62

Evidence of Endoscopic and Interventional Treatment of Chronic Pancreatitis and Pseudocysts

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Indications for Interventional Endoscopic or Surgical Therapy

Belt-like upper abdominal pain is regarded as a cardinal symptom of chronic pancreatitis (CP), together with weight loss, steatorrhea, and diabetes mellitus. In the absence of causal therapeutic options, treatment is restricted to symptom control by means of enzyme replacement, pain therapy, and optimal control of endocrine insufficiency. The complexity of disease management is justified as morphology on imaging and pain level do not correlate in most patients and an impressive ductal obstruction or intraductal calcification may be associated with little pain and subtle findings on imaging may be associated with a significant loss of quality of life due to constant pain [1]. Comparative trials with sham interventions to evaluate the placebo effect or the natural course of the disease have rarely been conducted, one example being the trial by Seza et al. Between 30% and 60% of patients develop complications of their disease such as strictures of the common bile duct, inflammatory masses, pancreatic pseudocysts, or pancreatic duct strictures or ductal stones, which require interventional or surgical treatment. Chronic pancreatitis with severe pain requiring constant analgesics should be treated by interventional or surgical procedures dependent on the symptom-causing pathogenic features [2]. The presence of an inflammatory mass clearly favors a surgical resection. In the case of a dilated pancreatic duct due to strictures and/or ductal stone both endoscopic as well as surgical drainage procedures are effective. The indication of an endoscopic drainage has not been fully clarified in randomized controlled trials (RCT). Endoscopic treatment of a dominant stricture of the main pancreatic duct is often followed by pain relief in the short term [3,4]. Retrospective studies have reported long-term pain relief in 32–68% of patients [4]. Two randomized controlled studies directly compared endoscopic procedures with resection or a surgical drainage procedure [1,5,6]. Those studies proved surgery to be superior to endoscopy with respect to long-term outcome; however, due to limitations in the study design, a reliable evidence-based assessment remains difficult under the current lack of consideration of the placebo effect, the natural course, and a possible selection bias. Nevertheless, endoscopic drainage can achieve a long-lasting complete or partial pain relief in at least one-third of patients; it is associated with lower mortality and does not impede surgery as a second-line therapy [6]. In the presence of a resectable pancreatic mass suspected to be caused by pancreatic carcinoma surgical resection should be performed. Without surgery, life expectancy for patients with pancreatic carcinoma is less than 1 year; after successful resection 20–25% of patients may survive more than 5 years [7–9]. Gastric outlet obstruction secondary to CP requires surgical or endoscopic treatment for persistent clinical symptoms. A noninterventional management supplemented by endoscopic dilatation may be sufficient for an adequate quality of life in at least 30% of cases. According to the natural course of CP further intervention will be necessary in about 30–60% of patients [10]. As there are no studies directly comparing the efficacy of pancreatic head resection, bypass surgery, and endoscopic insertion of self-expanding metal stents (fcSEMS) [11], the decision may be taken in view of the patient's comorbidities. Symptomatic stenosis of the common bile duct (CBD) will develop in 10–40% of cases requiring endoscopy with dilation and stent insertion. The outcome of endoscopic therapy in patients without acute inflammation of the pancreas has improved with

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new techniques but is still not entirely satisfactory. Stent therapy rarely resolves a stricture beyond 1 year of therapy [12], in particular in the presence of calcifications within the pancreatic head [13]. Lasting patency rates have significantly improved with the use of fcSEMS. Surgical resection should be performed if symptoms or cholestasis persist after temporary endoscopic therapy not longer than a year. For obstructive chronic painful pancreatitis with ductal dilatation of more than 5 mm, a recent trial (ESCAPE) recommended earlier surgery after a maximum of 6 months of opiate pain medication without clinical improvement or preceded by 3 months of endoscopic therapy without symptom improvement [14]. Fragmentation and removal of stones within the pancreatic duct by extracorporeal shock wave lithotripsy (ESWL) have somewhat replaced surgery since its introduction in 1989. Several retrospective studies have shown ESWL as an effective and safe management option for pain relief in chronic calcifying pancreatitis with pancreatic main duct stones greater than 5 mm [15], for which ESWL followed by ERCP may be the standard of care. Intraductal lithotripsy under direct endoscopic vision is a promising technique in evolution. Interventional endoscopic options in CP will be discussed in more detail below.

Treatment of Pancreatic Cysts

According to the revised Atlanta classification a pancreatic pseudocyst is an encapsulated collection of fluid with a well-defined inflammatory wall usually outside the pancreas with minimal or no necrotic tissue content. This entity usually arises in connection with CP [16]. A walled-off necrosis (WON) is defined as a mature, encapsulated collection of pancreatic and/or peripancreatic necrosis that has developed a well-defined inflammatory wall. WON usually occurs >4 weeks after the onset of necrotizing pancreatitis [16]. The prevalence of pancreatic pseudocysts in CP ranges between 20% and 40% [17]. They occur with the highest frequency in patients with alcoholic CP (70–78%), followed by idiopathic CP patients (6–16%), and biliary pancreatitis patients (6–8%) [17,18]. Approximately 40% of the fluid collections resolve spontaneously within the first 6 weeks after an acute attack of pancreatitis. In contrast, spontaneous remission of pseudocysts after 12 weeks is a rare event. Complications are observed in up to two-thirds of cases encompassing pain, infection, hemorrhage, cystic rupture, or obstruction of adjacent organs such as cholestasis, gastric outlet obstruction, or vascular stenosis. A multivariate analysis showed a pseudocyst/WON size <4 cm as the only favorable factor for spontaneous resolution [19]. The increase in size of a pseudocyst/WON to over 5 cm in diameter is associated with an increased risk of complications [20]. Asymptomatic pseudocysts >5 cm in diameter which do not resolve within 6 weeks can be an indication for treatment. The aim of this intervention is to avoid possible complications that may occur later in the course of the disease, such as a cyst rupture, infection or hemorrhage, the likelihood of such complications being approximately 50%. However, symptomatic pseudocysts should undergo treatment regardless of their size.

Only limited information is available with regard to interventional therapy of pancreatic pseudocysts for pain management. Most of the data at hand are based on retrospective case series [21–24], but three systematic reviews are available [25–27]. Pain relief will be achieved in a large number of patients (about 80%). Although medical management of CP can result in pain relief, in a certain percentage of patients, interventional or surgical drainage is still the more effective form of pain management regardless of the drainage procedure.

A diagnostic needle aspiration of the cyst may be performed for suspected infection or for suspected cancer. If needle aspiration of the cyst confirms an infection, then drainage is indicated. Surgical treatment should be carried out if malignancy is suspected. In 28% of all MRI scans of the abdomen, a cystic lesion of the pancreas is discovered as an incidental finding [28] when population-based cohorts are investigated, albeit most of these cysts are smaller than 1 cm in diameter. More than two-thirds of these lesions are dysontogenetic cysts or pancreatic pseudocysts. Of the cystic lesions that are not pancreatic pseudocysts but genuine cystic neoplasms, 30% are benign serous cystadenomas. Forty-five percent of the resected lesions are mucinous-cystic neoplasms and 25% intraductal papillary mucinous neoplasms (IPMN). Solid pseudopapillary tumors or cystic acinar cell carcinoma are rather rare entities. For the differential diagnosis of cystic tumors in asymptomatic patients, the question of a connection to the pancreatic duct (IPMN and pancreatic pseudocysts) and of the size of the cystic lesion (indication for resection in the case of IPMN or therapeutic indication for pseudocyst) is essential. Diagnostic needle aspiration of a cyst with the aid of EUS helps in differentiating between premalignant cystic neoplasms, cystic malignancies, and pseudocysts. In case the fluid analysis reveals a CEA >400 ng/mL, a variably increased or low amylase (lipase), high viscosity, mucin or epithelial cells in the cyst content, then a mucinous neoplasm must be assumed [28–30]. In addition to CEA and amylase/lipase, low pancreatic cyst fluid glucose has been established as a marker for the differentiation of mucinous versus non-mucinous pancreatic lesions. In 609 cystic lesions examined, a systematic review showed significantly increased pooled sensitivity (91% vs. 56%; $P < 0.001$)

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and diagnostic accuracy (94 % vs. 85 %; $P < 0.001$) compared to CEA alone [31].

If a connection to the pancreatic duct is excluded the final diagnosis of a mucinous cystic neoplasm (MCN) can be made. A serous cystadenoma is diagnosed in 30% of cystic lesions and virtually never turns into a malignant lesion. In this case aspiration of the cyst is negative for mucin, CEA, and amylase. Cytology reveals a glycogen-rich epithelium. Surgical, percutaneous, or endoscopic drainage of pancreatic pseudocysts demonstrate comparable results regarding technical success, efficacy, and recurrence rates [26,32]. Percutaneous drainage is associated with the risk of external fistula and may affect the patient's quality of life. Endoscopic drainage is less prone to complications when compared to surgical procedures. A systematic review of retrospective series of endoscopic and surgical drainage showed similar morbidity (13.3% vs. 16%) and long-term pseudocyst recurrence (10.7% vs. 9.8%) but lower mortality (0.2% vs. 2.5%) achieved by an endoscopic drainage [33]. Therefore, the endoscopic approach should have first preference as it is less invasive and more convenient for the patient. In a recent RCT that compared endoscopic versus surgical cystogastrostomy for pancreatic pseudocyst drainage endoscopic treatment was associated with shorter hospital stays, improved physical and mental health status of the patients, and lower costs [32]. However, the decision between endoscopic and surgical drainage should take into account the cyst location and additional pathophysiological features. Surgical drainage may be the preferable therapy in hemorrhagic pseudocysts as endoscopic drainage is associated with a higher risk of bleeding. Approximately 10% of pseudocysts recur in the long term after endoscopic drainage (Table 62.1). Although initial therapy of nonhemorrhagic pseudocysts should be endoscopic drainage, surgery may follow in case of recurrence. Drainage of pseudocysts can be carried out by transgastric, transduodenal, or transpapillary routes. Transmural drainage should be done under endoscopic ultrasound (EUS) guidance to assess the pseudocyst location, size, wall, content, and adjacent blood vessels. Two RCT compared transmural drainage with and without EUS guidance [34,35]. No difference was observed in terms of morbidity and clinical outcome but technical success was higher with EUS. The success rate in 1018 published patients with transmural drainage of a pseudocyst was 87% (Table 62.1), with more recent studies reporting success rates of more than 90%. The mortality rate in larger case series involving more than 30 patients was 0.2%, the recurrence and complications rates are reported to be around 9% and 13%, respectively. Without antibiotic prophylaxis the procedure-related incidence of an infection of a pseudocyst and the risk of development of a pancreatic abscess increases [36,37]. Antibiotic prophylaxis for transmural or transpapillary drainage of pancreatic pseudocysts is recommended in recent guidelines based on expert opinion [4,38]. Double-pigtail stents should be used for transmural drainage of pancreatic pseudocysts because straight stents are associated with more frequent and severe complications in a retrospective study [39]. Early stent retrieval within 2 weeks after cyst resolution was associated with a higher rate of recurrence in a prospective randomized trial suggesting that long-term stent placement for more than 2 months may prevent recurrence without an increase of severe adverse events [40]. In its clinical guideline ESGE recommends transmural drainage of pancreatic pseudocysts by inserting at least two double-pigtail plastic stents, which should not be retrieved before at least 2 months of stenting [4]. Recently, short, lumen-apposing, fully covered, self-expandable metal stents (LAMS) have been developed for EUS-guided drainage of peripancreatic fluid collections.

In CP with advanced pancreatic ductal changes, especially with pancreaticolithiasis, a pseudocyst should be considered and treated as part of an overall therapeutic concept. For small pancreatic cysts, the tendency to regress due to persistent inflammatory stimuli is a maximum of 26%, so that even in the case of small symptomatic cysts, an interventional or surgical procedure may be considered in the individual patient context.

Due to its ease of use and the large diameter, the LAMS may make drainage of peripancreatic fluid collections more effective, particularly the endoscopic debridement of WON [41,42]. Despite initial reports on bleeding, recent meta-analyses demonstrated superior efficacy and safety compared to plastic stents in the management of peripancreatic fluid collections [43,44]. The basic question of an ideal timing for WON drainage in case of infected pancreatic necrosis has been studied in the POINTER trial. With regard to mortality and the comprehensive complication index (which includes all major complications), there was no significant difference between immediate catheter drainage (catheter drainage within 24 hours after randomization) and postponed catheter drainage (stage of walled-off necrosis, when necrotic collections were largely or fully encapsulated). However, the cohort of the later WON drainage installation (partly percutaneous, partly EUS-assisted) required fewer interventions overall, especially in terms of the number of necrosectomies required, and patients stayed in hospital for a correspondingly shorter time [45]. Of note, the median time to "immediate catheter drainage" was after a mean of 24 days (median, 24 days; interquartile range, 20 to 30) after onset of symptoms and postponed catheter drainage after a mean of 34 days (median, 29 days; interquartile range, 24 to 40) after onset of symptoms (mean difference, –10 days; 95% confidence interval [CI],

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Table 62.1 Summary of transmural endoscopic pseudocyst/walled-off pancreatic necrosis drainage, including studies of: traumatic pancreatic pseudocysts [74], pancreatic abscess [79,85]; acute pseudocysts [81]; infected pseudocysts [83]; symptomatic peripancreatic fluid collections [43,87]. (Two studies compared in a prospective randomized trial ultrasound-guided vs. conventional transmural drainage of pseudocysts [32,31].)

	Number of patients	Success rate	Recurrence rate	Complications
Kozarek et al., 1985 [75]	4	50%	0%	25% (1 dead)
Cremer et al., 1989 [76]	33	85%	12%	9%
Sahel et al., 1991 [77]	37	86%	5%	14%
Bejanin et al., 1993 [78]	26	73%	15%	15%
Funnell et al., 1994 [79]	5	100%	0%	0%
Binmoeller et al., 1995 [48]	20	80%	23%	30%
Smits et al., 1995 [80]	25	88%	13%	20%
Vitale et al., 1999 [81]	27	82%	18%	4%
Libera et al., 2000 [82]	17	88%	6%	24%
White et al., 2000 [83]	20	100%	0%	10%
Giovannini et al., 2001 [84]	15	100%	0%	7%
Norton et al., 2001 [85]	17	82%	7%	18%
Baron et al., 2002 [86]	64	81%	12%	17%
Sharma et al., 2002 [87]	33	97%	15%	15%
Cahen et al., 2005 [39]	64	70%	5%	39%
Antillon et al., 2006 [88]	33	94%	3%	6%
Hookey et al., 2006 [47]	101	95%	16%	11% 1% (1 dead)
Kahaleh et al., 2006 [89]	99	94%	n.a.	19%
Kruger et al., 2006 [90]	35	94%	12%	0%
Weckman et al., 2006 [91]	68	90%	5%	10%
Varadarajulu et al., 2008 [34]	29	100%	n.a.	3% 3% (1 dead)
Park et al., 2009 [35]	60	83%	15%	8%
Varadarajulu et al., 2011 [92]	154	100%	1.5%	5%
Will et al., 2012	32	97%	15%	10%
Total	**1018**	**87%**	**9%**	**13%**

–19 to –5) and thus even "the immediate drainage group" followed current guideline recommendations.

Whether an ERCP with the attempt of draining the pseudocyst via the papilla should be performed instead of a primarily transgastric or transduodenal drainage is still a matter of controversy. According to retrospective studies, transpapillary drainage seems to be associated with lower morbidity (mainly pancreatitis) and similar long-term success but was used for smaller pancreatic cysts than transmural drainage [4,46–48]. It is reported that 22–57% of pancreatic pseudocysts may have a connection with the pancreatic ductal system [49]. Thus, an ERP can precede endoscopic transmural drainage in order to detect a connection with the duct or to exclude a rupture of pancreatic ducts (8% after acute necrotizing pancreatitis). Transmural drainage in the presence of an undetected rupture of the pancreatic duct or an association of the pancreatic pseudocyst with an obstructed pancreatic duct is less promising with regard to long-term outcome of therapy [50,51]. Treatment of pancreatic duct obstruction and—if possible—bridging of a pancreatic duct rupture is recommended in these cases.

Therapy of Pancreatic Duct Stenoses and Ductal Stones

Ductal and interstitial hypertension and possible pancreatic ischemia accompanying outflow obstruction due to pancreatic duct stenoses or ductal stones may play an

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important role in the pathogenesis of pain. The aim of endoscopic and surgical decompression therapy in patients with CP and pain and/or clinical episodes of acute pancreatitis is to remove the obstruction and to allow outflow of exocrine pancreatic juices into the duodenum. Biliary techniques such as sphincterotomy, dilatation, ESWL, and stent insertion have been modified for the pancreatic duct. Endoscopic decompression represents an alternative to surgery and is associated with low morbidity and low mortality. Endoscopic interventions do not interfere with surgery that might still be necessary later in the course of the disease. Clinical success after endoscopic reduction of the intraductal pressure does provide some indication of the later result of surgical drainage or a resection procedure.

Pancreatic ductal stones are a consequence rather than the cause of CP. They can, however, lead to consecutive outflow obstruction and thus cause pseudocysts or fistulae development, recurrent exacerbations or contribution to the pathogenesis of pain. Under these conditions, treatment of pancreatic ductal stones seems appropriate. Endoscopic treatment appears particularly suitable for treating solitary stones and obstructions close to the papilla or in the body of the pancreas. After pancreatic sphincterotomy, pancreatic duct stones <5 mm may be extracted without prior fragmentation. Radiopaque obstructing stones ≥5 mm should be fragmented by ESWL followed by extraction of the fragments by ERCP [4]. There is evidence from a prospective randomized trial that the subsequent endoscopic removal of the fragments is not a prerequisite for the effectiveness of the procedure [52]. One large-scale single-center retrospective study with follow-up of 272 patients after ESWL and ERCP for >60 months reported no pain in 60% of patients, mild to moderate pain in 36%, and episodic severe pain in 4% of patients [53]. Recurrence of intraductal calculi was seen in 23% of patients. A recent meta-analysis of 27 studies (total of 3189 patients) showed that ESWL is useful for clearing pancreatic duct stones greater than 5 mm and for decreasing pain [15]. The pooled proportion of patients with absence of pain at follow-up (median 2 years) was 53% (95% CI: 50.8–54.6) and mild to moderate pain was 33% (95% CI: 31.4–35.5). Quality of life improved in 88% and complete ductal clearance was achieved in 71%. However, no studies have compared the treatment of ductal stones with the natural course or a sham intervention. In principle, individual pancreatic duct stones that cause pain due to obstruction of the outflow of pancreatic secretion are treated with ESWL, pancreaticoscopic electrohydraulic lithotripsy or laser lithotripsy. A current prospective study investigating the effectiveness of direct EHL-guided lithotripsy showed promising results regarding feasibility and safety of EHL [54].In two older studies, in which endoscopic treatment was compared with surgery, i.e., drainage operation, the results after surgery were significantly better with respect to long-term pain reduction [1,5]. Recent data from the multicenter, prospective ESCAPE trial point in the same direction. Patients with symptomatic pancreatic duct stenosis, a blockage of the pancreatic duct and a duct width of >5 mm experienced an advantage of early surgery compared to a "step-up approach" with optimized medical therapy, endoscopic intervention, and “delayed” surgery: complete or partial pain reduction at 18-months follow-up in 58% vs. 39%; $P = 0.1$) [14]. However, neither the complication rate of surgery nor surgical mortality were taken into account as endpoints, which are nevertheless of considerable importance in guiding patients. The treatment of pain in patients with diffuse calcifications by means of ESWL has not been substantiated in any studies.

Patients with dominant pancreatic duct strictures with a prestenotic dilatation ≥6 mm in diameter, which may be responsible for pain, recurrent exacerbations, maintenance of a pseudocyst, fistula, or other complications, can be treated by endoscopic dilatation and plastic stent placement [4]. Removal of the obstruction of the pancreatic duct is effective for the treatment of pain on short to intermediate terms. Success rates between 65% and 95% have been reported [4]. In the largest hitherto examined cohort of 1021 patients, a long-term reduction (mean 4.5 years) of pancreas-related pain was achieved in 85% of cases [55]. However, 24% underwent surgery during further follow-up, which—on an intention to treat basis—reduced the rate of successful treatment to 65%. In 79% of the patients stent therapy for control of pain had to be repeated within 1 year and in 97% within 2 years. The only randomized study recruited 41 consecutive patients with CP with a dominant pancreatic duct stricture to either receive pancreatic duct stenting or to serve as control. During a mean follow-up of 62.5 ± 20.9 months pain recurred in 15% of patients with pancreatic duct stenting (3/20) and in 50% of control patients (11/22) ($P < 0.05$). Progression of exocrine insufficiency in the stent group was significantly slower than in the control group ($P < 0.05$), while endocrine function showed no difference between groups [56]. Preliminary studies suggest temporary placement of fcSEMS into the pancreatic duct for pain relief may be a safe and effective short-term treatment [57–59]. Their potential advantage versus plastic stents is the longer period of stent patency. A recent meta-analysis found fcSEMS comparable to multiple plastic stents in the treatment of symptomatic refractory pancreatic duct strictures, but the risk of adverse events was increased [60]. However, long-term results are so far not available. Uncoated self-expandable metallic stents are not recommended due to the rapid proliferation of duct epithelium as a reaction to the metal

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mesh graft. Plastic stents inserted into the pancreatic duct can induce secondary changes with subsequent fibrosis and strictures [61,62]. There are currently no reliable data available regarding the necessary duration of stent therapy. Some authors recommend treatment over 1 year with an exchange of the stent at least every 3 months [4]. Other centers suggest exchanging the stent in case of reoccurring symptoms. A question which should be solved in a randomized trial. Improved pain management, however, was achieved by a pancreatojejunostomy in two RCT [1,5,6]. Endoscopic therapy led to pain reduction or complete pain relief in 32% [5] and 61% [1], respectively, whereas this was achieved in 75% [5] and 86% [1], respectively, by pancreatojejunostomy. However, endoscopic drainage can achieve a long-lasting complete or partial pain relief in a substantial proportion of patients, and does not impede surgery as a second-line therapy.

Endoscopic Treatment of Bile Duct Obstruction

Obstruction of the common bile duct (CBD) will develop in 3–46% of patients with CP [63]. Indications for endoscopic intervention include significant cholestasis, cholangitis, prevention of secondary biliary cirrhosis, and differentiation of the cause of pain (obstruction of the CBD vs. CP). Long-term success rates can be achieved in one- to two-thirds of the patients dependent on the endoscopic drainage modality [4]. Thus endoscopic therapy is indicated as an interim procedure until definitive surgery, for example as an acute intervention in septic patients, or in patients unfit for surgery, or in those unwilling to undergo surgery. Complications include stent occlusion and cholangitis. Prophylactic antibiotic therapy together with ursodeoxycholic acid has not been proven to be effective [64–66]. Endoscopic drainage should, therefore, be of limited duration.

Immediate endoscopic drainage should be performed in the case of obstructive cholangitis. Although no published studies have compared endoscopic therapy to observation without drainage as treatment of mechanical cholestasis as part of the therapy for cholangitis is important and well substantiated by clinical experience. If CP causes distal obstruction of the bile duct with cholestasis or obstructive jaundice, then either surgical treatment or endoscopic stent therapy can be performed. A retrospective analysis of all patients treated with an average observation period of 45 months demonstrated that stent therapy for the obstruction of the CBD in patients with CP has no additional effect beyond 1 year [12]. Surgical treatment should therefore be pursued for recurrence of CBD obstruction after 1 year of stent therapy. A prospective study showed an even worse long-term effect of stent management of distal bile duct obstruction in patients with calcifying pancreatitis (long-term effect 9%) [13]. In these cases surgical treatment is clearly preferred.

The placement of multiple plastic stents into the biliary stricture of patients with CP is superior to insertion of single plastic stents. In prospective, nonrandomized and retrospective studies the success rate after insertion of up to five plastic stents into the CBD was higher than after a single stent with long-term success rates of up to 92% of patients during a period of 12–48 months after stent removal [67–69]. A prospective nonrandomized study at 13 centers in 11 countries treated 187 patients with benign biliary strictures by fcSEMS [70]. Removal was scheduled at 10–12 months. On an intention-to-treat basis the stricture resolution rate was 76%, and the rate of stricture recurrence was 14.8% (95% CI: 8.2–20.9%) during follow-up of 20 months. Thus, effective long-term success was achieved in 62.7% of patients. A randomized controlled study compared insertion of multiple plastic stents with a single fcSEMS in 112 patients for treatment of benign biliary strictures during 1 year [71]. The resolution rate of biliary strictures was 85.4% with plastic stents and 92.6% with fcSEMS ($P < 0.001$). The mean number of ERCP to achieve resolution was significantly lower for fcSEMS than for plastic stents. The recurrence rate within 1 year of follow-up did not differ significantly between groups (14% with fcSEMS vs. 5% with plastic stents).

In a large meta-analysis of 1298 patients with benign biliary stenosis who were treated with fcSEMS, a lasting therapeutic success with complete regression of the biliary stenosis was achieved in 83% [72]. For the subgroup of patients with biliary stricture due to a chronic inflammatory process of the pancreas, there was a somewhat greater heterogeneity compared to postoperative benign bile duct strictures, but also comparable results. fcSEMS were as effective as multiple plastic stents but required fewer ERCPs. Thus, fcSEMS placement appears to provide an advantageous alternative to plastic stents in the management of benign biliary strictures. Exchange of single plastic stents should be undertaken at least every 3 months because otherwise occlusion of the stent may cause cholangitis. The exchange interval is less critical with the insertion of multiple stents and is much longer if fully coated metal stents are used. Those are patent for up to 9 months [73]; however, partial obstruction by sludge or stones often occurs.

The management of chronic bile duct obstruction after unsuccessful attempts of endoscopic treatment should be surgical. If there is an indication to treat cholestasis by surgery, a preoperative endoscopic insertion of a stent into the bile duct should only be undertaken if (i) surgery cannot be done promptly, or (ii) cholangitis is present.

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A multicenter prospective randomized study examined the effect of preoperative endoscopic stent insertion into the CBD for mechanical cholestasis secondary to carcinoma of the head of the pancreas before pancreas resection. Preoperative drainage significantly increased the rate of complications (39% severe complications without drainage vs. 74% with drainage). Therefore, in the absence of cholangitis, bile drainage is not indicated if surgery can be performed promptly [74]. A short individual life expectancy of a patient, a high comorbidity, and a difficult, foreseeable technical feasibility of an operation (e.g., marked collateral circulation secondary to portal hypertension), are all in favor of an endoscopic treatment of bile duct obstruction.

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