenosis of biliary confluence: Efficiency of multiple drainage approach to drain a maximum of liver segments. *United European Gastroenterol J* 2019; 7: 52–59 doi:10.1177/2050640618803812
- [108] Morimoto K, Matsumoto K, Obata T et al. Optimal liver drainage rate for survival in patients with unresectable malignant hilar biliary obstruction using 3D-image volume analyzer. *Therap Adv Gastroenterol* 2023; 16: 17562848231206980
- [109] Ruas JN, Mendonca EQ, Lenz L et al. Correlation between liver volume drainage and clinical success after endoscopic biliary drainage of hilar malignant obstruction. *Clinics (Sao Paulo)* 2025; 80: 100540
- [110] Paik WH, Jung MK, Kim DU et al. Side-by-side placement of fully covered metal stents versus conventional 7F plastic stents in malignant hilar biliary obstruction: Prospective randomized controlled trial. *Dig Endosc* 2024; 36: 473–480 doi:10.1111/den.14669
- [111] Yoshida T, Hara K, Imaoka H et al. Benefits of side-by-side deployment of 6-mm covered self-expandable metal stents for hilar malignant biliary obstructions. *J Hepatobiliary Pancreat Sci* 2016; 23: 548–555 doi:10.1002/jhbp.372
- [112] Takahashi S, Fujisawa T, Ushio M et al. Retrospective evaluation of slim fully covered self-expandable metallic stent for unresectable malignant hilar biliary obstruction. *J Hepatobiliary Pancreat Sci* 2023; 30: 408–415 doi:10.1002/jhbp.1221
- [113] Choi JH, Lee SH, You MS et al. Step-wise endoscopic approach to palliative bilateral biliary drainage for unresectable advanced malignant hilar obstruction. *Sci Rep* 2019; 9: 13207 doi:10.1038/s41598-019-48384-x
- [114] Lee BS, Ryu JK, Jang DK et al. Reintervention for occluded metal stent in malignant bile duct obstruction: A prospective randomized trial comparing covered and uncovered metal stent. *J Gastroenterol Hepatol* 2016; 31: 1901–1907 doi:10.1111/jgh.13392
- [115] Tejedor-Tejada J, Alvarez-Alvarez A, Olmos JM et al. Secondary uncovered versus fully-covered metal stents for the management of occluded stent in unresectable distal malignant biliary obstruction. *Gastroenterol Hepatol* 2024; 47: 502218 doi:10.1016/j.gastrohep.2024.502218
- [116] Fujii M, Kawamoto H, Tsutsumi K et al. Management of occluded metallic stents in malignant hilar biliary stricture. *Hepatogastroenterology* 2013; 60: 447–451 doi:10.5754/hge12679
- [117] Inoue T, Naitoh I, Okumura F et al. Reintervention for stent occlusion after bilateral self-expandable metallic stent placement for malignant hilar biliary obstruction. *Dig Endosc* 2016; 28: 731–737 doi:10.1111/den.12657
- [118] Moreels TG. Endoscopic retrograde cholangiopancreatography in patients with altered anatomy: How to deal with the challenges? *World J Gastrointest Endosc* 2014; 6: 345–351 doi:10.4253/wjge.v6.i8.345
- [119] Moreels TG. ERCP in the patient with surgically altered anatomy. *Curr Gastroenterol Rep* 2013; 15: 343 doi:10.1007/s11894-013-0343-3
- [120] Moreels TG. Altered anatomy: enteroscopy and ERCP procedure. *Best Pract Res Clin Gastroenterol* 2012; 26: 347–357 doi:10.1016/j.bpg.2012.03.003
- [121] van Wanrooij RJ, Bronswijk M, Kunda R et al. Therapeutic endoscopic ultrasound: European Society of Gastrointestinal Endoscopy (ESGE) Technical Review. *Endoscopy* 2022; 54: 310–332 doi:10.1055/a-1738-6780
- [122] Rondonotti E, Spada C, Adler S et al. Small-bowel capsule endoscopy and device-assisted enteroscopy for diagnosis and treatment of small-bowel disorders: European Society of Gastrointestinal Endoscopy (ESGE) Technical Review. *Endoscopy* 2018; 50: 423–446 doi:10.1055/a-0576-0566
- [123] Das M, van der Leij C, Katoh M et al. CIRSE Standards of Practice on percutaneous transhepatic cholangiography, biliary drainage and stenting. *Cardiovasc Intervent Radiol* 2021; 44: 1499–1509 doi:10.1007/s00270-021-02903-4
- [124] Forbes A, Cotton PB. ERCP and sphincterotomy after Billroth II gastrectomy. *Gut* 1984; 25: 971–974 doi:10.1136/gut.25.9.971
- [125] Park TY, Song TJ. Recent advances in endoscopic retrograde cholangiopancreatography in Billroth II gastrectomy patients: A systematic review. *World J Gastroenterol* 2019; 25: 3091–3107 doi:10.3748/wjg.v25.i24.3091
- [126] Park TY, Bang CS, Choi SH et al. Forward-viewing endoscope for ERCP in patients with Billroth II gastrectomy: a systematic review and meta-analysis. *Surg Endosc* 2018; 32: 4598–4613
- [127] Coşkun O, Ödemiş B. A comparative study of side-viewing duodenoscope and forward-viewing gastroscope to perform endoscopic retrograde cholangiopancreatography in patients with Billroth II

- gastrectomy. *Surg Endosc* 2021; 35: 4222–4230 doi:10.1007/s00464-020-07904-x
- [128] Kim SB, Kim KH, Kim TN. Comparison of endoscopic retrograde cholangiopancreatography outcomes between cap-fitted forward and side viewing endoscopes in patients with Billroth II anastomosis. *BMC Gastroenterol* 2023; 23: 115 doi:10.1186/s12876-023-02701-x
- [129] Marques de SáI, Chaves CB, Correia de Sousa J et al. Side-viewing duodenoscope versus forward-viewing gastroscope for endoscopic retrograde cholangiopancreatography in Billroth II gastrectomy patients. *GE Port J Gastroenterol* 2023; 30: 267–274
- [130] Chahal P, Baron TH, Topazian MD et al. Endoscopic retrograde cholangiopancreatography in post-Whipple patients. *Endoscopy* 2006; 38: 1241–1245 doi:10.1055/s-2006-945003
- [131] Wang AY, Sauer BG, Behm BW et al. Single-balloon enteroscopy effectively enables diagnostic and therapeutic retrograde cholangiography in patients with surgically altered anatomy. *Gastrointest Endosc* 2010; 71: 641–649
- [132] Lenze F, Meister T, Matern P et al. Single-balloon enteroscopy-assisted endoscopic retrograde cholangiopancreatography in patients with surgically altered anatomy: higher failure rate in malignant biliary obstruction - a prospective single center cohort analysis. *Scand J Gastroenterol* 2014; 49: 766–771
- [133] Wang J, He Y, Yu D et al. Endoscopic retrograde cholangiopancreatography with balloon-assisted enteroscopy in patients with Roux-en-Y anastomosis and Whipple operation. *Medicine (United States)* 2020; 99: e22653
- [134] Khashab MA, El Zein MH, Sharzei K et al. EUS-guided biliary drainage or enteroscopy-assisted ERCP in patients with surgical anatomy and biliary obstruction: an international comparative study. *Endosc Int Open* 2016; 4: E1322–E1327 doi:10.1055/s-0042-110790
- [135] Inamdar S, Slattery E, Sejjal DV et al. Systematic review and meta-analysis of single-balloon enteroscopy-assisted ERCP in patients with surgically altered GI anatomy. *Gastrointest Endosc* 2015; 82: 9–19
- [136] Tanisaka Y, Ryozaawa S, Mizuide M et al. Status of single-balloon enteroscopy-assisted endoscopic retrograde cholangiopancreatography in patients with surgically altered anatomy: Systematic review and meta-analysis on biliary interventions. *Dig Endosc* 2021; 33: 1034–1044
- [137] Anvari S, Lee Y, Patro N et al. Double-balloon enteroscopy for diagnostic and therapeutic ERCP in patients with surgically altered gastrointestinal anatomy: a systematic review and meta-analysis. *Surg Endosc* 2021; 35: 18–36
- [138] Tanisaka Y, Mizuide M, Fujita A et al. Endoscopic ultrasound-guided biliary drainage in patients with surgically altered anatomy: a systematic review and Meta-analysis. *Scand J Gastroenterol* 2023; 58: 107–115
- [139] Mutignani M, Forti E, Pugliese F et al. Endoscopic entero-enteral bypass to treat postsurgical benign complications of hepatico-jejunostomy: Update of a 7-year single-center experience. *Endosc Int Open* 2023; 11: E394–E400 doi:10.1055/a-2032-3077
- [140] Banerjee N, Parepally M, Byrne TK et al. Systematic review of trans-gastric ERCP in Roux-en-Y gastric bypass patients. *Surg Obes Relat Dis* 2017; 13: 1236–1242 doi:10.1016/j.soard.2017.02.005
- [141] Aiolfi A, Asti E, Rausa E et al. Trans-gastric ERCP after Roux-en-Y gastric bypass: systematic review and meta-analysis. *Obes Surg* 2018; 28: 2836–2843 doi:10.1007/s11695-018-3258-0
- [142] Hajibandeh S, Tarazi M, Mansour M et al. Procedural outcomes of laparoscopic-assisted endoscopic retrograde cholangiopancreatography in patients with previous Roux-en-Y gastric bypass surgery: a systematic review and meta-analysis. *Obes Surg* 2021; 31: 282–298 doi:10.1007/s11695-020-04954-x
- [143] Saad B, Nasser M, Matar RH et al. Safety and efficacy of LA-ERCP procedure following Roux-en-Y gastric bypass: a systematic review and meta-analysis. *Surg Endosc* 2023; 37: 6682–6694 doi:10.1007/s00464-023-10276-7
- [144] da Ponte-Neto AM, Bernardo WM, de A Coutinho LM et al. Comparison between enteroscopy-based and laparoscopy-assisted ERCP for accessing the biliary tree in patients with Roux-en-Y gastric bypass: systematic review and meta-analysis. *Obes Surg* 2018; 28: 4064–4076
- [145] Prakash S, Elmunzer BJ, Forster EM et al. Endoscopic ultrasound-directed transgastric ERCP (EDGE): a systematic review describing the outcomes, adverse events, and knowledge gaps. *Endoscopy* 2022; 54: 52–61 doi:10.1055/a-1376-2394
- [146] Su T, Chen T, Wang J et al. Endoscopic-directed trans-gastric retrograde cholangiopancreatography in patients with Roux-en-Y gastric bypasses: a meta-analysis. *J Clin Gastroenterol* 2023; 57: 871–878
- [147] Wang F, Ge XX, Deng XT et al. Endoscopic retrograde cholangiopancreatography using a pediatric colonoscope in patients with Roux-en-Y gastrectomy and an intact major duodenal papilla. *Exp Ther Med* 2024; 28: 390
- [148] Ni JB, Zhu MY, Li K et al. The feasibility of cap-assisted routine adult colonoscope for therapeutic endoscopic retrograde cholangiopancreatography in patients with Roux-en-Y reconstruction after total gastrectomy. *J Dig Dis* 2021; 22: 721–726
- [149] Fugazza A, Anderloni A, Paduano D et al. Underwater cap-assisted endoscopic retrograde cholangiopancreatography in patients with surgically altered anatomy: a pilot study. *Endoscopy* 2021; 53: 927–931
- [150] Yang MJ, Kim JH, Hwang JC et al. Mechanistic loop resolution strategy for short-type single-balloon enteroscopy-assisted endoscopic retrograde cholangiopancreatography in patients with Roux-en-Y reconstruction after gastrectomy (with video). *Surg Endosc* 2022; 36: 8690–8696
- [151] Sato T, Nakai Y, Kogure H et al. ERCP using balloon-assisted endoscopes versus EUS-guided treatment for common bile duct stones in Roux-en-Y gastrectomy. *Gastrointest Endosc* 2024; 99: 193–203 e5 doi:10.1016/j.gie.2023.09.001
- [152] Tanisaka Y, Ryozaawa S, Itoi T et al. Efficacy and factors affecting procedure results of short-type single-balloon enteroscopy-assisted ERCP for altered anatomy: a multicenter cohort in Japan. *Gastrointest Endosc* 2022; 95: 310–318 e1 doi:10.1016/j.gie.2021.09.008
- [153] Cho E, Park CH, Kim Y et al. Impact of scope exchange from a long single balloon enteroscope to a gastroscope during enteroscopy-assisted endoscopic retrograde cholangiopancreatography in patients with surgically altered anatomy. *Gut Liver* 2022; 16: 308–316
- [154] Tanisaka Y, Mizuide M, Fujita A et al. Factors affecting complete stone extraction in the initial procedure in short type single-balloon enteroscopy-assisted endoscopic retrograde cholangiography for patients with Roux-en-Y gastrectomy. *Scand J Gastroenterol* 2022; 57: 1390–1396
- [155] Yokoyama K, Kanno A, Tanaka A et al. Factors affecting complete stone removal and bile duct stone recurrence in patients with surgically altered anatomy treated by double-balloon endoscopy-assisted endoscopic retrograde cholangiography. *Dig Endosc* 2024; 36: 1269–1279
- [156] Farina E, Cantu P, Cavallaro F et al. Effectiveness of double-balloon enteroscopy-assisted endoscopic retrograde cholangiopancreatography (DBE-ERCP): A multicenter real-world study. *Dig Liver Dis* 2023; 55: 394–399 doi:10.1016/j.dld.2022.10.014
- [157] Park DH, Jeong SU, Lee BU et al. Prospective evaluation of a treatment algorithm with enhanced guidewire manipulation protocol for EUS-guided biliary drainage after failed ERCP (with video). *Gastrointest Endosc* 2013; 78: 91–101

- [158] Kanno Y, Koshita S, Ogawa T et al. EUS-guided biliary drainage for unresectable malignant biliary obstruction: 10-year experience of 99 cases at a single center. *J Gastrointest Cancer* 2019; 50: 469–477 doi:10.1007/s12029-018-0096-1
- [159] Iwashita T, Uemura S, Mita N et al. Endoscopic ultrasound guided-antegrade biliary stenting vs percutaneous transhepatic biliary stenting for unresectable distal malignant biliary obstruction in patients with surgically altered anatomy. *J Hepatobiliary Pancreat Sci* 2020; 27: 968–976
- [160] Minaga K, Takenaka M, Ogura T et al. Endoscopic ultrasound-guided biliary drainage for malignant biliary obstruction with surgically altered anatomy: a multicenter prospective registration study. *Therap Adv Gastroenterol* 2020; 13: 1756284820930964
- [161] Matsunami Y, Itoi T, Sofuni A et al. EUS-guided hepaticocenterostomy with using a dedicated plastic stent for the benign pancreaticobiliary diseases: A single-center study of a large case series. *Endosc Ultrasound* 2021; 10: 294–304
- [162] Tyberg A, Desai AP, Kumta NA et al. EUS-guided biliary drainage after failed ERCP: a novel algorithm individualized based on patient anatomy. *Gastrointest Endosc* 2016; 84: 941–946 doi:10.1016/j.gie.2016.05.035
- [163] Balducci D, Ratone JP, Schaefer M et al. EUS-guided hepaticojunostomy in patients with history of total gastrectomy: a multicenter retrospective feasibility study (with video). *Gastrointest Endosc* 2025; 101: 117–122
- [164] El-Domiaty N, Alric H, Di Gaeta A et al. Transjejunal ERCP through an endoscopic ultrasound-guided jejuno-duodenal anastomosis in a patient with gastric bypass without excluded stomach. *Endoscopy* 2023; 55: E1027–E1028
- [165] Nennstiel S, Freivogel K, Faber A et al. Endoscopic and percutaneous biliary interventions in patients with altered upper gastrointestinal anatomy-the Munich Multicenter Experience. *Surg Endosc* 2021; 35: 6853–6864
- [166] Vanella G, Bronswijk M, Maleux G et al. EUS-guided intrahepatic biliary drainage: a large retrospective series and subgroup comparison between percutaneous drainage in hilar stenoses or postsurgical anatomy. *Endosc Int Open* 2020; 8: E1782–E1794 doi:10.1055/a-1264-7511
- [167] Perez-Cuadrado-Robles E, Phillpotts S, Bronswijk M et al. PERcutaneous transhepatic CHOLangioscopy using a new single-operator short cholangioscope (PERCHOL): European feasibility study. *Dig Endosc* 2024; 36: 719–725 doi:10.1111/den.14697
- [168] Uribe Rivera AK, Seeliger B, Saldivar CA et al. Percutaneous transhepatic cholangioscopy for benign and malignant biliary disease using a novel short single-operator cholangioscope. *Surg Endosc* 2023; 37: 7774–7783
- [169] Boskoski I, Beyna T, Lau JY et al. Efficacy and safety of a single-use cholangioscope for percutaneous transhepatic cholangioscopy. *Endosc Int Open* 2024; 12: E981–E988 doi:10.1055/a-2366-2265
- [170] Parlak E, Cicek B, Disibeyaz S et al. Endoscopic retrograde cholangiography by double balloon enteroscopy in patients with Roux-en-Y hepaticojunostomy. *Surg Endosc* 2010; 24: 466–470
- [171] James TW, Fan YC, Baron TH. EUS-guided hepaticocenterostomy as a portal to allow definitive antegrade treatment of benign biliary diseases in patients with surgically altered anatomy. *Gastrointest Endosc* 2018; 88: 547–554 doi:10.1016/j.gie.2018.04.2353
- [172] Parsa N, Runge T, Ichkhanian Y et al. EUS-guided hepaticogastrostomy to facilitate cholangioscopy and electrohydraulic lithotripsy of massive intraductal stones after Roux-en-Y hepaticojunostomy. *VideoGIE* 2020; 5: 418–420 doi:10.1016/j.vgie.2020.05.038
- [173] Yu T, Hou S, Du H et al. Simplified single-session EUS-guided transhepatic antegrade stone removal for management of choledocholithiasis in patients with surgically altered anatomy. *Gastroenterol Rep (Oxf)* 2024; 12: goae056
- [174] Brenner TA, Bapaye J, Zhang L et al. EUS-directed transenteric ERCP-assisted internalization of a percutaneous biliary drain in Roux-en-Y anatomy. *VideoGIE* 2022; 7: 364–366 doi:10.1016/j.vgie.2022.07.005
- [175] Sondhi AR, Sonnenday CJ, Parikh ND et al. EUS-guided gastrojejunal anastomosis to facilitate endoscopic retrograde cholangiography in a patient with a right lobe liver transplant and Roux-en-Y anatomy. *VideoGIE* 2020; 5: 473–475
- [176] Ichkhanian Y, Yang J, James TW et al. EUS-directed transenteric ERCP in non-Roux-en-Y gastric bypass surgical anatomy patients (with video). *Gastrointest Endosc* 2020; 91: 1188–1194 e2
- [177] Mutignani M, Forti E, Larghi A et al. Endoscopic entero-enteral bypass: an effective new approach to the treatment of postsurgical complications of hepaticojunostomy. *Endoscopy* 2019; 51: 1146–1150 doi:10.1055/a-0914-2855
- [178] Hakuta R, Ishida K, Nakai Y et al. A retrospective comparative study of biliary drainage using balloon endoscopy and endoscopic ultrasound for malignant obstruction in patients with surgically altered anatomy. *Surg Endosc* 2024; 38: 7269–7277
- [179] Imamine R, Shibata T, Yabuta M et al. Long-term outcome of percutaneous biliary interventions for biliary anastomotic stricture in pediatric patients after living donor liver transplantation with Roux-en-Y hepaticojunostomy. *J Vasc Interv Radiol* 2015; 26: 1852–1859
- [180] Sanada Y, Sakuma Y, Onishi Y et al. Hepatolithiasis after living donor liver transplantation in pediatric patients: mechanism, diagnosis, treatment, and prognosis. *Transpl Int* 2022; 35: 10220 doi:10.3389/ti.2022.10220
- [181] Ko GY, Sung KB, Yoon HK et al. Percutaneous transhepatic treatment of hepaticojejunal anastomotic biliary strictures after living donor liver transplantation. *Liver Transpl* 2008; 14: 1323–1332 doi:10.1002/lt.21507
- [182] Righi D, Franchello A, Ricchiuti A et al. Safety and efficacy of the percutaneous treatment of bile leaks in hepaticojunostomy or split-liver transplantation without dilatation of the biliary tree. *Liver Transpl* 2008; 14: 611–615 doi:10.1002/lt.21416
- [183] Nakamura K, Ishii Y, Tatsukawa Y et al. Comparative study of therapeutic outcomes in patients who developed hepatolithiasis after hepaticojunostomy: balloon-assisted enteroscopic approach versus percutaneous transhepatic approach. *Surg Endosc* 2025; 39: 1160–1168 doi:10.1007/s00464-024-11479-2
- [184] Tsutsumi K, Kato H, Yabe S et al. A comparative evaluation of treatment methods for bile duct stones after hepaticojunostomy between percutaneous transhepatic cholangioscopy and peroral, short double-balloon enteroscopy. *Therap Adv Gastroenterol* 2017; 10: 54–67
- [185] Lee SH, Ryu JK, Woo SM et al. Optimal interventional treatment and long-term outcomes for biliary stricture after liver transplantation. *Clin Transplant* 2008; 22: 484–493 doi:10.1111/j.1399-0012.2008.00813.x
- [186] Chon HK, Choi KH, Seo SH et al. Efficacy and safety of percutaneous transhepatic cholangioscopy with the Spyglass DS Direct Visualization System in patients with surgically altered anatomy: a pilot study. *Gut Liver* 2022; 16: 111–117 doi:10.5009/gnl210028
- [187] Uemura RS, Khan MA, Otoch JP et al. EUS-guided choledochoduodenostomy versus hepaticogastrostomy: a systematic review and meta-analysis. *J Clin Gastroenterol* 2018; 52: 123–130 doi:10.1097/MCG.0000000000000948
- [188] Mao K, Hu B, Sun F et al. Choledochoduodenostomy versus hepaticogastrostomy in endoscopic ultrasound-guided drainage for malignant biliary obstruction: a meta-analysis and systematic review. *Surg Laparosc Endosc Percutan Tech* 2021; 32: 124–132 doi:10.1097/SLE.0000000000000992

- [189] Hedjoudje A, Sportes A, Grabar S et al. Outcomes of endoscopic ultrasound-guided biliary drainage: A systematic review and meta-analysis. *United European Gastroenterol J* 2019; 7: 60–68 doi:10.1177/2050640618808147
- [190] Rizqiansyah CY, Awatara PID, Amar N et al. Efficacy and safety of endoscopic ultrasonography (EUS) hepaticogastrostomy (HGS) versus choledochoduodenostomy (CDS) in ERCP-failed malignant biliary obstruction: A systematic review and META-analysis. *JGH Open* 2024; 8: e70037 doi:10.1002/jgh3.70037
- [191] Khan MA, Akbar A, Baron TH et al. Endoscopic ultrasound-guided biliary drainage: a systematic review and meta-analysis. *Dig Dis Sci* 2016; 61: 684–703 doi:10.1007/s10620-015-3933-0
- [192] Binda C, Dajti E, Giuffrida P et al. Efficacy and safety of endoscopic ultrasound-guided hepaticogastrostomy: a meta-regression analysis. *Endoscopy* 2024; 56: 694–705 doi:10.1055/a-2282-3350
- [193] Tarrio I, Moreira M, Araujo T et al. EUS-guided choledochoduodenostomy after failed endoscopic retrograde cholangiopancreatography in distal malignant biliary obstruction. *GE Port J Gastroenterol* 2023; 30: 65–73 doi:10.1159/000528808
- [194] Kunda R, Perez-Miranda M, Will U et al. EUS-guided choledochoduodenostomy for malignant distal biliary obstruction using a lumen-apposing fully covered metal stent after failed ERCP. *Surg Endosc* 2016; 30: 5002–5008 doi:10.1007/s00464-016-4845-6
- [195] Di Mitri R, Amata M, Mocciaro F et al. EUS-guided biliary drainage with LAMS for distal malignant biliary obstruction when ERCP fails: single-center retrospective study and maldeployment management. *Surg Endosc* 2022; 36: 4553–4569
- [196] Jacques J, Privat J, Pinard F et al. Endoscopic ultrasound-guided choledochoduodenostomy with electrocautery-enhanced lumen-apposing stents: a retrospective analysis. *Endoscopy* 2019; 51: 540–547
- [197] Rai P, Lokesh CR, Goel A et al. Endoscopic ultrasound-guided choledochoduodenostomy using partially-covered self-expandable metal stent in patients with malignant distal biliary obstruction and unsuccessful ERCP. *Endosc Int Open* 2018; 6: E67–E72 doi:10.1055/s-0043-120664
- [198] On W, Paranandi B, Smith AM et al. EUS-guided choledochoduodenostomy with electrocautery-enhanced lumen-apposing metal stents in patients with malignant distal biliary obstruction: multicenter collaboration from the United Kingdom and Ireland. *Gastrointest Endosc* 2022; 95: 432–442
- [199] Vanella G, Bronswijk M, van Wanrooij RL et al. Combined endoscopic management of biliary and gastric outlet obstruction (CABRIOLET Study): A multicenter retrospective analysis. *DEN Open* 2023; 3: e132 doi:10.1002/deo2.132
- [200] Binda C, Anderloni A, Fugazza A et al. EUS-guided gallbladder drainage using a lumen-apposing metal stent as rescue treatment for malignant distal biliary obstruction: a large multicenter experience. *Gastrointest Endosc* 2023; 98: 765–773 doi:10.1016/j.gie.2023.06.054
- [201] Debourdeau A, Daniel J, Caillio L et al. Effectiveness of endoscopic ultrasound (EUS)-guided choledochoduodenostomy vs. EUS-guided gallbladder drainage for jaundice in patients with malignant distal biliary obstruction after failed endoscopic retrograde cholangiopancreatography: Retrospective, multicenter study (GALLBLADEUS Study). *Dig Endosc* 2025; 37: 103–114
- [202] Facciorusso A, Mangiavillano B, Paduano D et al. Methods for drainage of distal malignant biliary obstruction after ERCP failure: a systematic review and network meta-analysis. *Cancers (Basel)* 2022; 14: 3291 doi:10.3390/cancers14133291
- [203] Ginestet C, Sanglier F, Hummel V et al. EUS-guided biliary drainage with electrocautery-enhanced lumen-apposing metal stent placement should replace PTBD after ERCP failure in patients with distal tumoral biliary obstruction: a large real-life study. *Surg Endosc* 2022; 36: 3365–3373
- [204] Khashab MA, Valeshabad AK, Afghani E et al. A comparative evaluation of EUS-guided biliary drainage and percutaneous drainage in patients with distal malignant biliary obstruction and failed ERCP. *Dig Dis Sci* 2015; 60: 557–565
- [205] Tellez-Avila FI, Herrera-Mora D, Duarte-Medrano G et al. Biliary drainage in patients with failed ERCP: percutaneous versus EUS-guided drainage. *Surg Laparosc Endosc Percutan Tech* 2018; 28: 183–187
- [206] Marx M, Caillol F, Autret A et al. EUS-guided hepaticogastrostomy in patients with obstructive jaundice after failed or impossible endoscopic retrograde drainage: A multicenter, randomized phase II Study. *Endosc Ultrasound* 2022; 11: 495–502 doi:10.4103/EUS-D-21-00108
- [207] Ekkelenkamp VE, de Man RA, Ter Borg F et al. Prospective evaluation of ERCP performance: results of a nationwide quality registry. *Endoscopy* 2015; 47: 503–507 doi:10.1055/s-0034-1391231
- [208] Domagk D, Oppong KW, Aabakken L et al. Performance measures for ERCP and endoscopic ultrasound: a European Society of Gastrointestinal Endoscopy (ESGE) Quality Improvement Initiative. *Endoscopy* 2018; 50: 1116–1127 doi:10.1055/a-0749-8767
- [209] El Nakeeb A, Askr W, El Hanafy E et al. Long term outcomes of choledochoduodenostomy for common bile duct stones in the era of laparoscopy and endoscopy. *Hepatogastroenterology* 2015; 62: 1371–16–10
- [210] Okamoto H, Miura K, Itakura J et al. Current assessment of choledochoduodenostomy: 130 consecutive series. *Ann R Coll Surg Engl* 2017; 99: 545–549 doi:10.1308/rcsann.2017.0082
- [211] Yamaki S, Satoh S, Yamamoto T et al. Risk factors and treatment strategy for clinical hepatico-jejunojejunostomy stenosis defined with intrahepatic bile duct dilatation after pancreaticoduodenectomy: A retrospective study. *J Hepatobiliary Pancreat Sci* 2022; 29: 1204–1213
- [212] Mallery S, Matlock J, Freeman ML. EUS-guided rendezvous drainage of obstructed biliary and pancreatic ducts: Report of 6 cases. *Gastrointest Endosc* 2004; 59: 100–107 doi:10.1016/s0016-5107(03)02300-9
- [213] Clair JS, Zafar Y, Ashat M et al. Effectiveness and safety of EUS rendezvous after failed biliary cannulation with ERCP: a systematic review and proportion meta-analysis. *J Clin Gastroenterol* 2023; 57: 211–217
- [214] Choudhury A, Samanta J, Muktesh G et al. Endoscopic ultrasound-guided rendezvous technique versus precut sphincterotomy as salvage technique in patients with benign biliary disease and difficult biliary cannulation: a randomized controlled trial. *Ann Intern Med* 2024; 177: 1361–1369
- [215] Gornals JB, Sumalla-Garcia A, Quintana S et al. Endoscopic ultrasound-guided biliary rendezvous after failed cannulation, and comparison between benign vs malignant biliopancreatic disorders: outcomes at a single tertiary-care centre. *Ann Med* 2024; 56: 2416607
- [216] Chivot C, Yzet C, Bouzerar R et al. Safety and efficacy of percutaneous transhepatic-endoscopic rendezvous procedure in a single session. *Surg Endosc* 2021; 35: 3534–3539 doi:10.1007/s00464-020-07812-0
- [217] Bokemeyer A, Muller F, Niesert H et al. Percutaneous-transhepatic-endoscopic rendezvous procedures are effective and safe in patients with refractory bile duct obstruction. *United European Gastroenterol J* 2019; 7: 397–404
- [218] Yoon SB, Yang MJ, Shin DW et al. Endoscopic ultrasound-rendezvous versus percutaneous-endoscopic rendezvous endoscopic retrograde cholangiopancreatography for bile duct access: Systematic review

- and meta-analysis. *Dig Endosc* 2024; 36: 129–140 doi:10.1111/den.14636
- [219] Dhir V, Itoi T, Khashab MA et al. Multicenter comparative evaluation of endoscopic placement of expandable metal stents for malignant distal common bile duct obstruction by ERCP or EUS-guided approach. *Gastrointest Endosc* 2015; 81: 913–923 doi:10.1016/j.gie.2014.09.054
- [220] Godat S, Bories E, Caillol F et al. Efficacy and safety in case of technical success of endoscopic ultrasound-guided transhepatic antegrade biliary drainage: A report of a monocentric study. *Endosc Ultrasound* 2017; 6: 181–186 doi:10.4103/2303-9027.208174
- [221] Sundaram S, Mane K, Patil P et al. Endoscopic ultrasound-guided antegrade stent placement in patients with failed ERCP as a modality of preoperative and palliative biliary drainage. *Dig Dis Sci* 2023; 68: 1551–1558
- [222] Behera RK, Srivastava DN, Kumar P et al. Right-sided versus left-sided percutaneous transhepatic biliary drainage in the management of malignant biliary obstruction: a randomized controlled study. *Abdom Radiol (NY)* 2021; 46: 768–775 doi:10.1007/s00261-020-02651-y
- [223] Pedersoli F, Schroder A, Zimmermann M et al. Percutaneous transhepatic biliary drainage (PTBD) in patients with dilated vs. nondilated bile ducts: technical considerations and complications. *Eur Radiol* 2021; 31: 3035–3041
- [224] Lee TH, Choi JH, Park do H et al. Similar efficacies of endoscopic ultrasound-guided transmural and percutaneous drainage for malignant distal biliary obstruction. *Clin Gastroenterol Hepatol* 2016; 14: 1011–1019 e3 doi:10.1016/j.cgh.2015.12.032
- [225] Artifon EL, Aparicio D, Paione JB et al. Biliary drainage in patients with unresectable, malignant obstruction where ERCP fails: endoscopic ultrasonography-guided choledochoduodenostomy versus percutaneous drainage. *J Clin Gastroenterol* 2012; 46: 768–774
- [226] Artifon EL, Loureiro JF, Baron TH et al. Surgery or EUS-guided choledochoduodenostomy for malignant distal biliary obstruction after ERCP failure. *Endosc Ultrasound* 2015; 4: 235–243 doi:10.4103/2303-9027.163010
- [227] Vanella G, Dell'Anna G, Cosenza A et al. Same-session endoscopic diagnosis and symptom palliation in pancreato-biliary malignancies: Clinical impact of rapid on-site evaluation (ROSE). *Endosc Int Open* 2024; 12: E297–E306 doi:10.1055/a-2251-3551
- [228] Nam K, Kim DU, Lee TH et al. Patient perception and preference of EUS-guided drainage over percutaneous drainage when endoscopic transpapillary biliary drainage fails: An international multicenter survey. *Endosc Ultrasound* 2018; 7: 48–55
- [229] Vanella G, Bronswijk M, Dell'Anna G et al. Classification, risk factors, and management of lumen apposing metal stent dysfunction during follow-up of endoscopic ultrasound-guided choledochoduodenostomy: Multicenter evaluation from the Leuven-Amsterdam-Milan Study Group. *Dig Endosc* 2023; 35: 377–388
- [230] Gaujoux S, Jacques J, Bourdariat R et al. Pancreaticoduodenectomy following endoscopic ultrasound-guided choledochoduodenostomy with electrocautery-enhanced lumen-apposing stents an ACHBT - SFED study. *HPB (Oxford)* 2021; 23: 154–160
- [231] Tyberg A, Sarkar A, Shahid HM et al. EUS-guided biliary drainage versus ERCP in malignant biliary obstruction before hepatobiliary surgery: an international multicenter comparative study. *J Clin Gastroenterol* 2023; 57: 962–966
- [232] Staub J, Siddiqui A, Taylor LJ et al. ERCP performed through previously placed duodenal stents: a multicenter retrospective study of outcomes and adverse events. *Gastrointest Endosc* 2018; 87: 1499–1504
- [233] Khashab MA, Valeshabad AK, Leung W et al. Multicenter experience with performance of ERCP in patients with an indwelling duodenal stent. *Endoscopy* 2014; 46: 252–255
- [234] Mutignani M, Tringali A, Shah SG et al. Combined endoscopic stent insertion in malignant biliary and duodenal obstruction. *Endoscopy* 2007; 39: 440–447 doi:10.1055/s-2007-966327
- [235] Simoes PK, Schattner MA, Gerdes H et al. Endoscopic stenting for malignant biliary obstruction is technically successful in patients with preexisting duodenal stents. *Endosc Int Open* 2022; 10: E429–E433
- [236] Yamao K, Kitano M, Takenaka M et al. Outcomes of endoscopic biliary drainage in pancreatic cancer patients with an indwelling gastroduodenal stent: a multicenter cohort study in West Japan. *Gastrointest Endosc* 2018; 88: 66–75 e2
- [237] Hamada T, Nakai Y, Lau JY et al. International study of endoscopic management of distal malignant biliary obstruction combined with duodenal obstruction. *Scand J Gastroenterol* 2018; 53: 46–55
- [238] Sharaiha RZ, Khan MA, Kamal F et al. Efficacy and safety of EUS-guided biliary drainage in comparison with percutaneous biliary drainage when ERCP fails: a systematic review and meta-analysis. *Gastrointest Endosc* 2017; 85: 904–914
- [239] Ogura T, Chiba Y, Masuda D et al. Comparison of the clinical impact of endoscopic ultrasound-guided choledochoduodenostomy and hepaticogastrostomy for bile duct obstruction with duodenal obstruction. *Endoscopy* 2016; 48: 163
- [240] Matsumoto K, Kato H, Tsutsumi K et al. Long-term outcomes and risk factors of biliary stent dysfunction after endoscopic double stenting for malignant biliary and duodenal obstructions. *Dig Endosc* 2017; 29: 617–625 doi:10.1111/den.12830
- [241] Bronswijk M, Vanella G, van Wanrooij RJ et al. Same-session double EUS-guided bypass versus surgical gastroenterostomy and hepaticojejunostomy: an international multicenter comparison. *Gastrointest Endosc* 2023; 98: 225–236 e1 doi:10.1016/j.gie.2023.03.019
- [242] Kesar V, Abel WF, Bapaye J et al. EUS-directed transduodenal ERCP in concomitant gastric outlet and biliary obstruction. *Gastrointest Endosc* 2025; 101: 885–889 doi:10.1016/j.gie.2024.12.003
- [243] Jain H, Dey D, Odat RM et al. Endoscopic ultrasound-guided gastroenterostomy versus duodenal stenting for gastric outlet obstruction: A systematic review, meta-analysis, and meta-regression. *Medicine (Baltimore)* 2024; 103: e39948 doi:10.1097/MD.00000000000039948
- [244] Li JS, Lin K, Tang J et al. EUS-guided gastroenterostomy for gastric outlet obstruction: a comprehensive meta-analysis. *Minim Invasive Ther Allied Technol* 2023; 32: 285–299 doi:10.1080/13645706.2023.2221336
- [245] Teoh AYB, Lakhtakia S, Tarantino I et al. Endoscopic ultrasonography-guided gastroenterostomy versus uncovered duodenal metal stenting for unresectable malignant gastric outlet obstruction (DRA-GOO): a multicentre randomised controlled trial. *Lancet Gastroenterol Hepatol* 2024; 9: 124–132 doi:10.1016/S2468-1253(23)00242-X
- [246] Vanella G, Dell'Anna G, Capurso G et al. EUS-guided gastroenterostomy for management of malignant gastric outlet obstruction: a prospective cohort study with matched comparison with enteral stenting. *Gastrointest Endosc* 2023; 98: 337–347 e5
- [247] Canakis A, Bomman S, Lee DU et al. Benefits of EUS-guided gastroenterostomy over surgical gastrojejunostomy in the palliation of malignant gastric outlet obstruction: a large multicenter experience. *Gastrointest Endosc* 2023; 98: 348–359 e30 doi:10.1016/j.gie.2023.03.022
- [248] Rughwani H, Kalapala R, Katrevula A et al. Carbon footprinting and environmental impact of gastrointestinal endoscopy procedures at a tertiary care institution: a prospective multi-dimensional assessment. *Gut* 2025; 74: 926–934 doi:10.1136/gutjnl-2024-332471
- [249] Rodriguez de Santiago E, Dinis-Ribeiro M, Pohl H et al. Reducing the environmental footprint of gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society

of Gastroenterology and Endoscopy Nurses and Associates (ES-GENA) Position Statement. *Endoscopy* 2022; 54: 797–826

- [250] Lacroute J, Marcantoni J, Petitot S et al. The carbon footprint of ambulatory gastrointestinal endoscopy. *Endoscopy* 2023; 55: 918–926 doi:10.1055/a-2088-4062
- [251] Desai M, Campbell C, Perisetti A et al. The environmental impact of gastrointestinal procedures: a prospective study of waste generation, energy consumption, and auditing in an endoscopy unit. *Gastroenterology* 2024; 166: 496–502 e3 doi:10.1053/j.gastro.2023.12.006
- [252] Namburam S, von Renteln D, Damianos J et al. Estimating the environmental impact of disposable endoscopic equipment and endoscopes. *Gut* 2022; 71: 1326–1331
- [253] Kozarek RA, Raltz SL, Ball TJ et al. Reuse of disposable sphincterotomes for diagnostic and therapeutic ERCP: a one-year prospective study. *Gastrointest Endosc* 1999; 49: 39–42 doi:10.1016/s0016-5107(99)70443-8
- [254] Cunha Neves JA, Baddeley R, Pohl H et al. Endoscopic Sustainability Primary Reporting Essentials (E-SPARE): European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. *Endoscopy* 2025; 57: 674–688
- [255] Johnson G, Webster G, Boskoski I et al. Curriculum for ERCP and endoscopic ultrasound training in Europe: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. *Endoscopy* 2021; 53: 1071–1087 doi:10.1055/a-1537-8999
- [256] Wang Y, Lyu Y, Li T et al. Comparing outcomes following endoscopic ultrasound-guided biliary drainage versus percutaneous transhepatic biliary drainage for malignant biliary obstruction: a systematic review and meta-analysis. *J Laparoendosc Adv Surg Tech A* 2022; 32: 747–755 doi:10.1089/lap.2021.0587
- [257] Hayat U, Bakker C, Dirweesh A et al. EUS-guided versus percutaneous transhepatic cholangiography biliary drainage for obstructed distal malignant biliary strictures in patients who have failed endoscopic retrograde cholangiopancreatography: A systematic review and meta-analysis. *Endosc Ultrasound* 2022; 11: 4–16