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REVIEW

Endoscopic Management of Complications in Chronic Pancreatitis

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Abstract

Purpose of Review Management of complications in patients with chronic pancreatitis is often suboptimal. This review discusses detailed endoscopic approaches for managing complications in CP.

Literature Findings CP is characterized by progressive and irreversible destruction of pancreatic parenchyma and ductal system resulting in fibrosis, scarring, and loss of glandular function. Abdominal pain remains is the most common symptom of the disease and the main aim of medical, endoscopic, and surgical therapy is to help relieve symptoms, prevent disease progression, and manage complications related to CP. In fact, advances in our understanding of CP have improved medical care and quality of life in these patients. With significant sequela, morbidity and a progressive nature, a thorough understanding of the pathophysiology, natural course, diagnostic approaches, and optimal management strategies for this disease is warranted.

Summary The existing modalities and new innovations in this field are safe, effective, and likely to have a positive impact on management of complication in CP whenever used in the right context.

Keywords Chronic pancreatitis · Complications · Endoscopic therapy

Introduction

Chronic pancreatitis (CP) is a pathologic fibro-inflammatory syndrome of the pancreas in individuals with genetic, environmental and/or other risk factors who develop persistent pathologic responses to parenchymal stress or injury. Common characteristics of established and advanced disease include varying degrees of parenchymal inflammation, atrophy, fibrosis, duct alteration and strictures, calcifications, pancreatic exocrine and/or endocrine glandular destruction, and dysplasia [1, 2]. The disease manifests predominantly as

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disabling abdominal pain, with or without loss of exocrine and/or endocrine pancreatic function.

CP is multifactorial and often arises after repeated episodes of acute pancreatitis (AP) from different etiologies, persistent main pancreatic duct (MPD) obstruction, long-lasting exposure to toxins, an autoimmune insult or a genetically driven process. The discovery of cationic trypsinogen 1 and 2 (PRSS1/2), serine protease inhibitor Kazal type 1 (SPINK1), and cystic fibrosis transmembrane conductance regulator (CFTR) mutations indicated that hereditary pancreatitis as a cause CP used to be underestimated and the disease incidence is far more common than originally envisioned [3–7].

The key histopathologic features of the disease, regardless of the etiology, are varying degrees and combinations of fibrosis, acinar atrophy, chronic inflammatory infiltrate, and ductal system distortion and/or obstruction. Most patients are young males at disease manifestation, and cigarette-smoking in combination with excessive alcohol use are well-known independent risk factors that potentiate disease progression [8]. The diagnosis of CP is usually based on patient's symptoms, imaging findings, and relevant laboratory tests. However, patients with suspected CP may not have symptoms of pancreatic insufficiency or radiographic abnormalities during initial evaluations, making the diagnosis challenging [9, 10]. Pancreatic enzymes might be normal with progressive destruction of the gland, and direct testing of the pancreatic function with administration of the hormone secretin is only available at a few centers. Indirect assessment of pancreatic function using tests such as fecal elastase is another possible route to evaluate for pancreatic insufficiency, but the test accuracy is questionable. Imaging tools include computed tomography (CT), magnetic resonance cholangiopancreatography (MRCP), and endoscopic ultrasound (EUS), all of which can detect glandular atrophy, ductal dilation, and parenchymal calcifications [11]. However, the specificity and sensitivity of each in diagnosing CP is not well defined, given the difficulty of obtaining or the lack of histopathological correlation. Furthermore, the histological evidence of fibrosis and tissue loss, which can be considered as the most definitive diagnostic criteria, is either unavailable or inconclusive in early stages of the disease [12].

Chronic debilitating pain, diabetes mellitus, pancreatic pseudocysts, biliary strictures/obstruction, and pancreatic adenocarcinoma are the main causes of morbidity and mortality in CP. Pancreatic fluid collections and biliary obstruction occur at a rate of 20%–40% and 3–23%, respectively [13–17]. The disease is associated with substantial healthcare utilization and costs. In this article, we discuss various endoscopic methods for management of complications in patients with CP.

Global Management of CP

The management of CP patients has undergone significant evolvement over the past decade. The model strategy for successful outcomes includes accurate diagnosis, assessment of modifiable etiologies and symptom burden, and a multidisciplinary approach with close monitoring of therapeutic effects and complications.

The treatment of pain remains the greatest challenge in managing these patients, and it accounts for most CP-related health-care utilization, and lower social engagement and quality of life [18]. The first step in treating pain is to look for possible etiologies such as pancreatic pseudocysts, ductal strictures/stone, luminal obstruction, and cancer [19]. Endoscopic therapy assists with treating obstruction caused by strictures or stones in the MPD or the distal biliary tree, ductal disruption, and pseudocyst drainage [20–23]. Surgical resection and/or drainage is usually reserved for individuals who have failed medical and/or endoscopic therapy. Surgery is suitable for pain, local complications such as gastric, duodenal or biliary obstruction, and in certain patients with suspected pancreatic cancer [24, 25]. Total pancreatectomy with islet autotransplantation (TPIAT) is now a reliable therapy to retain pancreatic endocrine function, alleviate pain and improve quality of life in adult and pediatric patients suffering from CP and has been shown to have long-term success [26, 27].

Exocrine insufficiency most commonly develops after 5 to 10 years of CP, and treatment usually requires pancreatic enzyme replacement therapy (PERT) and supplementation with fat-soluble vitamins as appropriate [28]. Longstanding disease can also result in endocrine insufficiency manifested by a lack of insulin and other counter-regulatory islet hormones such as glucagon. The prevalence of diabetes mellitus among patients with CP is unknown, but diabetes and impaired glucose tolerance are observed in many, depending on the stage of disease. Additional complications that can occur in patients with CP and needs attention include mineral bone disease, pancreatic pseudocysts, and pancreatic cancer [29, 30].

Endoscopic Therapy for CP

Endoscopic therapy for CP is commonly indicated for symptomatic pseudocysts, intractable persistent pain that failed medical management, main pancreatic duct (MPD) stones and strictures, and biliary strictures [31]. The likelihood for successful treatment depends on several factors including patient's age, disease duration, nature of symptoms, and opioid dependency. Available modalities appear

Table 1 Indications and options of endoscopic therapy in chronic pancreatitis

Complication	Indications for intervention	Endoscopic therapy	Technical success (%)	Clinical success (%)
Pseudocysts	Large symptomatic pseudocysts; biliary, gastric outflow or duodenal obstruction; splanchnic vein thrombosis with left-sided portal hypertension; vascular compression	EUS-guided pseudocyst drainage via plastic or LAMS stents	> 90	75–90
		ERCP and transpapillary MPD stenting in patients with pseudocysts < 5 cm communicating with MPD, MPD stricture or leakage		
MPD stones	Intractable pain	ESWL & ERCP	70.7	54–86
		D-SOP with EHL/laser lithotripsy	90	65
		EUS-guided MPD drainage	90–100	82–92
MPD strictures	Intractable pain	ERCP and stenting for MPD	85–95	65–84
		EUS-guided access and drainage of an obstructed MPD	74	83
Biliary strictures	Obstructive jaundice and/or acute cholangitis, persistent cholestasis with ALP > 2–3 times ULN for ≥ 4 weeks even in asymptomatic patients	ERCP and stenting with multiple plastic or covered stents	92	48–71
Internal fistula	Persistent PD leak with pancreatic pleural effusion or ascites	ERCP with transpapillary MPD stenting	> 90	58
Isolated gastric or GE varices	Bleeding	Endoscopic variceal obturation	Not reported	Not reported
Persistent severe pain	Persistent pain that failed medical measures	EUS-guided celiac plexus block in patients who are not surgical candidates or have not responded to medical therapy, endotherapy, or ESWL	> 90	51–59

ALP Alkaline phosphatase, *D-SOP* Digital single-operator pancreatoscopy, *EHL* Electrohydraulic lithotripsy, *ERCP* Endoscopic retrograde cholangiopancreatography, *ESWL* Extracorporeal shock wave lithotripsy, *EUS* Endoscopic ultrasound, *GE* Gastroesophageal, *LAMS* Lumen apposing metal stents, *MPD* Main pancreatic duct, *ULN* Upper limit of normal

safe and effective in the right context and new innovations in this field continue to contribute toward better outcomes. Table 1 summarizes the indications for endoscopic interventions in individuals with CP.

Pancreatic Pseudocysts

A pseudocyst is a fluid collection enclosed by a wall of fibrous granulation tissue and occurs in 20% and 40% of patients with CP. Pseudocysts may communicate with the PD in up to 60% of cases [32]. Small (< 5 cm) asymptomatic and uncomplicated pseudocysts should not be drained, as symptoms and complications usually arise with collections greater than 5 cm in size [33, 34]. Endotherapy for pancreatic pseudocysts is guided by the presence of related symptoms or complications including pain; infection; biliary, gastric outflow or duodenal obstruction; rupture into the peritoneal cavity; pancreato-pleural fistula (PPF); vascular (portal or splenic vein) thrombosis leading to left-sided portal hypertension; or pseudoaneurysm formation. Hemorrhagic pseudocysts may need endovascular, surgical, or combined approach [35]. Studies comparing endoscopic to surgical drainage showed that both approaches provided no significant differences in mortality. However, endotherapy was superior in terms of short-term quality of life, hospital length of stay, adverse events rates, and cost [36–40]. A caveat with endoscopic drainage is that it may be less successful with infected pseudocysts [39].

Although pancreatic duct disruption is more common with walled-off necrosis, when present with pseudocysts, transpapillary drainage may be useful and increase chances of long-term success with EUS transmural drainage. The use of CT scans, MR cholangiopancreatography and/or EUS can delineate the PD anatomy, including the presence of disruption or stricture(s) [41, 42]. Endoscopic retrograde pancreatography (ERP) with pancreatic sphincterotomy, MPD stenting ideally across the disruption if possible, or a combination of both techniques can facilitate successful drainage. Drainage via this approach is associated with lower complications and has yielded success rates of nearly 90% of collections [43–46]. Small pseudocysts (< 5 cm in size) that communicate with the main PD could be treated with the transpapillary approach alone. Transluminal drainage is the

preferred technique if transpapillary drainage is not possible and for larger cysts as the associated gastric and/or duodenal compression usually makes endoscopic access difficult. The reported technical success rate is usually greater than 90% with a clinical success rate of 75–90% [47].

The use of EUS-guided drainage has mostly replaced conventional endoscopy and is recommended as a first-line treatment of accessible pseudocysts. EUS allows careful evaluation for blood vessels in the path of needle entry, close apposition of the cyst wall and gastric lumen, and lack of necrotic debris in the cavity. The technique involves establishing access from the stomach (trans-gastric) or the duodenum (trans-duodenal) and creation of cystogastrostomy or a cystoduodenostomy [48, 49]. After access has been established, two or more double pigtail plastic stents are usually placed to maintain patency of the fistulous tract. These stents are left in place until resolution of the collection(s) to avoid recurrence [50–52]. While the pigtail stents should remain for a minimum of 60 days, they can stay in place for longer periods or until spontaneous dislocation. Thicker, infected collections can be technically challenging and may not drain adequately through plastic stents [53, 54]. The use of lumen-apposing metal stents (LAMS) or fully covered self-expandable metal stents (FCSEMSs) may be favorable in thicker collections and walled-off necrosis (WON) [55–57]. LAMS offer a larger lumen that can be traversed with a gastroscope to mobilize the collection's contents if necessary [58–60]. In patients undergoing LAMS placement, early stent removal within a standardized time frame (usually 4 weeks) balances excellent clinical efficacy while minimizing the risk of severe delayed bleeding related to the stent [53, 54].

Common complications related to endoscopic drainage include bleeding from adjacent dilated vessels or pseudoaneurysms, perforation, and infection [61]. Careful review of imaging studies prior to the procedure and the use of EUS are important measures in preventing these complications. Antibiotic prophylaxis is recommended immediately before endoscopic drainage of sterile pancreatic fluid collections whether via transluminal or transpapillary approach. Further antimicrobial coverage should be based on the presence or absence of infected collections.

Pancreatic Duct Strictures

Benign strictures of the MPD occur as a result of inflammation or fibrosis in CP. Dilation of the MPD to more than 6 mm is considered an indicator of increased ductal and parenchymal pressure. Dominant MPD strictures are defined by the presence of an upstream MPD dilatation $\geq$ 6 mm in diameter, or prevention of contrast medium outflow alongside a 6-Fr catheter inserted upstream from the stricture. Refractory strictures are symptomatic dominant strictures that persist or relapse after 1 year of single pancreatic stent placement [62, 63]. The main purpose of ductal decompression is to relieve long-lasting pain and to avoid the need for opioids. Other beneficial effects such as preservation of pancreatic endocrine and exocrine function have not yet clearly been demonstrated [64].

Endoscopic therapy is successful in the majority of these patients and should be attempted as the first approach before surgical considerations. Predictors of successful outcomes include a short disease duration and a younger age [65]. Patients who smoke or drink alcohol should be informed of the additional value of discontinuing these substances.

The clinical response should be evaluated at 6–8 weeks; if it appears unsatisfactory, the patient should be discussed in a multidisciplinary team and surgical options should be considered. Both endoscopy and surgery have morbidity rates of 18–58% and mortality rates of 0–5%. The long-term pain relief ranges between 54 and 85% at 2–12 years [65, 66].

Most patients respond to treatment with dilation and pancreatic stent placement across the stricture. The choice of stent size depends on the caliber of the stricture, preferably 10Fr or larger sizes when a single stent is used, to avoid stent related pain and frequent hospitalizations [67]. Stents should be removed or exchanged on demand, preferably within 1 year. Criteria for treatment discontinuation are an adequate outflow of contrast medium and passage through the stricture of a 6-Fr catheter. Some experts favor the use of multiple plastic stents in patients with persistent pancreatic strictures or as a primary strategy to avoid blockage of side branches compared with using single larger-caliber stents [68]. While removable FCSEMS can be used for a short duration with good therapeutic outcomes, the risk of stent migration as well as de novo strictures arising at the proximal end of the stents preclude its use in CP [69]. Adverse events associated with endotherapy for PD strictures include pain, AP, stent occlusion and/or migration, infection, perforation, stone formation, and bleeding. Moreover, PD stents may result in periductal damage and scarring, new strictures or focal CP [61, 70, 71].

Complex cases that fail conventional endotherapy and are not appropriate candidates for surgery and patients with a surgically altered anatomy should be considered for EUS-guided drainage of the MPD. The technique consists of puncturing the MPD through the gastric or duodenal wall and advancing a guidewire into the MPD to proceed with transpapillary (rendezvous technique) or transmural drainage using a plastic stent. This intervention can be an effective option for pain control with an overall clinical success rate approaching 90% with a median stent patency of 6 months [72–79]. However, EUS-guided drainage of the MPD should only be performed at high-volume centers with expertise in these procedures to minimize adverse events such as bleeding, perforation and severe pancreatitis.

Pancreatic Stones

Pancreatic stones seem to arise as direct calcified stones or as radiolucent protein plugs that may or may not become calcified during the course of the disease [80]. Most pancreatic stones are calcified and radiopaque, and their prevalence increases with time reaching 50% at 5 years and 100% at 14 years from the onset of the disease.

Pancreatic endotherapy and/or extracorporeal shockwave lithotripsy (ESWL) are the two recommended first-line interventions for symptomatic PD stones with upstream obstruction. Endotherapy can be difficult given the underlying PD strictures or the difference between the size of the stone and the downstream PD. ESWL may be required to fragment stones before endoscopic removal is attempted. Successful fragmentation via ESWL has been defined as stones broken into fragments less than or equal 2 or 3 mm, or by the demonstration of decreased stone density at X-ray, increased surface, and heterogeneity of the stone which may fill the MPD and adjacent side branched ducts [81]. Ductal clearance has been defined as complete, partial, or unsuccessful if the proportion of stones cleared was > 90%, 50–90%, or < 50%, respectively [82].

The technical success of pancreatic sphincterotomy and stone extraction using a basket or a balloon with or without PD stenting is higher for small stones (< 4 mm) and strictures/stones in the head of the pancreas than the body or the tail. Other factors associated with long-term success of endoscopic therapy include shorter disease duration, complete clearance of the main PD, lack of associated stricture, and discontinuation of alcohol and smoking [83]. Several studies have demonstrated encouraging short-term (77–100%) and long-term (54–86%) improvement in pain after pancreatic endotherapy for CP [81, 84]. However, technical difficulties are usually encountered with larger stones (> 10 mm), diffuse location, stone impaction, and location upstream from a stricture [85, 86]. Endotherapy with basket stone extraction is discouraged for stones larger than 5 mm without prior ESWL given the higher risk of procedure failure and complications [81]. Endoscopic extraction is usually warranted for stone fragments after ESWL, which may require several sessions to obtain successful clearance of the duct [87]. The use of peroral pancreatoscopy (POP) with lithotripsy for stone clearance is a newer approach. Intraductal laser or electrohydraulic lithotripsy (EHL) is other options in these patients with success rates varying from 47 to 83% and should be considered after failed previous ESWL and ERP [88]. Pharmacological therapy to relieve the pain can be considered if endoscopic therapy and/or ESWL fail or are contraindicated with the final step being early surgery for non-responders.

Surgery has been shown to result in more durable pain relief than endoscopic therapy in patients with CP and PD obstruction in randomized trials. A study comparing surgery or endoscopy therapy found that surgery was associated with a higher complete pain relief (37% vs 14%), while rates were similar for partial pain relief (49% vs 51%; p value not significant) at 5-year follow-up. However, this study was criticized because of several limitations that may have influenced the outcomes [89, 90]. The recent ESCAPE trial also showed that in patients with CP, early surgery compared with an endoscopy-first approach to treatment resulted in lower pain scores when integrated over 18 months [91]. Given the increased risks associated with surgery, some experts recommend endotherapy as the preferred initial approach in centers with high-volume and expertise, reserving surgery for complex cases which failed endoscopic therapy, show recurrent symptoms, have coexisting pathology (mass, biliary or duodenal obstruction), and have concern for malignant obstruction. Direct pancreatoscopy during ERCP has reshaped the landscape of pancreatic stone treatment, and allows near or complete main duct pancreatic stone clearance in the majority of patients with one or even multiple obstructing pancreatic duct stones. The ESCAPE study did show that complete duct clearance of main PD stones in the endoscopic arm resulted in nearly identical outcomes as surgery. In the study, comparing endoscopy and surgery for pain relief in CP, complete ductal clearance was achieved in only 60% of cases. However, pancreatoscopy and intraductal lithotripsy were not used. Further studies comparing intraductal lithotripsy with other modalities are likely to show superior outcomes.

Celiac Plexus Block and Neurolysis

The celiac plexus of nerves transmits pain sensation for the pancreas and most of the abdominal viscera. The endoscopic route of this intervention involves EUS-guided delivery of a local anesthetic into the nerves supplying the nociceptive afferent signals from the pancreas. Celiac plexus block (CPB) is a transient interruption of the plexus by local anesthetic, while celiac plexus neurolysis (CPN) is prolonged interruption of the transmission of pain from the celiac plexus using chemical ablation. CPB is generally performed in the unilateral position, while CPN is performed in the unilateral or bilateral position. In selected patients, CPB has been associated with enhanced pain relief, less serious complications, and patient satisfaction [92, 93]. While the combination of local anesthetic and steroid is commonly employed, the literature demonstrated no additional benefit by adding steroid to local anesthetic. Diffuse injection of an anesthetic agent above the superior mesenteric vein

usually results in a favorable outcome but only lasts around 2–3 months with no clear benefit from repeated injections in those who do not respond to initial therapy.

A meta-analysis of EUS-guided CPB and CPN reported response rates of 59% in CP and 80% in pancreatic cancer; however, most of these patients continued to take analgesics [92, 94]. Most studies evaluating percutaneous CPB for controlling pain from CP have been small retrospective case series and have reported marginal benefit.

Related adverse effects may occur in up to 40% of patients, including transient worsening of pain, diarrhea, and hypotension [95]. For these reasons, the procedure should be restricted to selected, severe cases of CP with pain that is not controlled with other modalities.

Total Pancreatectomy and Islet Auto-Transplantation (TPIAT)

Pancreatectomy (even partial) with islet auto-transplantation should always be considered as a primary surgical option for CP with intractable pain refractory to medical and/or endoscopic therapy. Pain relief following surgery enables narcotic tapering or discontinuation in most patients, and the transplanted islets cells have been shown to safely prevent or minimize post-surgical diabetes. A local series from our center, extending back to 30 years, demonstrated that both goals can be achieved to a reasonable degree in CP patients who undergo TPIAT [96, 97]. Factors that may influence success of surgery include but are not limited to duration of chronic pancreatitis, type of medical and/or endoscopic interventions performed before surgery as well as opioid use and duration before surgery. A longstanding disease and/or high opioid use may contribute to central sensitization and opioid-induced hyperalgesia that could limit the benefit of TPIAT [98]. Furthermore, medical and psychological comorbidities such as gastroparesis, depression, and anxiety have been suggested as potential risk factors for poor outcomes [20, 98]. An ongoing multicenter study currently enrolls and follows TPIAT recipients, aiming to evaluate patient selection and timing for surgery to optimize pain relief and quality of life [96].

Biliary Strictures

In patients with CP, inflammatory edema, fibrosis, or a mass in the head of the pancreas can result in biliary obstruction from strictures. The prevalence ranges from 3 to 23%, with studies reporting rates as high as 46% [99]. Endoscopic drainage of the biliary tract is required in patients with persistent elevation of serum alkaline phosphatase (greater than > 2–3 times the upper limit of normal) and/or persistent cholestasis and advisable to avoid cholangitis, cholestatic liver damage and secondary biliary cirrhosis [100, 101]. However, before embarking on endoscopic therapy of a presumed CP-related biliary stricture, it is essential to evaluate for the presence of malignancy in patients with risk factors such as age above 50 years, females, white race, and those with hereditary pancreatitis [102]. Endoscopic evaluation should include brushings and/or biliary biopsy during ERCP for biliary strictures.

CP-related biliary strictures are difficult to manage, especially in those with pancreatic head calcifications. Furthermore, the need for repeated ERCP adds a considerable cumulative risk of procedure-related complications, patient stress, radiation exposure, and cost. Endotherapy with placement of multiple plastic or FCSEMS is currently recommended as the first approach by multiple societies. Successful long-term outcomes with placement of multiple plastic stents have been shown to be 92% compared with 24% with single stent for similar follow-up durations [103–107].

The use of uncovered or partially covered SEMS should be avoided given the risk of stent ingrowth and secondary strictures from irritation by the uncovered portion. The main advantages of FCSEMSs include a need for fewer endoscopic procedures and a lower rate of stent occlusion. However, common concerns associated with their use are stent dislocation and acute cholecystitis [108, 109]. A stent duration of more than 3 months is recommended for FCSEMSs used to treat benign biliary strictures. This was independently associated with stricture resolution in a multicenter trial that included 133 patients with benign biliary strictures of whom 44 had CP-related strictures [110]. FCSEMS are currently considered an alternative to multiple, side-by-side, plastic biliary stents. However, despite their main advantages including a reduced number of endoscopic procedures and a lower incidence of stent occlusion, FCSEMSs need improvements in their design as well as additional large multicenter trials before they can be recommended as a first-line option for the endoscopic treatment of CP-related biliary strictures. In summary, if correctly applied, multiple plastic stents as well as FCSEMS can be effective in the majority of patients with CP-related biliary strictures.

EUS has added to the therapeutic armamentarium in the management of patients with biliary strictures. Several studies have evaluated the feasibility and efficacy of EUS-guided rendezvous biliary drainage. The procedure is offered to patients with CP and biliary strictures who failed transpapillary stent therapy. Surgical biliary drainage should be considered in patients with significant calcifications, mass of the pancreatic head, and those with unresolving or recurring strictures after 1 year of endoscopic stenting [111, 112].

Internal Fistula

Interventional endotherapy should be undertaken for the management of internal pancreatic fistulas (such as pancreato-peritoneal and pancreato-pleural fistulas) in patients with DPDS or PD obstruction. Pancreatico-pleural fistula (PPF) is an uncommon but recognized complication of CP with an estimated prevalence of 0.4% [113]. The majority of patients are middle-aged males with history of alcohol-induced pancreatitis and predominantly present with pulmonary symptoms secondary to pleural effusion [114, 115]. Elevated pancreatic enzyme levels in the pleural fluid aspirate together with a documented fistulous communication between the pancreas and pleural cavity aids in establishing the diagnosis. Traditionally, management has been conservative or endoscopic with surgical intervention being considered in refractory cases [114]. ERCP with PD stenting has been recommended either as an initial intervention or after failed conservative management with minimal associated morbidity and mortality [116, 117]. As most fistulae arise from the pancreatic head or body, the main purpose of PD stent placement, besides decompressing the duct, is to bridge the site of disruption. Our experience with endotherapy for PPFs demonstrated complete resolution of PD disruption following 2–3 ERCP with PD stenting within 2–4 weeks without procedure-related adverse events [118]. Early recognition and a multi-disciplinary approach in centers with specialized experience are vital for successful outcomes.

Variceal Bleeding

Splenic vein thrombosis is a well-known complication of CP and present in approximately 12% of patients. Although the natural history of the disease remains controversial, most patients remain asymptomatic, and bleeding occurs in less than 7% of cases [119]. In these patients, endoscopic ultrasound-guided gastric variceal obturation using N-butyl-cyanoacrylate is an effective method in achieving hemostasis. Some also advocate for injecting coils in an effort to decrease embolization risk from glue injection. Splenectomy can still be considered for prevention of recurrent bleeding [120].

Conclusion

Endotherapy in CP is indicated for management of intractable pain and local complications including pancreatobiliary ductal obstruction and pseudocysts. The existing modalities and new innovations in this field are safe and effective whenever used in the right context. Endoscopic drainage of pancreatic pseudocysts remains superior to surgery relative to short-term quality of life, adverse events rates, and cost. Similarly, ESWL and ERCP remain the treatment of choice for MPD clearance in patients with MPD stones and obstruction. Despite development in stent technology, CP-related biliary strictures are difficult to treat, and long-term outcomes are usually unfavorable especially in individuals with pancreatic head calcifications. Multiple plastic stents and potentially FCSEMS improve outcomes for these biliary strictures. Lastly, even though endoscopic therapy for intractable pain is a widely acceptable strategy, certain procedures including EUS-guided celiac nerve block should be restricted to select, severe cases of CP with pain uncontrolled by other modalities.

Key Points

- Endoscopic management of patients with chronic pancreatitis (CP)-related complications has undergone significant changes over the past decade. In expert hands, these interventions are safe and achieve reasonable clinical success in most patients.
- The treatment of pain remains the greatest challenge in managing patients with CP. While medical therapy is appropriate for most patients, endoscopy remains the first-line therapy for painful CP with an obstructed main pancreatic duct (MPD) or dominant MPD strictures.
- Endoscopic drainage of uncomplicated symptomatic pseudocysts within endoscopic reach has been shown to be feasible in almost all patients and is superior to surgical drainage.
- Biliary strictures should be thoroughly evaluated to rule out malignancy. Benign strictures usually managed with temporary insertion of multiple side-by-side plastic stents or of a FCSEMS.
- Surgery should be considered if ductal obstruction reoccurs after one year of endoscopic stent treatment.
- Endoscopic therapy should be undertaken for the management of internal pancreatic fistula in patients presenting with main pancreatic duct disruption or obstruction.

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Declarations

Conflict of interest The authors declare that this work was conducted in the absence of commercial, financial or non-financial relationships that could be interpreted as a potential conflict of interest.

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