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Endoscopic removal of proximally migrated pancreatic duct stents: a case series and literature review

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Abstract

Background Proximal migration of pancreatic stents is an uncommon but significant problem that poses risks of pain and pancreatitis. It is often a challenging situation for endoscopists, necessitating surgical retrieval in 10% of cases.

Method A 10-year retrospective review was performed of stent removal procedures performed at a tertiary care center in northern India between January 2010 and December 2019.

Results Sixteen patients (mean age 39.52 years, 13 [81.25%] males) with proximally migrated pancreatic stents (PMPSs) were studied. Thirteen (81.25%) patients had a dilated pancreatic duct (PD) and 3 (18.75%) had a non-dilated PD. In the majority of patients, the PMPSs were located at the genu (50%), while 62% were 10 cm in length. Three (18.75%) patients had fragmented stents, whereas the remaining 13 (81.25%) had intact stents *in situ*. Complete retrieval of the PPMS and stent fragments was possible in 12 (75%) patients, with grasping forceps being used in the majority (50%). In patients with fragmented stents and difficult locations (n=3), pancreatoscopy-assisted techniques resulted in the retrieval of the stent or fragments. PMPSs could not be retrieved in 3 patients: all these failures were during the study period when a SpyGlass pancreatoscope was not available in our unit. Two patients (12.5%) reported post-procedural pain that responded to intravenous analgesics.

Conclusions Endoscopic retrieval of proximally migrated stents, using a combination of techniques and accessories, is safe and effective. Pancreatoscopy increases the success rates. Surgery is rarely required for stent removal.

Keywords Endoscopy, pancreas, stents, endoscopic retrograde cholangiopancreatography, pancreatitis

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Introduction

Pancreatic stents are often placed to manage pancreatic duct (PD) strictures, as well as disruptions, and as a prophylactic measure to prevent pancreatitis following endoscopic retrograde cholangiopancreatography (ERCP) [1]. These stents can migrate distally towards the duodenum or proximally towards the pancreatic tail, with distal migration rates of 7.5% and proximal migration rates of 1-12.3% [2-4]. The distally migrated stents usually do not cause any adverse effects, as they are naturally excreted out through the intestines—although rare side-effects such as intestinal obstruction or perforation have occasionally been reported [5,6]. On the other hand, proximally migrated stents can obstruct the PD, resulting in obstructive pancreatitis; therefore, these stents need to be removed. The small diameter of the normal PD, its bent course at the genu, the presence of strictures or stones, the absence of dedicated accessories, and a lack of expertise all contribute

to the difficulty in retrieving proximally migrated pancreatic stents (PMPSs). PMPSs pose a challenge to endoscopists, necessitating surgical retrieval in approximately 10% of cases. Various endoscopic techniques and accessories have been used to remove PMPSs, but none of these techniques or accessories is considered a gold standard [7-9]. The availability of the SpyGlass pancreatoscope and its dedicated accessories, including a snare and forceps, have increased the success rates of endoscopic retrieval of PMPSs [10-12]. We retrospectively analyzed the safety and efficacy of various endoscopic techniques for the removal of PMPSs, and the impact of the introduction of pancreatoscopy on the removal of these stents.

Patients and methods

A 10-year retrospective review was performed of stent removal procedures performed at a tertiary care center in northern India between January 2010 and December 2019. The size, type, status (intact or fragmented) and position of migrated stents (in the PD), the status of the PD (dilated or not dilated), the method used, the number of sessions needed for extraction, success, complications, and the need for surgical retrieval were analyzed.

Endoscopic procedure

ERCP was performed in the prone position under conscious sedation using intravenous midazolam. Patients also received pre-procedure rectal diclofenac for prevention of post-ERCP pancreatitis and prophylactic antibiotics (intravenous ciprofloxacin). ERCP was carried out using a duodenoscope (TJF 160/Q180V/Q190V duodenoscope; Olympus, Japan). After cannulation of the PD, a guidewire was maneuvered deep into the PD, and pancreatic sphincterotomy was performed, or extended if a previous sphincterotomy was deemed by the endoscopist to be inadequate. An attempt to remove the proximally migrated stent/stent fragment was made in a stepwise fashion.

First, Rat Tooth Alligator Jaw grasping forceps (Olympus, Japan) were used for stent retrieval. The forceps were carefully negotiated across the papilla under fluoroscopy and attempts were made to catch the distal end of the stent. If the stent could not be retrieved using grasping forceps, deep cannulation of the PD using a guide wire was performed, followed by attempts at stent retrieval using an extraction balloon. An attempt was made to negotiate the balloon upstream from the migrated stent and subsequently to drag the stent towards the duodenum by pulling the inflated balloon. If the balloon could not be placed upstream of the migrated stent, the balloon was inflated alongside the stent and pulled back in order to drag the stent outwards towards the duodenum.

If the stent could not be extracted using grasping forceps or an extraction balloon, an attempt was made to selectively cannulate the stent with a guide wire, and then extract it using a Soehendra stent retriever (Wilson-Cook, Winston-Salem, USA). During the first 7 years of the study period, if the stent could not be retrieved using the abovementioned methods the patient was advised to undergo surgical stent removal.

During the last 3 years of the study period, SpyGlass pancreatoscopy (Boston Scientific, USA) has been added to the armamentarium of tools available for the endoscopic removal of PMPSs in our unit; therefore, during this part of the study it was used for stent retrieval in situations where the grasping forceps, extraction balloon and Soehendra stent retriever had failed to remove the PMPS. The pancreatoscope was inserted through the accessory channel of the duodenoscope (TJF Q180V/Q190V; Olympus, Japan) and positioned close to the distal end of the PMPS. The migrated stent was then retrieved under endoscopic visualization using either the biopsy forceps (Spy Bite) or the snare (Spy Snare). A pancreatogram was obtained after the procedure to confirm duct integrity and exclude duct disruption.

Outcomes

The various outcome measures evaluated were the technical success of retrieval of PMPSs using the various techniques described above, the number of endoscopic sessions, the need for surgery, and adverse events.

Results

Sixteen patients (mean age 39.52 years, 13 [81.25%] males and 3 [18.75%] females) with proximally migrated pancreatic stents were studied. Thirteen (81.25%) patients had a dilated PD and 3 (18.75%) patients had a non-dilated PD. Eight (50%) stents were lodged in the genu, 5 (31.25%) in the body, 2 (12.5%) in the body and tail regions, and 1 (6.25%) stent was lodged in the tail region. All the patients had straight stents lodged *in situ*. Ten (62.5%) patients had 5-Fr stents lodged, 5 patients (31.25%) had 7-Fr size stents, and 1 patient had a 10 F stent lodged *in situ*. Ten (62.5%) of these stents were 10 cm in length, 3 (18.75%) were 12 cm, and 1 each (6.25%) had lengths of 5, 7 and 9 cm. Three (18.75%) patients had fragmented stents, and the remaining 13 (81.25%) had intact stents *in situ*.

Complete retrieval of PMPSs and stent fragments was possible in 12 (75%) patients. In 8 patients (50%), the stents could be retrieved using grasping forceps (Fig. 1,2). In 1 patient the PMPS was retrieved using a combination of extraction balloon and grasping forceps, whereas in 1 patient the stent could be retrieved using a novel endoscopic ultrasound-guided extrusion method and snare [13]. In 2 patients, where all the conventional techniques for stent retrieval failed, the stents were retrieved using a pancreatoscope (Fig. 3). Despite the use of multiple endoscopic accessories (grasping forceps, snare, extraction balloon and Soehendra stent retriever) the stent/fragments could not be retrieved in 3 (18.75%) patients. All these 3 failures were during the initial 7-year period of the

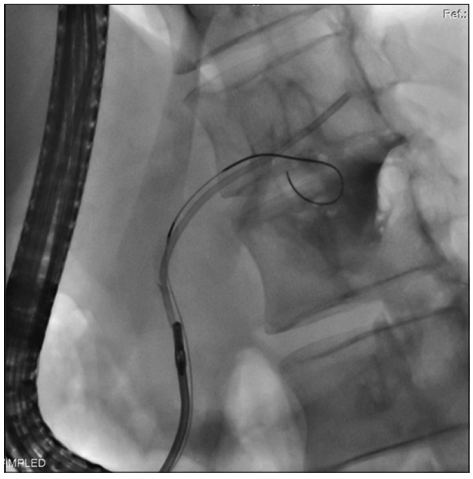

Figure 1 Endoscopic removal of proximally migrated stent lodged at genu using grasping forceps

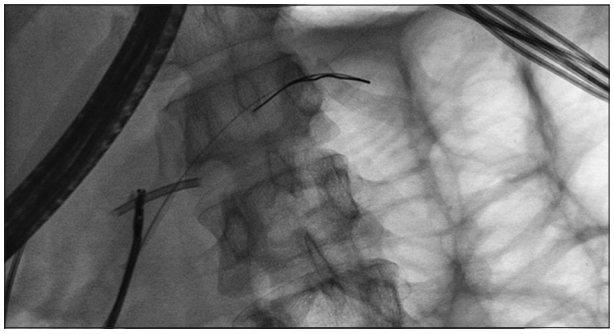

Figure 2 Endoscopic removal of proximally migrated fragmented stent using grasping forceps

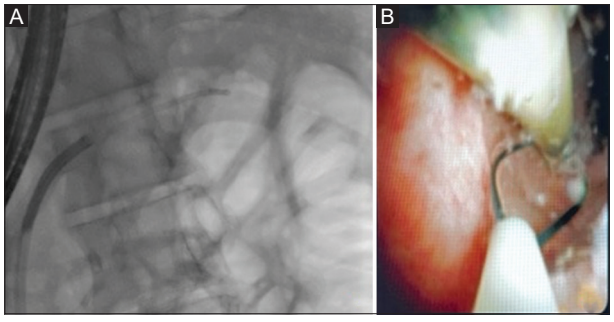

Figure 3 SpyGlass-assisted removal of proximally migrated fragment of pancreatic stent. (A) SpyGlass positioned near the fragmented stent. (B) Spy Snare used to retrieve the fragment

study, when the SpyGlass pancreatoscope was not available in our unit. One of these 3 patients underwent surgical removal of the stent, whereas the other 2 patients refused surgery.

After the availability of the pancreatoscope, endoscopic stent retrieval was attempted in both the patients in whom initial retrieval had failed. In 1 patient, 1 of the stent fragments could be retrieved, whereas the other fragment, lodged distally in the tail, could not be retrieved. In the other patient, the stent could not be retrieved because it was densely adherent to the surrounding PD. In 8 (50%) patients the PMPS was successfully retrieved in a single session, whereas 2 patients (12.5%) required 2 sessions, and another 2 patients (12.5%) 3 endoscopic sessions.

Two patients (12.5%) reported postprocedural pain that responded to intravenous analgesics. None of the patients developed post-ERCP pancreatitis. The details of all the patients, stents and removal techniques are summarized in Table 1.

Discussion

PD stents help in the management of various benign pancreatic diseases by maintaining duct patency and thus relieving obstructive symptoms. Proximal migration of the PD stent is a significant complication of stent placement and may result in various adverse effects, including incomplete drainage of the PD, recurrence of obstructive symptoms and damage to the PD. Various risk factors, including stents that are too short or too long, rigid straight stents not conforming to the duct contours, flaps on the distal part of the stent, a dilated duct, and sphincter of Oddi dysfunction have been reported to favor proximal stent migration [14]. In our case series of patients with PMPSs, the PD was dilated in the majority (81.25%) of patients, and the migrated stents were of longer length (10 or 12 cm); all of them were straight stents.

In the majority of patients, the distal end of the PMPS was located near the genu of the pancreas and could be retrieved using grasping forceps. Endoscopic removal was unsuccessful in 3 patients whose stents were lodged in the distal body or tail of the pancreas. In addition, 2 of these 3 patients had a non-dilated PD, suggesting that stents lodged proximally in the upstream body or tail, along with the presence of a non-dilated PD, can make endoscopic stent retrieval difficult. PMPSs can be retrieved endoscopically using (i) direct traction methods, such as foreign body forceps, snare and basket; (ii) indirect traction with a stone-extraction balloon; (iii) PD stent lumen cannulation-assisted techniques (lasso technique and its variations, Soehendra stent retriever assisted technique); and (iv) pancreatoscopy-assisted techniques. Endoscopists around the world have described various ingenious and unique techniques, which are summarized in Table 2 [4,7,11,15-25]. Recently, successful PD stent retrieval has also been reported using a drill dilator [26]. The drill dilator is a novel thin-tapered drill dilating device developed for endoscopic ultrasound-guided interventions.

In 1993, Sherman *et al* described a method of exchanging biliary stents while maintaining guidewire (GW) access in obstructed biliary systems which he described as a "lasso technique". This involved passing a GW into the previously placed stent and advancing it through the stent across the obstruction to gain deep access into the biliary system. This was followed by the passage of a 5-Fr mini-snare over the GW through the channel of the scope to reach the lower end of the biliary stent, which was ensnared and extracted through the channel of the scope while the GW remained in position. The

Table 1 Details of all the patients, stents and removal techniques

Case No.	Age	Sex	Pancreatic duct	Stent position	Stent condition	Stent size	Stent type	Retrieval method	Retrieval sessions	Outcome	Comment	Complication
1	36	Male	Dilated	Genu	Whole stent	7Fr×12 cm	Straight	Grasping forceps	1	Successful	None	None
2	38	Male	Dilated	Genu	Whole stent	5Fr×10 cm	Straight	Endoscopic ultrasound-guided extrusion	2	Successful	None	None
3	46	Male	Dilated	Body	Fragmented	7Fr×10 cm	Straight	Grasping forceps	3	Successful	None	Pain
4	38	Male	Dilated	Body	Whole stent	5Fr×9 cm	Straight	Multiple	4	Unsuccessful	Stent left *in situ*	None
5	44	Male	Not dilated	Body	Whole stent	5Fr×10 cm	Straight	Multiple	3	Unsuccessful	Stent left *in situ*	None
6	62	Female	Dilated	Body/Tail	Fragmented	5Fr×12 cm	Straight	SpyGlass assisted	4	Successful	None	Pain
7	51	Male	Dilated	Body/Tail	Fragmented	5Fr×12 cm	Straight	SpyGlass assisted	3	Successful	One fragment left *in situ*	None
8	37	Male	Dilated	Genu	Whole stent	10Fr×10 cm	Straight	Grasping forceps	1	Successful	None	None
9	35	Male	Dilated	Genu	Whole stent	5F×10 cm	Straight	Grasping forceps	1	Successful	None	None
10	29	Male	Dilated	Genu	Whole stent	7Fr×10 cm	Straight	SpyGlass assisted	2	Successful	None	None
11	41	Male	Dilated	Genu	Whole stent	7Fr×10 cm	Straight	Extraction balloon + Grasping forceps	1	Successful	None	None
12	29	Female	Not dilated	Genu	Whole stent	5Fr×5 cm	Straight	Grasping forceps	1	Successful	None	None
13	47	Male	Dilated	Genu	Whole stent	5Fr×10 cm	Straight	Grasping forceps	1	Successful	None	None
14	38	Male	Not dilated	Tail	Whole stent	7Fr×7 cm	Straight	Multiple	3	Unsuccessful	Surgery performed	None
15	29	Male	Dilated	Body	Whole stent	5Fr×10 cm	Straight	Grasping forceps	1	Successful	None	None
16	33	Female	Dilated	Body	Whole stent	5Fr×10 cm	Straight	Grasping forceps	1	Successful	None	None

new stent was then inserted over the same GW [27]. The same technique can be used to catch PMPSs after passing the GW into the migrated PD stent.

Table 2 Pancreatoscopy-assisted techniques

Author [ref.]	Year	Technique
Baron *et al* [8]	1999	Interventional cardiology accessories
Vila *et al* [17]	2010	Variation of lasso* technique
Nambu *et al* [9]	2010	5-Fr nasopancreatic drain assisted
Takahara *et al* [19]	2012	Turned guidewire looping method
Vila *et al* [23]	2013	Lasso technique (around the stent)
Ishigaki *et al* [18]	2014	Gooseneck snare assisted removal
Kudo *et al* [16]	2015	Guidewire through hole of 1-sided cup biopsy forceps
Bhandari *et al* [7]	2016	Coronary angioplasty balloon assisted retrieval
Bhandari *et al* [7]	2016	Lasso technique (through the stent)
Yao *et al* [24]	2018	Snare over in-stent guidewire (pancreatoscopy assisted)
Yi *et al* [15]	2023	Mini basket through sphincterotome
Higashimori *et al* [25]	2023	Pediatric biopsy forceps through tapered sheath

*The lasso technique was originally described by Sherman *et al* for biliary stent exchange [26]

Vila *et al* described a modification of this "lasso technique" in which the GW was passed alongside the stent to guide the snare to the distal end of the stent [17]. Bhandari *et al* also described an interesting technique (which they also refer to as the "lasso technique"), where after the GW has been passed through the PMPS, if the GW recoils in the PD and comes back out of the papilla, the GW tip can be held with a snare/grasping forceps/biopsy forceps, and the stent can be retrieved by applying traction to the GW which has "lassoed" the entire length of the stent from inside and outside [7].

Matsumoto *et al* proposed a classification of PMPSs (Typed A, B, C and D) and described techniques based on the proposed classification [28]. In Type A PMPSs, the tip of the proximal stent is located in the main PD and the duct has no stricture, whereas in Type B the tip of the stent is located in the PD with the stent positioned across the stricture. In Type C, the stent is located in the PD but is positioned upstream from the stricture, and in Type D, the distal (downstream) tip of the stent is located in a side branch duct.

Case series describing the endoscopic removal of PMPSs have been summarized in Table 3 [4,7,20,21,29]. The endoscopic retrieval success rate reported in most studies has been ~80% and our case series also reported a success rate of 75%. In earlier studies, balloon extraction was the predominantly described method, whereas in later studies the combination of balloon and grasping forceps has been the predominant method of extraction. In our study, grasping forceps were predominantly used, and stents could be retrieved in a single session in 37.5% of the patients. Furthermore, the use of the SpyGlass increased the success rates of endoscopic removal of PMPSs, with no endoscopic failure reported in our unit since the availability of pancreatoscopy.

Table 3 Case series describing the endoscopic removal of proximally migrated pancreatic stents

Author [ref.]	Year	n	Success rate	Single session retrieval rate	Most common retrieval method	Surgery	Observation	PEP
Lahoti *et al* [20]	1998	26	76.9% (20/26)	50% (13/26)	Basket 38.5% (10/26)	11.5% 3/26	11.5% 3/26	0% 0/26
Price *et al* [4]	2009	23	78% (18/23)	60.9% (14/23)	Balloon extraction. 44.4% (8/18)	17.4% (4/23)	(4.3%) 1/23	4.3% (1/23)
Gong *et al* [28]	2011	15	100% (15/15)	100% (15/15)	Balloon extraction. 60% (9/15)	0% (0/15)	0% (0/15)	0% (0/15)
Lu *et al* [21]*	2015	35	88.6% (31/35)	85.7% (30/35)	Balloon + Grasping Forceps 37.1% (13/35)	NA	NA	14.3% (5/35)
Bhandari *et al* [7]	2016	14	92.8% (13/14)	57.1% (8/14)	Rat tooth forceps/ Pancreatoscope guided/ over-the-wire snare.† 21.4% (3/14)	0% 0/15	NA	14.3% (2/14)
Our study	2024	16	75% (12/16)	37.5% (6/16)	Grasping forceps	1/16	2/16	0/16

*36 procedures were performed, in which only 1 patient had a stent retrieved at the second attempt. In another patient, after retrieval of the first migrated stent, the exchanged stent also migrated and was removed in a second procedure †In this study, all 3 techniques were successful in 3 patients

PEP, post-endoscopic retrograde cholangiopancreatography pangreatitis

Endoscopic removal of PMPSs can result in various complications, such as PD disruption, stent fragmentation and postprocedural pancreatitis [30]. However, none of our patients developed any significant adverse events post-procedure. The small sample size, retrospective study design and lack of comparison amongst the various techniques are important limitations of our study.

In conclusion, endoscopic retrieval of proximally migrated stents using a combination of techniques and accessories is safe and effective. With a combination of traditional accessories and pancreatoscopy whenever necessary, most stents, including fragmented stents, can be safely removed, and surgery is seldom necessary.

Summary Box

What is already known:

- A small diameter of the normal pancreatic duct (PD), bent course at the genu, presence of strictures/stones, absence of dedicated accessories, and lack of expertise contribute to the difficulty in retrieving proximally migrated pancreatic stents (PMPSs)
- Various endoscopic techniques and accessories have been used to remove PMPSs, but none is considered the gold standard

What the new findings are:

- Proximal migration into the tail, stent fragmentation and the presence of a non-dilated PD can make endoscopic retrieval challenging
- In expert hands, grasping forceps are an effective tool for retrieval of PMPSs, especially in dilated ducts with stent lodgment near the genu, while pancreatoscopy improves the endoscopic retrieval rates of PMPSs

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