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Endoscopic Retrograde Cholangiopancreatography (ERCP)

Prevention and Management of Adverse Events

Expert Opinion Statement on behalf of the Swiss Society of Gastroenterology

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Abstract

ERCP is an invasive endoscopic technique with relevant morbidity even in institutions with a high case volume. It has evolved from a purely diagnostic to a mainly therapeutic intervention in the last decade. Several international guidelines cover different aspects of indications, technique, prevention and management of adverse events associated with this endoscopic technique. This expert opinion statement on behalf of the Swiss Society of Gastroenterology summarizes recommendations of existing international guidelines and incorporates recent data, providing a concise manual for swiss endoscopists performing ERCP in their daily practice.

Summary

Main Recommendations

1. The risks and benefits of ERCP should be weighed carefully on a case by case basis.

2. ERCP should be performed, if a therapeutic intervention is likely. Diagnostic ERCPs must be avoided in favour of endoscopic ultrasound (EUS) or magnetic resonance cholangiopancreatography (MRCP).

3. Routine rectal administration of a nonsteroidal anti-inflammatory drug (e.g. diclofenac or indomethacin) immediately before or after ERCP in all patients without contraindication should be performed. In high risk patients for post ERCP pancreatitis placement of a 5F plastic pancreatic stent is recommended. (Recommendation Grade B)

4. Aggressive hydration with lactated Ringer's solution (e.g. 3ml/kg/hour during ERCP, 20ml/kg bolus after ERCP, 3ml/kg/hour for 8 hours after ERCP) is recommended in patients with contraindication to NSAIDs, provided that they are not at risk for volume overload and a pancreatic stent was not placed. (Recommendation Grade B)

5. Prophylactic antibiotic therapy should be given in case of cholangitis, anticipated incomplete biliary drainage, primary sclerosing cholangitis (PSC), in patients after liver transplantation, in severely immunocompromised patients and in case of cholangioscopy. (Recommendation Grade B)

6. The number of cannulation attempts should be kept as low as possible. (Recommendation Grade B)

7. Guidewire-assisted cannulation techniques should be preferred over the contrast-assisted method since it reduces the rate of post ERCP pancreatitis. (Recommendation Grade B)

8. We recommend the use of mixed current for sphincterotomy, as this decreases the risk of bleeding. (Recommendation Grade B)

9. Endoscopic balloon dilatation is not recommended as an alternative to sphincterotomy in routine ERCP but can be used after a sphincterotomy to enable the removal of large stones. (Recommendation Grade B)

10. If cannulation is difficult, an early precut sphincterotomy should be considered to reduce the risk of post ERCP pancreatitis. (Recommendation Grade B)

11. If a precut sphincterotomy has to be performed and pancreatic cannulation is easily obtained, the placement of a 5F plastic stent is recommended to guide the cut. (Recommendation Grade B)

Methodology

This expert opinion statement on behalf of the Swiss Society of Gastroenterology has been created by a national collaboration among an expert panel of swiss gastroenterologists in the field of endoscopy. The recommendations are mainly based on three clinical guidelines of the European Society of Gastrointestinal Endoscopy (ESGE). "Papillary cannulation and sphincterotomy techniques at ERCP 2016"[1], "Prophylaxis of post-ERCP pancreatitis updated 2014"[2] and "ERCP-related adverse events" 2020[3] and the guideline of the American Society for Gastrointestinal Endoscopy (ASGE) "Adverse events associated with ERCP" 2017[4]. Recent data covering hydration therapy in the prophylaxis of post ERCP pancreatitis and a very recent meta-analysis covering endoscopic papillary balloon dilatation are also considered in this guideline.

The GRADE system is used for rating the quality of evidence.

High quality evidence: Recommendation Grade A

Evidence comes from one or more well-designed and well-executed randomized controlled trials (RCTs) that yield consistent and directly applicable results. Further research is very unlikely to change our confidence in the estimate of effect.

Moderate quality evidence: Recommendation Grade B

Evidence comes from randomized controlled trials with important limitations and a very small number of participants, well-designed controlled trials without randomization, well-designed cohort or case-control studies, and multiple time series with or without intervention. Further research will probably have an important impact on our confidence in the estimate of effect and may change the estimate.

Low quality evidence: Recommendation Grade C

Evidence comes from observational studies. Further research is very likely to have an important impact on our confidence in the estimate of effect and will probably change the estimate.

Very low quality evidence: Recommendation Grade D

Evidence is conflicting, of poor quality, or lacking, and hence the balance of benefits and harms cannot be determined. Any estimate of effect is very uncertain as evidence is either unavailable or does not permit a conclusion.

1. Introduction

Since its introduction in 1968, ERCP has evolved from a diagnostic to a mainly therapeutic procedure. The clinical appropriateness of ERCP has become one of the main issues considering the rising performance of imaging modalities such as endoscopic ultrasound (EUS) and magnetic resonance cholangiopancreatography (MRCP). The considerable morbidity of the ERCP procedure requires a critical appraisal of its indications.

2. Indications and timing of ERCP

The ERCP indication is provided if a therapeutic intervention appears likely. Diagnostic ERCPs must be avoided, in favor of endoscopic ultrasound and magnetic resonance cholangiopancreatography. Common indications for ERCP are cholangitis, choledocholithiasis (symptomatic or asymptomatic), benign or malignant biliary obstructions and bile leaks.

2.1. Common bile duct stones (Figure 1)

Patients with a serum total bilirubin > 68 umol/l, ascending cholangitis or a common bile duct stone on transabdominal ultrasound are considered high risk for common bile duct stones and direct referral for ERCP is recommended.

In patients with an intermediate risk endoscopic ultrasound and magnetic resonance cholangiopancreatography can clarify indications for ERCP. Both examinations have excellent diagnostic accuracy for common bile duct stones, with endoscopic ultrasound providing a higher detection rate of small prepapillary stones[5]. Regardless of the modality selected, a multidisciplinary approach (endoscopist, radiologist, surgeon) is critical in the management of patients with suspected common bile duct stones to allow avoidance of unnecessary ERCPs with their associated adverse events. In case of cholecystectomy in presence of additional common bile duct stones intraoperative ERCP in rendezvous technique can be considered since being very safe and efficient[6].

2.2. Cholangitis

Cholangitis is clinically diagnosed by the presence of jaundice, fever and right upper quadrant abdominal pain (Charcot's triad).

The revised Tokyo Guideline[8] classifies acute cholangitis as **severe** (organ dysfunction of one of the following: cardiovascular, neurological, respiratory, renal, hepatic, **moderate** (any of the following: fever > 39 °C, white blood cell count > 12,000 or < 4,000/mm³, age > 75y, total bilirubin > 85umol/l, hypoalbuminemia) and **mild** (no criteria of severe or moderate cholangitis).

We recommend the following timing for biliary drainage according to the severity of cholangitis:

- severe: as soon as possible and within a maximum of 12 hours
- moderate and mild: within 48–72 hours

2.3. Biliary pancreatitis

A biliary cause of acute pancreatitis is likely if the alanine aminotransferase level is at least three times the upper limit of the normal range (positive predictive value of 95%)[9]. Indications for ERCP in suspected biliary pancreatitis are not clearly established. Due to the fact that most stones in patients with biliary pancreatitis pass the papilla spontaneously, ERCP should be performed in patients with concomitant cholangitis, a stone within the common bile duct detected on imaging, a persistent biliary (stone) obstruction marked by elevation of bilirubin > 68umol/l (4mg/dl) on day 2[10] or deterioration of the patient[11]. In patients with an intermediate risk for persistent common bile duct stones (Figure 1) endoscopic ultrasound can rule out a persistent stone and avoid unnecessary ERCP. If cholecystectomy after biliary pancreatitis can't be performed for comorbidity reasons, a sphincterotomy can reduce the risk of recurrent acute biliary pancreatitis[12].

Low risk (0–5%)	Intermediate risk (> 5–50%)	High risk (> 50%)
Normal liver function tests Normal bile duct size on abdominal ultrascund	Age > 55y Cholecystitis Dilated bile duct > 6mm Bilirubin level 31–67umol/l Abnormal liver tests other than Bilirubin	Cholangitis Stone detected on imaging Persistent billary obstruction (Bilirubin level > 68umol/l)
No further evaluation	**First-line EUS or MRCP**	**First -line ERCP**

Figure 1: Indications for EUS/MRCP and ERCP in patients with suspected choledocholithiasis[7]

2.4. Biliary obstruction due to pancreatic cancer

In patients with resectable pancreatic cancer of the head with biliary obstruction (bilirubin 40–250umol/l) routine preoperative biliary drainage increases the rate of complications[13]. Therefore, ERCP should be avoided in these patients if surgical resection can be performed within 7–10 days, as long as there are no signs of cholangitis. Preoperative biliary drainage may also be indicated in case of severe symptomatic jaundice (intense pruritus) and before neoadjuvant chemotherapy in jaundiced patients.

2.5. Sphincter of Oddi Dysfunction

Patients with a suspected dysfunction of the sphincter of Oddi type III (biliary pain with normal bilirubin and lipase levels and liver tests and no dilation of the biliary or pancreatic duct on imaging) should not undergo ERCP.

3. Prevention and Management of complications in ERCP

3.1. Post ERCP pancreatitis

Post ERCP pancreatitis (defined as new or worsened abdominal pain combined with > 3 times the normal value of amylase or lipase at more than 24 hours after ERCP) occurs in 3–10% of patients in systematic reviews, most episodes are mild with a mortality rate of 0.7%[14]. A transient asymptomatic lipasemia occurs in up to 75% of patients after ERCP regardless of symptoms. A serum amylase level < 1.5 times upper limit of normal 4 hours after ERCP makes subsequent post ERCP pancreatitis unlikely[15].

3.1.1. Risk factors for post ERCP pancreatitis

Patient-related risk factors for post ERCP pancreatitis include younger age, female gender, normal bilirubin level, non-dilated bile ducts, PEP in the personal history as well as pregnancy. Chronic pancreatitis has a protective effect on post ERCP pancreatitis.

Procedure-related risk factors for post ERCP pancreatitis include difficult cannulation (repetitive cannulation attempts for > 5min, > 5 attempts, more than one pancreatic duct cannulation), wire cannulation and injection of contrast medium into the main pancreatic duct and balloon dilatation of an intact sphincter. Case volume and experience are the main **investigator-dependent factors** for post ERCP pancreatitis. (Table 1)

Independent risk factors for post-ERCP pancreatitis	Odds ratios
Patient-related definite risk factors	
Previous post-ERCP pancreatitis	3.23–8.7
Female sex	1.4–2.23
Previous pancreatitis	2.00–2.9
Suspected sphincter of Oddi dysfunction	2.04–4.37
Patient-related likely risk factors	
Non dilated extrahepatic bile duct	3.8
Younger patient age (< 35 years old)	1.59–2.87
Absence of chronic pancreatitis	1.87
Normal serum bilirubin	1.89
End stage renal disease	1.7
Procedure-related definite risk factors	
Difficult cannulation	1.76–14.9
Pancreatic guidewire passage > 1	2.1–2.77
Pancreatic injection	1.58–2.27
Procedure-related likely risk factors	
Precut sphincterotomy	2.11–3.1
Intraductal ultrasound	2.41
Failure to clear bile duct stones	4.51
Pancreatic sphincterotomy	1.23–3.07
Large balloon dilation of an intact sphincter	4.51

Table 1. Independent risk factors for post-ERCP pancreatitis[1, 3]

3.1.2. Prevention of post ERCP pancreatitis

Pharmacological prophylaxis
Several meta-analyses of randomized trials[16,17] have shown that rectal administration of a non-steroidal anti-inflammatory drug (indomethacin 100mg, diclophenac 100mg) administered before or immediately after ERCP[18] significantly reduce the rate of post ERCP pancreatitis in low and high-risk patients[19]. Routine rectal administration of a non-steroidal anti-inflammatory drug should therefore be performed in all patients without contraindication. Bleeding rate and other complications are not affected by rectal NSAIDs. (Recommendation Grade B)

Prophylactic pancreatic duct stent placement
Several randomized trials and meta-analyses have proven a reduction of incidence and severity of post ERCP pancreatitis performing prophylactic pancreatic duct stenting finding a number needed to treat of 8 to avoid one episode of pancreatitis[20]. Especially in patients at high risk for a post ERCP pancreatitis (one definite or two likely patient or procedure related risk factors), a pancreatic stent can be placed. 5F stents are superior to 3F stents. Passage of the pancreatic duct stent should be evaluated within 5 to 10 days of placement using abdominal X-ray. Retained stents should be removed endoscopically. (Recommendation Grade A)

Nevertheless the study of Choksi et al. reported that in those patients in whom pancreatic duct stenting was unsuccessful, 35% developed a post ERCP pancreatitis, but when a rectal non-steroidal anti-inflammatory drug was given the rate of post ERCP pancreatitis was only 5%[21].The combination of rectal non-steroidal anti-inflammatory drugs and placement of a pancreatic stent did not show to be superior to either approach alone[22].

Hydration

Vigorous hydration with lactated Ringer's solution before, during and after ERCP can significantly lower the rate of post ERCP pancreatitis. Lactated Ringer's solution 3mL/kg/h during ERCP, a 20ml/kg bolus and 3ml/kg/h for 8 hours after ERCP showed a post ERCP pancreatitis rate of 3% vs 11.6% compared to standard hydration in a randomized controlled trial[23]. Hydration therapy is recommended in cases of contraindication for pharmacological prophylaxis with rectal non-steroidal anti-inflammatory drug. (Recommendation Grade B)

Sublingual Nitrates

In patients with contraindication to NSAIDs and to aggressive hydration we suggest the administration of 5mg of sublingual glyceryl trinitrate before ERCP. An updated meta-analysis[24] (11 RCTs with 2095 patients) showed a reduction in the overall incidence of post ERCP pancreatitis but not of moderate to severe PEP. (Recommendation Grade B)

In a recent study the combination therapy with rectal Diclofenac and sublingual nitrates has been shown to be superior to rectal Diclofenac alone in preventing post ERCP pancreatitis (5.6% vs. 9.5%, p=0.03)[25]. However more evidence is needed on this combination treatment.

3.2. Cannulation technique, sphincterotomy and papillary balloon dilatation

The guidewire-assisted technique for primary biliary cannulation should be the standard of care since it is associated with a lower rate of post ERCP pancreatitis compared to the contrast-assisted method[26].The number of cannulation attempts should be kept as low as possible. More than 10 attempts to cannulate the papilla have been shown to be an independent risk factor for post ERCP pancreatitis[27].

Sphincterotomy with pure cutting current is associated with a higher bleeding rate, compared to mixed current, but with an equal rate of post ERCP pancreatitis. Therefore, mixed current should be used.

Papillary balloon dilatation

Endoscopic papillary balloon dilatation (balloons up to 10mm) is not recommended as an alternative to sphincterotomy in routine ERCP since it increases the rate of post ERCP pancreatitis[28]. On the other hand, a very recent meta-analysis[29] showed that endoscopic balloon dilatation of an intact sphincter (using balloons > 10mm) is as effective as sphincterotomy in terms of stone clearance and need for endoscopic mechanical lithotripsy, without harboring an increased risk for pancreatitis. If a small sphincterotomy is combined with a balloon dilatation in biliary stone patients, pancreatitis rate seems not to be increased[30], therefore being an alternative to above mentioned routine approaches.

Precut techniques

In cases of difficult biliary cannulation (defined by > 5min, > 5 attempts or more than one pancreatic duct cannulation) early precut can lead to a reduction of the post ERCP pancreatitis rate[31]. Various precut techniques are described, including fistulotomy (starting directly over the roof of the papilla), standard needle knife papillotomy (beginning at the orifice), the transpancreatic precut sphincterotomy and the needle knife papillotomy assisted by pancreatic stenting. In a small retrospective study comparing different precut techniques the risk of post ERCP pancreatitis was significantly lower after fistulotomy (2.6%) compared to conventional precut (20.9%) and transpancreatic precut (22.4%)[32]. If access to the pancreatic duct is easily obtained or the pancreatic duct was cannulated at least 2 times in attempt to intubate the common bile duct, we recommend the placement of a pancreatic stent prior to the precut to guide the cut. The biliary cannulation rate with this pancreatic stent assisted technique has shown to be significantly higher than with conventional needle knife precut technique (96.9% vs 86.1%)[33] and is associated with a lower complication rate. The pancreatic stent should be left in place for 7–10 days, which reduces the incidence and severity of post ERCP pancreatitis[34] (Recommendation Grade B). In patients with a small papilla, which is difficult to cannulate, transpancreatic biliary sphincterotomy can be considered, if unintentional insertion of a guidewire into the pancreatic duct occurs. In patients who have had transpancreatic sphincterotomy, prophylactic pancreatic stenting should be performed (Recommendation Grade B). All precut techniques mentioned above should be performed by experienced endoscopists who achieve a selective biliary cannulation rate of at least 90% using standard cannulation techniques (Recommendation Grade C).

3.3. Post sphincterotomy bleeding

Post sphincterotomy bleeding occurs in about 0.3–2%[35]. Bleeding can be immediate or delayed (hours to days after sphincterotomy).

Risk factors for post sphincterotomy bleeding
Coagulopathy, active cholangitis, anticoagulation within 3 days after ERCP and bleeding already during the intervention are risk factors for bleeding. Precut sphincterotomy and the use of pure cutting current are also associated with a higher bleeding rate. NSAIDs and Aspirin do not increase the bleeding rate and can be administered before, during or after the intervention[36].

Prevention of post sphincterotomy bleeding
Unnecessary sphincterotomies should be avoided in patients with one or more risk factors for a post sphincterotomy bleeding. Endoscopic large balloon dilatation without sphincterotomy is associated with a lower rate of bleeding[37], but with an increased risk of pancreatitis[38]. Therefore it should be reserved for patients with a significantly increased risk of bleeding. The use of mixed current decreases the risk of post sphincterotomy bleeding[39]. A randomized trial of 120 patients found that prophylactic injection of hypertonic saline-epinephrine solution (1mL of 3.65% hypertonic saline solution with 0.005% epinephrine) oral to the papilla lowers the risk of post ERCP bleeding[40]. This measure can be considered in patients at risk for a post sphincterotomy bleeding.

Management of post sphincterotomy bleeding
Injection of epinephrine 1:10.000 around the sphincterotomy is effective in most cases[41] and first choice in managing a post sphincterotomy bleeding. In addition bipolar coagulation, argon plasma coagulation alone or in combination with adrenaline injection can be used. Temporary balloon tamponade can be helpful to control an intraprocedural bleeding. The use of fully covered metal stents has shown excellent results, especially in situations with refractory or major bleeding[42]. These stents are also effective to control bleeding in the preampullary and distal part of the choledochal duct. Angiographic coiling and surgery are equally effective in treating refractory bleeding[43], but are second choice due to their considerably higher morbidity compared to the endoscopic insertion of a fully covered metal stent.

3.4. Infections after ERCP

Cholangitis
Cholangitis and sepsis occur in 0.5–3% after ERCP. Routine antibiotic prophylaxis is not recommended for ERCP in unselected patients, as prophylactic antibiotics do not significantly reduce the rate of cholangitis in this setting[44]. In patients with anticipated incomplete biliary drainage (primary sclerosing cholangitis, hilar tumors), severe immunosupression, after liver transplantation and in patients undergoing cholangioscopy antibiotic prophylaxis is recommended[45] (Recommendation Grade B). Antibiotics that cover the biliary flora such as enteric gram-negative organisms and enterococci should be used and continued after the procedure if biliary drainage stays incomplete after ERCP.

Cholecystitis
Post ERCP cholecystitis rarely occurs. After the insertion of a fully covered metal stent cholecystitis occurs in about 1.9–12%[46] and is believed to occur as a result of cystic duct obstruction. Two meta-analyses reported similar incidence of cholecystitis between covered and uncovered stents[47]. The value of antibiotic prophylaxis in this context is not clearly clarified yet.

3.5. Perforation due to ERCP

A duodenal perforation occurs in 0.08–0.6% of ERCPs with a mortality rate of 8–23%. Perforations must promptly be diagnosed and treated in a multidisciplinary setting (endoscopist, radiologist, surgeon). Signs of peritonitis usually develop 4–6 hours after perforation.

Risk factors for perforation
Female gender, older age, sphincter of Oddi dysfunction type III, postoperative condition with altered anatomy and duodenal diverticula are **patient-related risk factors**. Difficult cannulation, intramural contrast injection, long-lasting examination, sphincterotomy (with or without precut) are the most important **intervention-related risk factors**.

Classification and management of perforations
If a perforation is suspected immediate antibiotic therapy should be started and an abdominal CT-scan (with oral and intravenous contrast) should be performed.

If there are no signs of peritonitis or systemic inflammation, a conservative approach can be justified in close clinical follow up in a multidisciplinary team consisting of gastroenterologist, radiologist and surgeon (Recommendation Grade C).

Type I: Perforation of the duodenal wall through the duodenoscope
Previously surgically occluded, nowadays these lesions can be treated endoscopically using endoclips, over the scope clips (OTSC) or other endoscopic methods[48] with a close clinical follow-up. Usually an antibiotic therapy is given to these patients.

Type II: Periampullary perforation of the medial duodenal wall by sphincterotomy
The incidence of these lesions can be minimized by limiting the length of the cutting wire, which gets into contact with the tissue and by performing stepwise cutting.

If such a lesion is detected during ERCP, it should be treated immediately endoscopically. The insertion of a FCSEMS to seal the perforation and divert biliary content is a simple but very effective first line treatment [49] and represents the method of choice. These stents should be left in place for about 4 weeks.

Type III: Lesions of the biliary tract or pancreatic duct by guidewire manipulation
These lesions are difficult to recognize, tend to be small and likely to heal spontaneously. Therapeutically, these lesions can be treated by stenting, if necessary at all.

Type IV: Diminutive retroperitoneal perforations without significance
They result from excessive insufflation during endoscopy together with sphincter manipulation. These perforations can be treated purely by observation, if the patient stays asymptomatic. An antibiotic therapy is usually given.

4. Performance measures for ERCP

The European Society for Gastrointestinal Endoscopy (ESGE) and United European Gastroenterology (UEG) recently published a paper on performance measures for endoscopic ultrasound and ERCP [50]. Concerning ERCP the following key performance quality measures should be reached:

1. Antibiotic prophylaxis before ERCP at least 90% if indicated
2. Bile duct cannulation rate at least 90%
3. Appropriate stent placement in patients with biliary obstruction below the hilum in at least 95% of the interventions
4. Bile duct stone extraction in at least 90%
5. Post-ERCP pancreatitis less than 10%

The implementation of performance measures in ERCP is important to identify institutions and individual endoscopists with lower performance levels with the aim to improve their skills, ameliorating the quality of endoscopy especially in advanced procedures such as ERCP with its relevant complication risk.

5. Comparison of recommendations of international guidelines on ERCP

Table 2 compares main recommendations of the American Society for Gastrointestinal Endoscopy (ASGE) and the European Society for Gastrointestinal Endoscopy (ESGE).

Topic	ASGE [4]	ESGE [2]
Prevention of post-ERCP pancreatitis	Rectal NSAID in high risk individuals without contraindication Pancreatic duct stenting in high risk individuals Periprocedural hydration with lactated ringers solution	Rectal NSAID in all patients without contraindication Pancreatic duct stenting in high risk individuals
Antibiotic Prophylaxis	Possibility of incomplete biliary drainage (i.e. PSC), patients after liver transplantation	Biliary occlusion, pancreatic pseudocyst, previous cholangitis, therapeutic ERCP
Cannulation technique	Guidewire assisted technique	Guidewire assisted technique
Papillary balloon dilatation of an intact sphincter	Not recommended	Not recommended
Difficult biliary cannulation	Early precut	Early precut
Current used for sphincterotomy	Mixed current	Mixed current

Table 2: Comparison of recommendations of international societies for gastrointestinal endoscopy

Other societies do not support any detailed technical recommendations for ERCP.

6. Discussion

Aim of this expert opinion statement is to concisely sum up international guidelines in the field of ERCP and to provide swiss endoscopists with an update on the most important points of these recommendations. ERCP is an endoscopic intervention with relevant morbidity even in institutions with a high case volume. Therefore national and international guidelines are essential to prevent adverse events and give a clear guidance how to manage complications. This expert opinion statement on behalf of the Swiss Society of Gastroenterology (SGG-SSG) brings together state of the art knowledge, incorporating statements of international guidelines of the ESGE und ASGE as well as recently published data concerning technical und practical issues in ERCP. It is a compact and concise manual for endoscopists performing ERCP in their daily practice.

1 Testoni Pier Alberto Mariani A, Aabakken L, Arvanitakis M, Bories E, Costamagna G, Devière J, Dinis-Ribeiro M, Dumonceau JM, Giovannini M, Gyokeres T, Hafner M, Halttunen J, Hassan C, Lopes L, Papanikolaou IS, Tham TC, Tringali A, van Hooft J, Williams EJ. Papillary cannulation and sphincterotomy techniques at ERCP: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. Endoscopy 2016 2016 Jul;48(7):657-83.

2 Dumonceau JM, Andriulli A, Elmunzer BJ, Mariani A, Meister T, Deviere J, Marek T, Baron TH, Hassan C, Testoni PA, Kapral C. Prophylaxis of post-ERCP pancreatitis: European Society of Gastrointestinal Endoscopy (ESGE) Guideline – Updated June 2014. Endoscopy 2014 2014 Sep;46(9):799-815.

3 Dumonceau JM, Kapral C, Aabakken L, Papanikolaou IS, Tringali A, Vanbiervliet G, Beyna T, Dinis-Ribeiro M, Hritz I, Mariani A, Paspatis G, Radaelli F, Lakhtakia S, Veitch AM, van Hooft JE. ERCP-related adverse events: European Society of Gastrointestinal Endoscopy (ESGE) Guideline. Endoscopy 2020 Feb 2020 Feb;52(2):127-149.

4 ASGE Standards of practice committee, Chandrasekhara V, Khashab MA, Muthusamy VR, Acosta RD, Agrawal D, Bruining DH, Eloubeidi MA, Fanelli RD, Faulx AL, Gurudu SR, Kothari S, Lightdale JR, Qumseya BJ, Shaukat A, Wang A, Wani SB, Yang J, DeWitt JM. Adverse events associated with ERCP. Gastrointestinal Endoscopy 2017 Jan;85(1):32-47.

5 Meeralam Y, Al-Shammari K, Yaghoobi M. Diagnostic accuracy of EUS compared with MRCP in detecting choledocholithiasis: a meta-analysis of diagnostic test accuracy in head-to-head studies. Gastrointest Endosc 2017 Dec;86(6):986-993.

6 Gurusamy K, Sahay SJ, Burroughs AK, Davidson BR. Systematic review and meta-analysis of intraoperative versus preoperative endoscopic sphincterotomy in patients with gallbladder and suspected common bile duct stones. British Journal of Surgery 2011 Jul;98(7):908-16.

7 Frossard JL, Morel PM. Detection and management of bile duct stones. Gastrointest Endosc. 2010 Oct;72(4):808-16.

8 Kiriyama S, Kozaka K, Takada T, Strasberg SM, Pitt HA, Gabata T, Hata J, Liau KH, Miura F, Horiguchi A, Liu KH, Su CH, Wada K, Jagannath P, Itoi T, Gouma DJ, Mori Y, Mukai S, Giménez ME, Huang WS, Kim MH, Okamoto K, Belli G, Dervenis C, Chan ACW, Lau WY, Endo I, Gomi H, Yoshida M, Mayumi T, Baron TH, de Santibañes E, Teoh AYB, Hwang TL, Ker CG, Chen MF, Han HS, Yoon YS, Choi IS, Yoon DS, Higuchi R, Kitano S, Inomata M, Deziel DJ, Jonas E, Hirata K, Sumiyama Y, Inui K, Yamamoto M. Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholangitis (with videos). J Hepatobiliary Pancreat Sci 2018 Jan;25(1):41-54.

9 Tenner S, Dubner H, Steinberg W. Predicting gallstone pancreatitis with laboratory parameters: a meta-analysis. Am J Gastroenterol 1994 Oct;89(10):1863-6.

10 Chang L, Lo SK, Stabile BE, Lewis RJ, de Virgilio C. Gallstone pancreatitis: a prospective study on the incidence of cholangitis and clinical predictors of retained common bile duct stones. Am J Gastroenterol 1998 Apr;93(4):527-31.

11 Fogel EL Sherman S.ERCP for Gallstone pancreatitis. New England Journal of Medicine 2014 Jan 9;370(2):150-7.

12 Ridtitid W, Kulpatcharapong S, Piyachaturawat P, Angsuwatcharakon P, Kongkam P, Rerknimitr R. The impact of empiric endoscopic biliary sphincterotomy on future gallstone-related complications in patients with non-severe acute biliary pancreatitis whose cholecystectomy was deferred or not performed. Surg Endosc. 2018 Dec 7.

13 Van der Gaag NA, Rauws EA, van Eijck CH, Bruno MJ, van der Harst E, Kubben FJ, Gerritsen JJ, Greve JW, Gerhards MF, de Hingh IH, Klinkenbijl JH, Nio CY, de Castro SM, Busch OR, van Gulik TM, Bossuyt PM, Gouma DJ. Preoperative biliary drainage for cancer of the Head of the pancreas. N Engl J Med 2010 Jan 14;362(2):129-37.

14 Kochar B, Akshintala VS, Afghani E, Elmunzer BJ, Kim KJ, Lennon AM, Khashab MA, Kalloo AN, Singh VK. Incidence, severity and morality of post ERCP pancreatitis: a systematic review by using randomised controlled trials. Gastrointest Endosc 2015 Jan;81(1):143-149.

15 Thomas PR, Sengupta S. Prediction of pancreatitis following endoscopic retrograde cholangiopancreatography by the 4-h post procedure amylase level. J Gastroenterol Hepatol 2001 Aug;16(8):923-6.

16 Sun HL, Han B, Zhai HP, Cheng XH, Ma K.Rectal NSAIDs for the prevention of post- ERCP pancreatitis: A meta-analysis of randomized controlled trials. Surgeon 2014 Jun;12(3):141-7.

17 Dai HF[1], Wang XW, Zhao K. Role of nonsteroidal anti-inflammatory drugs in the prevention of post-ERCP pancreatitis: a meta-analysis. Hepatobiliary Pancreat Dis Int 2009 Feb;8(1):11-6.

18 Sethi S, Sethi N, Wadhwa V, Garud S, Brown A. A meta-analysis on the role of rectal diclofenac and indomethacin in the prevention of post-endoscopic retrograde cholangiopancreatography pancreatitis. Pancreas 2014 Mar;43(2):190-7.

19 Yaghoobi M, Rolland S, Waschke KA, McNabb-Baltar J, Martel M, Bijarchi R, Szego P, Barkun AN. Meta-analysis: rectal indomethacin for the prevention of post-ERCP pancreatitis. Aliment Pharmacol Ther 2013 Nov;38(9):995-1001.

20 Choudhary A[1], Bechtold ML, Arif M, Szary NM, Puli SR, Othman MO, Pais WP, Antillon MR, Roy PK. Pancreatic stents for prophylaxis against post-ERCP pancreatitis: a metanalysis systematic review. Gastrointest Endosc 2011 Feb;73(2):275-82.

21 Choksi NS, Fogel EL, Cote GA, Romagnuolo J, Elta GH, Scheiman JM, Chak A, Mosler P, Higgins PD, Korsnes SJ, Schmidt SE, Sherman S, Lehman GA, Elmunzer BJ. The risk of post-ERCP pancreatitis and the protective effect of rectal indomethacin in cases of attempted but unsuccessful prophylactic pancreatic stent placement. Gastrointest Endosc. 2015 Jan;81(1):150-5.

22 Akbar A[1], Abu Dayyeh BK, Baron TH, Wang Z, Altayar O, Murad MH. Rectal nonsteroidal anti-inflammatory drugs are superior to pancreatic duct stents in preventing pancreatitis after endoscopic retrograde cholangiopancreatography: a network meta-analysis. Clin Gastroenterol Hepatol. 2013 Jul;11(7):778-83.

23 Park CH, Paik WH, Park ET, Shim CS, Lee TY, Kang C, Noh MH, Yi SY, Lee JK, Hyun JJ, Lee JK. Aggressive intravenous hydration with lactated Ringer's solution for prevention of post-ERCP pancreatitis: a prospective randomized multicenter clinical trial. Endoscopy 2018 Apr;50(4):378-385.

24 Ding J, Jin X, Pan Y et al. Glyceryl trinitrate for prevention of post ERCP pancreatitis and improve the the rate of cannulation: a meta tanalysis of prospective, randomized controlled trials. Plos ONE 2013;8:e75645

25 Tomoda T, Kato H, Ueki T, Akimoto Y, Hata H, Fujii M, Harada R, Ogawa T, Wato M, Takatani M, Matsubara M, Kawai Y, Okada H. Combination of Diclofenac and Sublingual Nitrates Is Superior to Diclofenac Alone in Preventing Pancreatitis After Endoscopic Retrograde Cholangiopancreatography. Gastroenterology. 2019 May;156(6):1753-1760.

26 Tse F[1], Yuan Y, Moayyedi P, Leontiadis GI. Guidewire-assisted cannulation for the prevention of post-ERCP pancreatitis: a systematic review and meta-analysis. Endoscopy 2013 Aug;45(8):605-18.

27 Testoni PA[1], Mariani A, Giussani A, Vailati C, Masci E, Macarri G, Ghezzo L, Familiari L, Giardullo N, Mutignani M, Lombardi G, Talamini G, Spadaccini A, Briglia R, Piazzi L; SEIFRED Group. Risk factors for post-ERCP pancreatitis in high- and low-volume centers and among expert and non expert operators: a prospective multicenter study. Am J Gastroenterol 2010 Aug;105(8):1753-61.

28 Weinberg BM, Shindy W, Lo S. Endoscopic balloon sphincter dilation (sphincteroplasty) versus sphincterotomy for common bile duct stones. Cochrane Database Syst Rev 2006 Oct 18;(4).

29 Tringali A, Rota M, Rossi M, Hassan C, Adler DG, Mutignani M. A cumulative meta-analysis of endoscopic large balloon dilatation versus endoscopic sphincterotomy for removal of common bile duct stones. Endoscopy 2019 Jun;51(6):548-559.

30 Park JS, Jeong S, Lee DK, Jang SI, Lee TH, Park SH, Hwang JC, Kim JH, Yoo BM, Park SG, Lee DH. Comparison of endoscopic papillary large balloon dilation with or without endoscopic sphincterotomy for the treatment of large bile duct stones. Endoscopy 2019 Jan 9;15:91-101.

31 Mariani A, Di Leo M, Giardullo N, Giussani A, Marini M, Buffoli F, Cipolletta L, Radaelli F, Ravelli P, Lombardi G, D'Onofrio V, Macchiarelli R, Iiritano E, e Grazie M1, Pantaleo G, Testoni PAEarly precut sphincterotomy for difficult biliary access to reduce post-ERCP pancreatitis: a randomized trial. Endoscopy 2016 Jun;48(6):530-5.

32 Katsinelos P[1], Gkagkalis S, Chatzimavroudis G, Beltsis A, Terzoudis S, Zavos C, Gatopoulou A, Lazaraki G, Vasiliadis T, Kountouras J. Comparison of three types of precut technique to achieve common bile duct cannulation: a retrospective analysis of 274 cases. Dig Dis Sci 2012 Dec;57(12):3286-92.

33 Kubota K[1], Sato T, Kato S, Watanabe S, Hosono K, Kobayashi N, Hisatomi K, Matsuhashi N, Nakajima A. Needle-knife precut papillotomy with a small incision over a pancreatic stent improves the success rate and reduces the complication rate in difficult biliary cannulations. J Hepato- biliary Pancreat Sci 2013 Mar;20(3):382-8.

34 Cha SW, Leung WD, Lehman GA, Watkins JL, McHenry L, Fogel EL, Sherman S. Does leaving a main pancreatic duct stent in place reduce the incidence of precut biliary sphincterotomy-associated pancreatitis? A randomized prospective study. Gastrointest Endosc 2013 Feb;77(2):209-16.

35 Cotton PB[1], Garrow DA, Gallagher J, Romagnuolo J. Risk factors for complications after ERCP: a multivariate analysis of 11497 procedures over 12 years. Gastrointest Endosc 2009 Jul;70(1):80-8.

36 Freeman ML[1], Nelson DB, Sherman S, Haber GB, Herman ME, Dorsher PJ, Moore JP, Fennerty MB, Ryan ME, Shaw MJ, Lande JD, Pheley AM. Complications of endoscopic biliary sphincterotomy. N Engl J Med 1996 Sep 26;335(13).

37 Feng Y, Zhu H, Chen X, Xu S, Cheng W, Ni J, Shi R. Comparison of endoscopic papillary large balloon dilatation and endoscopic sphincterotomy for retrieval of choledocholithiasis: a meta-analysis of randomized controlled trials, J Gastroenterol 2012 Jun;47(6):655-63.

38 Tsujino T, Isayama H, Komatsu Y, Ito Y, Tada M, Minagawa N, Nakata R, Kawabe T, Omata M. Risk factors for pancreatitis in patients with common bile duct stones managed by endoscopic papillary large balloon dilatation. Am J Gastroenterol 2005.

39 Morris ML[1], Tucker RD, Baron TH, Song LM. Electrosurgery in gastrointestinal endoscopy: principles to practice. Am J Gastroenterol 2009.

40 Matsushita M, Takakuwa H, Shimeno N, Uchida K, Nishio A, Okazaki K. Prophylactic injection of hypertonic saline-epinephrine oral to the papilla for prevention of postsphincterotomy bleeding. J Clin Gastroenterol 2010.

41 Wilcox CM[1], Canakis J, Mönkemüller KE, Bondora AW, Geels W. Patterns of bleeding after endoscopic sphincterotomy, the subsequent risk of bleeding, and the role of epinephrine injection. Am J Gastroenterol 2004 Feb;99(2):244-8.

42 Itoi T[1], Yasuda I, Doi S, Mukai T, Kurihara T, Sofuni A. Endoscopic hemostasis using covered metallic stent placement for uncontrolled post-endoscopic sphincterotomy bleeding. Endoscopy 2011 Apr;43(4):369-72.

43 Dunne R[1], McCarthy E, Joyce E, McEniff N, Guiney M, Ryan JM, Beddy P Post-endoscopic biliary sphincterotomy bleeding: an interventional radiology approach. Acta Radiol 2013 Dec;54(10):1159-64.

44 Bai Y[1], Gao F, Gao J, Zou DW, Li ZS. Prophylactic antibiotics cannot prevent endoscopic retrograde cholangiopancreatography-induced cholangitis: a meta-analysis. Pancreas 2009 Mar;38(2):126-30

45 Cotton PB, Connor P, Rawls E, Romagnuolo J. Infection after ERCP and antibiotic prophylaxis: a sequential quality-improvement approach over 11 years. Gastrointest Endosc 2008 Mar;67(3):471-5.

46 Saxena P[1], Singh VK, Lennon AM, Okolo PI, Kalloo AN, Khashab MA. Endoscopic management of acute cholecystitis after metal stent placement in patients with malignant biliary obstruction: a case series. Gastrointest Endosc 2013 Jul;78(1):175-8.

47 Saleem A[1], Leggett CL, Murad MH, Baron TH. Meta-analysis of randomized trials comparing the patency of covered and uncovered self expandable metal stents for palliation of distal malignant bile duct obstruction. Gastrointest Endosc 2011 Aug;74(2):321-327.

48 Jin YJ[1], Jeong S, Kim JH, Hwang JC, Yoo BM, Moon JH, Park SH, Kim HG, Lee DK, Jeon YS, Lee DH. Clinical course and proposed treatment strategy for ERCP-related duodenal perforation: a multicenter analysis. Endoscopy 2013 Oct;45(10):806-12.

49 Shi D, Yang JF, Liu YP. Endoscopic treatment of endoscopic retrograde cholangiopancreatography-related duodenal perforations. J Laparoendosc Adv Surg Tech A 2019; 29: 385-391.

50 Domagk D, Oppong KW, Aabakken L, Czakó L, Gyökeres T, Manes G, Meier P, Poley JW, Ponchon T, Tringali A, Bellisario C, Minozzi S, Senore C, Bennett C, Bretthauer M, Hassan C, Kaminski MF, Dinis-Ribeiro M, Rees CJ, Spada C, Valori R, Bisschops R, Rutter MD: Performance measures for ERCP and endoscopic ultrasound: a European Society of Gastrointestinal Endoscopy (ESGE) Quality Improvement Initiative. Endoscopy 2018 Nov;50(11):1116-1127.