Removal of Migrated Pancreatic and Biliary Stents: Techniques and Outcomes

INTRODUCTION

Biliary and pancreatic stents are primarily used for the treatment of benign and malignant strictures of the biliary tract and pancreatic duct, among other indications. A recognized complication of the use of these stents is migration, which can be source of significant morbidity and mortality. Although distal migration is more common, proximally migrated stents can be challenging to retrieve and can create clinical problems for patients. The purpose of this article is to review current literature regarding migration of pancreatic and biliary stents, particularly proximal migration, and the techniques used to retrieve them.

Incidence of Proximally Migrated Stents

The incidence of proximal stent migration can be evaluated by location and type of stent. For plastic biliary stents, a 1992 study found that of 322 plastic biliary stents placed in the common bile duct 16 (4.9%) migrated proximally. Half of those patients were symptomatic at presentation. Factors that were associated with proximal migration in this study included larger stent diameter (odds ratio 4.5), a stent length less than 7 cm (odds ratio 7.8), and a malignant stricture secondary to cholangiocarcinoma (odds ratio of 5.2).\(^1\) A more recent study published in 2008 reported that in a group of 524 patients undergoing biliary stent placement, 24 plastic biliary stents migrated proximally (4.6%).\(^2\) One of 43 fully covered metal stents (2.3%) migrated proximally in this study.\(^3\) For uncovered metal stents, the proximal migration rate is quite low and usually less than 1%, attributed to the stent fixation by tumor ingrowth.\(^4\)

For pancreatic stents, the same 1992 study included 267 patients that had pancreatic stents placed with 14 of those migrating proximally (5.2%). Factors associated with proximal pancreatic stent migration were a diagnosis of sphincter of Oddi dysfunction (odds ratio 4.2) and stent length greater than 7 cm (odds ratio 3.2).\(^1\)

Complications of Proximally Migrated Biliary Stents

Many patients with proximal biliary stent migration may present asymptptomatically and are discovered at...
stent exchange, although patients can also present with a variety of symptoms including pain, jaundice, ductal obstruction, and cholangitis. In a 1995 study, cholangitis occurred in 4 out of 27 cases with benign strictures and 5 out of 17 cases with malignant strictures. The time to presentation for cholangitis varies with one patient presenting as early as 4 days and another presenting as far as 6 weeks from placement. Ductal obstruction typically occurs with rates of 2% to 21% of stent migration. The time to presentation with ductal obstruction can occur as far out as 3 months since placement. As many as 50-87.5% of patients with proximally migrated biliary stents can present without symptoms. The median time interval of presentation with proximal migration was 5 months.

Complications of Proximally Migrated Pancreatic Stents
Like biliary stents, many patients with proximal pancreatic stent migration may present asymptptomatically and can be discovered at stent exchange, but many other present with abdominal pain due to or unrelated to pancreatitis. Some of the recognized complications of proximally migrated pancreatic stents include pancreatitis, stent occlusion, morphologic changes of the pancreatic duct, and stent fracture. In a study looking at 9 patients with proximally migrated pancreatic stents, 3 patients presented with pancreatitis (33%). The other 6 patients (67%) presented without symptoms at stent exchange. Although there have been no studies looking at rate of ductal injury following migration, pancreatic stents are known to cause ductal changes including ductal irregularities, narrowing, and parenchymal changes. The median time interval from stent placement until stent migration was diagnosed was 2.3 months.

Retrieval Techniques
The retrieval of both pancreatic and biliary stents can be categorized as follows: direct traction on the stent, indirect traction on the stent, and retrieval after cannulating the duct, often involving cannulation of the stent lumen at the same time. Direct traction involves grasping the stent directly with a basket, forceps, snare, or a sphincterotome and pulling the stent out of the duct. Indirect traction is performed with inflating a balloon above or alongside the migrated stent and then pulling the balloon towards the distal duct in an attempt to move the distal end of the stent into the duodenum. Retrieval after cannulating the stent lumen usually involves cannulation with a guidewire and then using a variety of over-the-wire accessories to retrieve the stent. These accessories include Soehendra stent extractor, basket, occlusion balloon, dilation balloon, forceps, or a sphincterotomy.

Plastic Biliary Stents
A 1995 study reviewed the success rate of the available retrieval techniques for proximally migrated plastic biliary stents. The study included 44 cases of proximal migration. Twenty-seven of the forty-four proximally migrated plastic stents were placed for benign strictures while seventeen were used to treat malignant strictures. Of the methods used, cannulation and retrieval with a Soehendra stent extractor was the most common with thirteen of the thirty-six successful retrievals (36%). Other stent cannulation techniques used successfully were basket in two patients, forceps in one patient, dilation balloon in one patient, and a sphincterotome in which the distal flap of the stent was entrapped by the cautery wire in one patient. The second most successful technique was with indirect traction with a stone extraction balloon with seven successful extractions (19%). Direct traction was also successful technique with five stents removed directly with a basket (14%), five removed directly with forceps (14%), and one removed directly with a sphincterotome (3%). The authors reported an overall success rate of 82% with most of the irretrievable stents occurring in patients with malignant strictures.

In a 1999 retrospective study at a tertiary center reviewed forty-six patients with proximally migrated biliary stents, the most successful technique was with direct traction with a basket with twenty-two successful retrievals (59%). The second most successful technique was with a balloon with 4 successful retrievals (11%). However, the study did not differentiate between indirect traction and stent cannulation and what type of balloon that was used. Direct traction with forceps was used in three patients (8%). Direct cannulation with a Soehendra stent retriever was successful in 2 patients (5%). They also used a combination of indirect traction with a balloon and direct traction with a basket that was successful in three patients (8%). They also used a combination of basket and ball tip catheter that was successful in 2 patients (5%). They reported a success rate of 90%. The four stents that were irretrievable were
associated with malignant strictures.\textsuperscript{12}

A 1998 retrospective study at a tertiary center reviewed 33 cases of proximally migrated biliary stents. Eighteen of the cases were with benign strictures and fifteen with malignant strictures. The most commonly used technique for stent retrieval in patients with benign strictures was direct traction with ten successful retrievals. Of the ten cases, six used a basket, two used forceps, and two used a snare. Three of the benign stricture cases were successful with indirect traction with a stone extraction balloon. As for stent cannulation techniques, two cases were successful with a stone extraction balloon and one case with a Soehendra stent extractor. In patients with proximally migrated stents above with malignant strictures, the (continued on page 42)
most used technique was stent cannulation with six of the fifteen cases. Of the six successful stent cannulation techniques, three were with a stone extraction balloon and three were with a Soehendra stent extractor. With direct traction techniques, five of the fifteen stents were retrieved with four being retrieved with a basket and one with a snare. Indirect traction with a balloon was not successful in patients with proximally migrated stents above malignant strictures. Of the migrated stents in patients with benign strictures, sixteen of the eighteen stents were able to be retrieved (89%). Two patients were lost to follow up. Of the migrated stents associated with malignant strictures, twelve of the fifteen stents were able to be retrieved (80%). Three were not able to be retrieved and a second stent was placed to allow for drainage.9

A 2009 retrospective study at a tertiary referral center analyzed all patients that underwent biliary stent placement between December 2004 and March 2006. They identified twenty-four cases of proximal migration of plastic biliary stents out of a total of 524 patients. Half of the twenty-four migrated stents were removed with a stone extraction balloon with indirect traction. The other half were removed with direct traction with biopsy forceps. They were able to retrieve all of the proximally migrated stents endoscopically.2

Several case reports documenting novel techniques to remove proximally migrated plastic biliary stents exist. One case report used a sphincterotome advanced over a wire to beyond the proximal end of the stent. Then, the proximal end of the sphincterotome was bowed to form a hook, which caught the stent, allowing removal with traction.13 Another report used a cholangioscope to directly visualize the migrated stent and to allow selective cannulation of the stent itself with a guidewire followed by the stent being removed with a Soehendra stent extractor.14 Another case report demonstrated success with a combination of a basket and a guidewire to form a loop to catch the distal end of the stent.15 A comparison of the studies discussed for plastic biliary stent retrieval can be seen in Table 1.

### Metal Biliary Stents

Metal biliary stents come in two categories: covered or uncovered, with covered stents being further subdivided into partially covered, fully covered, and fully covered but fenestrated. Covered stents, as the name implies, are covered in polyurethane or polyethylene to prevent tumor ingrowth. It is this covering that also increases

### Table 1. Comparison of Techniques for Removal of Plastic Biliary Stents

<table>
<thead>
<tr>
<th>Study, Year</th>
<th>Retrieval Success Rate</th>
<th>Indirect Traction, Balloon</th>
<th>Direct Traction, Balloon</th>
<th>Basket</th>
<th>Forceps</th>
<th>Sphincterotome</th>
<th>Soehendra Stent Extractor</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamasky et al., 1995</td>
<td>36/44</td>
<td>7</td>
<td>1</td>
<td>2 (over guidewire), 5 (direct)</td>
<td>1 (over guidewire), 5 (direct)</td>
<td>1 (over guidewire), 1 (direct)</td>
<td>13</td>
<td>-</td>
</tr>
<tr>
<td>Chaurasia et al., 1999</td>
<td>42/46</td>
<td>4 (study did not differentiate direct or indirect)</td>
<td>22 (direct)</td>
<td>3 (direct)</td>
<td>-</td>
<td>2</td>
<td>3 (balloon with basket), 2 (basket and catheter)</td>
<td></td>
</tr>
<tr>
<td>Lahoti et al., 1998</td>
<td>28/33</td>
<td>3</td>
<td>5</td>
<td>10 (direct)</td>
<td>2 (direct)</td>
<td>-</td>
<td>4</td>
<td>3 (snare, direct), 1 unable to determine</td>
</tr>
<tr>
<td>Arhan et al., 2008</td>
<td>24/24</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>12 (direct)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
the risk of stent migration as the metal struts cannot imbed in the bile duct wall. Uncovered stents allow for the possibility of tumor ingrowth and are, overall, much less likely to migrate. Because covered stents are more likely to migrate, there is more literature regarding fully covered stent migration and their retrieval.

A 2008 prospective study from the Netherlands evaluated the removability of fully covered self-expandable metal stents (FCSEMS) in benign common bile duct strictures. FCSEMS were placed in six patients with proximal stent migration occurring in two patients. In the first patient, they attempted retrieval with a snare, but it caused the distal end of the stent to become impacted in the common bile duct wall. They attempted dilating the stricture and expanding the papillotomy opening, but the stent could not be retrieved. Plastic stents were placed to allow for drainage. In the second patient, the stent was cannulated with a guidewire and retrieved with a dilation balloon.16

A 2011 multicenter, prospective comparative pilot study studied the anti-migration effects and complications rates of fully covered self-expandable metal stents. In forty-three patients with benign strictures, twenty-two were assigned to the anchoring flap category and twenty-one to the flared end. Both of the FCSEMS had a flared end on the distal portion of the stent, but the stents with the anchoring flaps had four flaps at the proximal end of the stent. The flared end group had proximal migration in one patient and distal migration in six patients. The proximally migrated stent was successfully removed with rat-tooth forceps under fluoroscopy.17

A 2014 case series reported on five patients with proximally migrated fully covered self-expandable metal stents and their retrieval in patients with benign strictures. In the first patient, proximal migration and distal impaction was discovered eleven months later at elective ERCP. A wire was passed alongside the stent and a dilation balloon was used to retrieve the stent. Retrieval was not successful so plastic stents were placed to allow for drainage. Two months later, the plastic stents were removed and retrieval was attempted again with a dilation balloon and failed. A FCSEMS was placed for drainage. Two months later, the FCSEMS and the migrated stent was removed simultaneously with rat-tooth forceps. The other four patients were similar with migrated stent retrieval failure with dilation balloons, forceps, and loops. All four had a new FCSEMS placed at the distal end of the migrated stent and the two stents removed together with forceps two to six weeks later.18 This case series emphasizes some of the very real potential difficulties in removing proximally migrated SEMS. A comparison of the studies discussed can be seen in Table 2.

One case report exists describing a patient with a proximally migrated uncovered SEMS but this patient underwent attempt at stent removal, but instead placed a second stent across the biliary stricture to allow for drainage.1

### Pancreatic Stents

Pancreatic stents are used for a variety of conditions such as pancreatic duct strictures, drainage of pancreatic pseudocysts, treatment of pancreatic duct leaks, and (most commonly) as prophylaxis against the development of post-ERCP pancreatitis. All dedicated pancreatic duct stents are currently plastic. SEMS have been used in the pancreas in a limited manner off-label. Proximally migrated stents can present special challenges as the pancreas has ducts that are smaller and the pancreas is, in general, less tolerant of interventions. The pancreatic duct also has side branches with can trap the ends of a pancreatic duct stent, making retrieval potentially very difficult if the distal end of the stent cannot be accessed easily. Many of the techniques used for biliary stents are successful with retrieval of pancreatic stents.

A 2009 retrospective study reviewed thirty-three cases of proximally migrated pancreatic stents at a tertiary referral center. Of the thirty-three cases,
twenty-three were placed endoscopically while ten were placed surgically. The most successful technique was with a dilation balloon with indirect traction with eight of the endoscopic stents (35%) and two of the surgically placed stents (20%) removed with this technique. The second most common technique was with direct traction with forceps with five of the endoscopic stents (22%) and two of the surgical stents (20%) retrieved successfully.

Direct traction with a snare retrieved one endoscopic stent and one surgical stent. Stent cannulation with a guidewire followed by snare capture was successful in two of the endoscopically placed stents. Baskets were used in one endoscopic stent and two surgical stents. One of the surgical stents was removed, but it was unclear in the chart which technique was used.

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One endoscopic stent required interventional radiology and a loop snare. Nine patients required multiple procedures for successful retrieval. Five stents could not be retrieved with four requiring surgical removal and one patient treated with observation. The endoscopic retrieval success rate reported was 78% in endoscopic stents and 80% in surgical stents.

A 1998 retrospective study at a tertiary center reviewed clinical findings and outcomes in twenty-six cases of proximally migrated pancreatic stents. The study distinguished between main/ventral pancreatic stents (10 cases) and dorsal pancreatic stents (16 cases). For the main pancreatic duct stents, eight of the ten stents were successfully retrieved (80%). The stents were retrieved using a standard wire basket in 3 patients, a mini-basket in one patient, and wire guided basket in one patient. Two of the stents were removed with indirect traction with a stone extraction balloon and one was removed with direct traction with a stone extraction balloon. Of the two that were not able to be retrieved, one required a distal pancreatectomy because of the severity of the symptoms while the other patient was observed clinically and the stent was left in situ.

For the dorsal pancreatic duct migrated stents, 12/16 (75%) cases were successfully retrieved. The stents were retrieved using a basket in five patients, a stone extraction balloon providing indirect traction in 3 patients, a stone extraction balloon with direct traction in one patient, a snare in two patients, and a rat tooth forceps in one patient. In the 4 patients whose stents were not able to be retrieved, 2 were asymptomatic and were followed clinically with normal serum amylase levels after two years of follow up while the other two patients required surgical removal of the stents.

Several case reports have been published that document novel techniques to remove proximally migrated pancreatic stents. One case report attempted retrieval with snares, baskets and balloons with no success. At this point, the Spyglass (Boston Scientific, Natick MA) visualization system was used to directly evaluate the stent and revealed that the stent had migrated into a side branch of the pancreatic duct. The stent was grabbed by a miniature forceps and removed. Another case report used a rotatable cardiology guidewire with a 3.0 mm angioplasty balloon after failure with indirect traction with a stone extraction balloon, Soehendra stent extractor, and snare. Another case report used a guidewire to cannulate the stent as a means to facilitate placing another stent within the distal end of the initial (migrated) stent. The two stents were removed together en bloc with forceps and a snare.

Comparison of the retrieval techniques used in the studies can be seen in Table 3.

### Endoscopic Failure-Indications for Surgery

Failure to retrieve a proximally migrated endoscopic stent may warrant evaluation by surgery for stent removal, especially if the patient is symptomatic. A 2009 retrospective study reviewed thirty-three cases of proximally migrated pancreatic stents at a tertiary referral center. Of the thirty-three cases, five stents were not able to be retrieved endoscopically. One was asymptomatic and was observed. Of the four patients that required surgeries, three underwent distal pancreatectomies while the fourth had a surgical revision of a remote pancreaticojejunostomy.

In some patients attempts at stent removal, while usually successful, are contraindicated necessitating early surgical referral. A case report describes a patient that required surgical removal of a proximally migrated plastic biliary stent. Abdominal x-ray showed that the

<table>
<thead>
<tr>
<th>Study, Year</th>
<th>Retrieval Success Rate</th>
<th>Indirect Traction, Balloon</th>
<th>Direct Traction, Balloon</th>
<th>Forceps</th>
<th>Snare</th>
<th>Basket</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price et al., 2009</td>
<td>28/33</td>
<td>10</td>
<td>1</td>
<td>7</td>
<td>2 (direct), 2 (after cannulation)</td>
<td>3</td>
<td>1 - Interventional radiology, 1 - unknown</td>
</tr>
<tr>
<td>Lahoti et al., 1998</td>
<td>20/26</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>-</td>
</tr>
</tbody>
</table>
proximal end of the stent had migrated to the level of the diaphragm. CT abdomen showed that the proximal end had migrated into the inferior vena cava through the middle hepatic vein. Stent retrieval was not attempted because of the risk of uncontrolled bleeding. The stent was removed surgically and the patient underwent creation of a Roux en Y hepatojejunostomy.

**CONCLUSION**

Retrieval of migrated biliary and pancreatic stents can be challenging, especially proximally migrated stents. Most migrated stents can be removed endoscopically without the morbidity of surgery. Although most reports used a variety of techniques, some of the more commonly used were direct traction with a snare or forceps and indirect traction with a dilation or stone extraction balloon. These techniques are often the first to be used for the removal of the stents. Some of the retrievals required multiple attempts for removal. As more novel techniques develop, retrieval rates may improve. In those that fail endoscopic retrieval, surgical removal can still be considered.

**References**


15. Lee JH, Yan SL, Chen CH, Yeh YH, Yueh SK. Endoscopic retrieval of a proximally migrated biliary plastic stent using a guidewire loop technique. Endoscopy. 2014;46


