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Biliary stenting in difficult common bile duct stones: a single tertiary center experience

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Background/aim: We aimed to examine the effect of plastic biliary stenting in the treatment of common bile duct (CBD) stones.

Materials and methods: The data of 13,034 patients in our unit who had endoscopic retrograde cholangiopancreatography (ERCP) between 2008 and 2015 were scanned retrospectively.

Results: A biliary stent was placed in 61 of 74 patients. While the plastic biliary stent was placed in patients, the mean stone size after the 1st ERCP was 20 mm and the bile duct size was 13 mm. At the time of the 2nd ERCP conducted approximately 73.9 days later, the mean stone size was found to be 15 mm and the bile duct size was 12 mm. With recurrent ERCPs, the CBD stone was successfully removed in 53 patients but could not be removed in 8 patients. Among the 53 successful cases, 29 removals were successful in the 2nd ERCP session, 16 were successful in the 3rd session, 2 were successful in the 4th session, 1 was successful in the 5th session, 4 were successful in the 6th session, and 1 was successful in the 7th session.

Conclusion: For CBD stones that cannot be removed by standard methods, temporary plastic stenting is an alternative method.

Key words: Cholelithiasis, difficult common bile duct stone, endoscopic retrograde cholangiopancreatography, plastic stent

1. Introduction

Choledocholithiasis is the most common gastrointestinal disorder in the practice of therapeutic endoscopy. Endoscopic retrograde cholangiopancreatography (ERCP) is the primary technique combined with the endoscopic sphincterotomy, balloon, and basket technique that is used to remove common bile duct (CBD) stones. Although the success of stone extraction with ERCP is 80%–85% (1), in 10%–15% of cases, the stone cannot be removed due to its size (>15 mm), the distal CBD being short (<36 mm) and narrow-angled (<135°), or the impact of the stone and anatomical challenges (2).

Cases of patients whose stones cannot be removed with the basket and balloon catheter after endoscopic sphincterotomy are referred to as difficult cases (3). In difficult cases of biliary stenting, electrohydraulic lithotripsy (4,5), extracorporeal shock wave lithotripsy (6,7), and laser lithotripsy (8) can be used as alternatives to the standard method. However, for elderly patients with high comorbidity and patients at high-risk in surgical procedures and other endoscopic procedures, biliary stenting becomes prominent.

When the attempt to remove a CBD stone fails, a temporary plastic stent can be placed in the patient in order to facilitate the drainage of bile, function as a bridge for advanced methods, and minimize the impact of the stone. Previous studies have shown that this type of stent enables the reduction of stones and facilitates their removal (9).

In this study, we aimed to examine the effect of biliary stenting on the treatment of CBD stones.

2. Materials and methods

This study was conducted at the Yüksek İhtisas Training and Research Hospital Gastroenterology Clinic in Turkey between 1 January and 1 June 2015.

In this study, the data of 13,034 patients who underwent ERCP between February 2008 and January 2015 were scanned retrospectively. Large-sized multiple stones that could not be removed in the first operation using the basket and balloon catheter after endoscopic sphincterotomy were accepted as difficult stones. The data of 74 patients (among the patients in whom a plastic stent was placed due to a difficult stone) whose file information

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we could obtain, i.e. those with a recorded cholangiogram from which we could take measurements and those without nasobiliary drainage, were analyzed.

The files and recorded cholangiograms of patients enrolled in the study were examined retrospectively and their choledochal diameters (widest diameter) and stone diameters (largest stone) in the first and subsequent sessions were recorded, using their duodenoscope diameters as a reference.

Both features (stone and choledochal diameters) of patients in whom a plastic stent was placed in due to a difficult stone, between the first operation and subsequent operations, and the features of "successful" groups, in which the stones were entirely and endoscopically removed, as well as "unsuccessful" groups, in which the stones could not be entirely cleared, were examined. Patients were evaluated in terms of postprocedure complications of acute pancreatitis and cholangitis. Acute pancreatitis was defined as newly emerging abdominal pain requiring hospitalization for more than a night and an amylase/lipase level 3 times higher than normal after ERCP, and cholangitis was defined as fever lasting for more than 24 h due to biliary causes.

2.1. Endoscopic retrograde cholangiopancreatography and stenting

ERCP was performed using the Olympus TJF-240 and 260 (Olympus Medical System Corp., Tokyo, Japan) series duodenoscope after topical lidocaine and pharynx anesthesia, followed by sedation with intravenous pethidine HCl and midazolam. On reaching the second part of the duodenum, bowel movements were controlled by intravenous hyoscine-N-butyl bromide, or glucagon when the former was ineffective. A contrast medium was injected through the papilla cannulation with the help of a guide wire. When the stone was detected, endoscopic sphincterotomy was applied for naive patients and for those who had not undergone sphincterotomy before, large-diameter balloon (10–12 mm) dilatation was applied either directly or in addition to the sphincterotomy. Stones were removed using the balloon or the basket technique as well as using mechanical lithotripsy when necessary. A plastic stent was placed in patients whose stone could not be removed following the first procedure with basket and balloon catheter, due to various reasons beyond endoscopic sphincterotomy. These patients were considered as having difficult stones. Stent diameters were selected as 7F, 10F, or 11.5F depending on the characteristics or on the degree of the cases. Among the cases with biliary stent, the Amsterdam type stent was placed in 69 of them, a single pigtail stent (Boston Scientific Corporation, Natick, MA, USA) was placed in 1 of them, and a double pigtail stent was placed in 4 of them.

2.2. Statistical analysis

SPSS 20 for Windows (IBM Corp., Armonk, NY, USA) was used for statistical assessments. The suitability of variables to normal distribution was examined using visual (histograms and probability plots) and analytical (Kolmogorov–Smirnov/Shapiro–Wilk) methods. Descriptive analysis was presented using the median and interquartile range for normally distributed variables (using frequency tables for ordinal variables). Since choledochal size and stone size showed an abnormal distribution, these parameters were compared using the Wilcoxon test. $P < 0.05$ was considered statistically significant.

3. Results

CBD stones were determined in 5775 (44.3%) patients out of the retrospectively scanned 13,034 patients. Among these 5775 patients with CBD stones, the choledoch of 5368 patients (92.97%) was completely cleared of stones in the first session. Among the remaining 407 (7.03%) cases, various endoscopic procedures were applied for 333 (5.77%) of them, and a biliary stent was applied in 74 cases (1.28%), assuming that the stones were difficult stones. Since 13 of the 74 patients with biliary stents did not continue with the follow-up, the data of 61 patients (21 males, 40 females, average age: 68.4 years) were then examined.

At their first admission, 9 patients (14.8%) had cholangitis, 2 patients (3.2%) had pancreatitis, and 50 patients (82%) had abdominal pain. The papilla was naive in the stent and was placed in 38 cases (62.3%), with endoscopic sphincterotomy in 23 cases. A 10F stent was placed for 48 (78.6%) patients, 7F was placed for 11, and 11.5F was placed for 2. One plastic stent was placed for 58 patients (95.1%), 2 plastic stents for 2 patients (3.3%), and 3 plastic stents for 1 patient. In 13 (12 successful, 1 unsuccessful, 21.3%) of the 61 stents placed, the patients' papilla was at the edge of the diverticulum.

During ERCP, among 61 patients in the study group, 23 patients (37.7%), underwent balloon dilatation, 8 patients (13.1%) underwent the expansion of endoscopic sphincterotomy, and 5 patients (8.2%) underwent both balloon dilatation and the expansion of endoscopic sphincterotomy. The remaining 25 patients (40.9%) had no additional processing to carry out. In 28 patients (45.9%), lithotripsy was needed. During these operations, bleeding or perforation was not observed in any of the patients.

Cholangitis developed in a total of 4 patients (6.6%), including 3 cases in which the stone could not be removed, and the stent was placed within 30 days after the first ERCP session; in 1 patient, a stent was placed after a second ERCP session of stenting. Post-ERCP pancreatitis was observed in 2 patients (3.3%) after the first ERCP session.

Stone size was measured as an average of 20 mm (8–42 mm) after the first session of ERCP, and it decreased to about 15 mm (0–35 mm) in the second session ($P < 0.001$). Choledochal diameter was measured as an average of 13 mm (6–25 mm) in the first session of ERCP, and it decreased to 12 mm (6–23 mm) in the second session (Figure 1). The application period for the second ERCP in patients was determined as an average of 73.9 days.

CBD stones were removed from 53 of the 61 patients with biliary stents in repeated ERCP sessions (successful). Surgery was conducted on the remaining 8 patients (unsuccessful).

The features of the successful and unsuccessful cases after biliary stents were placed in patients are presented in the Table. Stone and choledoch sizes according to ERCP sessions in the successful and the unsuccessful groups are shown in Figure 2. There was no significant difference between the two groups in terms of demographic and clinical findings. Sphincterotomy was applied in 21 of the patients who underwent a successful operation and in 2 of the patients underwent a failed operation.

In patients who underwent a successful operation, after stent placement in the 1st ERCP session, 29 (54.7%) removals were successful in the 2nd session, 16 (30.1%) were successful in the 3rd session, 2 (3.8%) were successful in the 4th session, 1 (1.9%) was successful in the 5th session, 4 (7.6%) were successful in the 6th session, and 1 (1.9%) was successful in the 7th session (Figure 3). In the successful group, all of the stones were cleared within 2.7 ± 1.4 months.

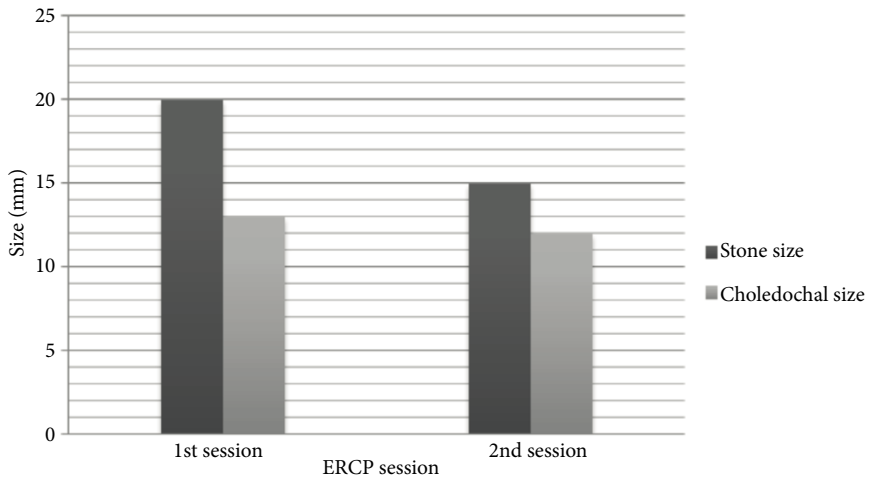

Figure 1. The change in stone and choledochal size in patients with biliary stent after the 1st and 2nd sessions of ERCP.

Table. The features of successful and unsuccessful cases after biliary stent.

Variables	Successful treatment	Unsuccessful treatment	P
	n = 53	n = 8	
Age (years)	67.6 ± 15.6	74.3 ± 10.3	0.140
Sex, female, n (%)	33 (62.3)	7 (87.5)	0.161
Stone size (1st session)	20 (8–40)	20.5 (10–42)	0.584
Stone size (2nd session)	15 (0–30)	16 (13–35)	0.206
Choledochal size (1st session)	13 (6–25)	14 (9–20)	0.974
Choledochal size (2nd session)	12 (6–23)	13 (11–20)	0.341
Presence of diverticula, n (%)	12 (22.6)	1 (12.5)	0.514
Gall-bladder operation, n (%)	21 (39.4)	2 (25)	0.426
Number of ERCP sessions, n (min–max)	2 (2–6)	2 (1–7)	0.369
Stent length, F (min–max)	11.6 (9–18)	11 (9–12)	0.124
2nd ERCP time, days (min–max)	70 (2–401)	121 (16–125)	0.093

ERCP: Endoscopic retrograde cholangiopancreatography.

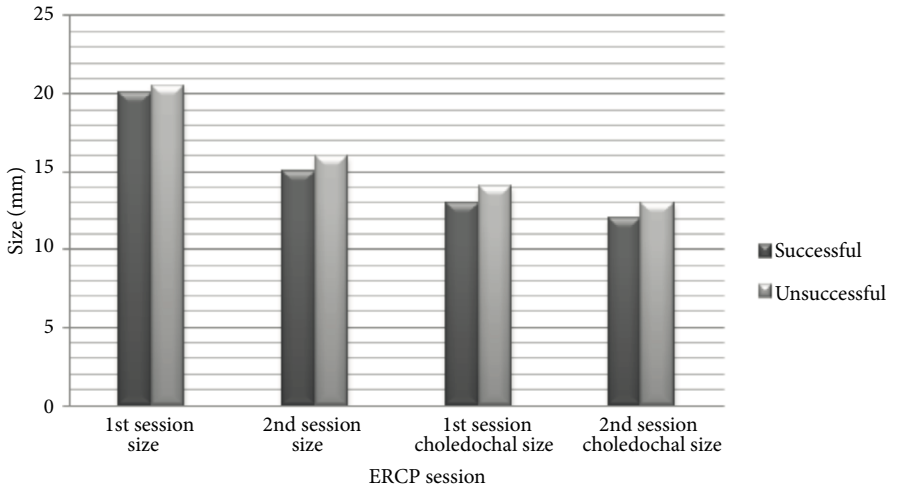

Figure 2. The comparison of stone and choledochal size in patients with successful and unsuccessful process after the 1st and 2nd procedure.

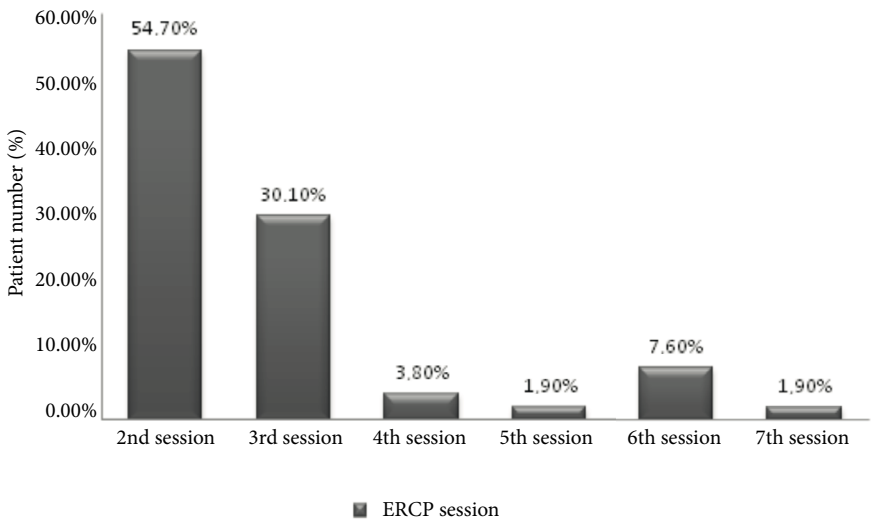

Figure 3. The success rate (%) of stone removal in the successful group based on ERCP procedure.

4. Discussion

The sensitivity and the specificity of ERCP in the diagnosis of CBD stones are over 95% (10). After endoscopic sphincterotomy, CBD stones are treated successfully in 85%–90% of patients with basket and balloon catheter (3,4).

Some factors may influence the success of the ERCP. These factors are the size of the stone, multiple stones, impaction of the stone, CBD in sigmoid shape, a periampullary diverticulum that obstructs sufficient sphincterotomy, stenosis, and patients that undergo biliodigestive surgeries (for example, previous Billroth II gastrectomy) (4,11–14).

When an attempt to remove a CBD stone fails, a temporary plastic stent can be placed in the patient in order to facilitate the drainage of bile, function as a bridge for advanced methods, and prevent the stone from being impacted. Previous studies have shown that plastic stenting enables the reduction of stones and facilitates their removal (9). Therefore, the biliary stent and lithotripsy being another method can be considered as a projected method, prior to surgery, in impacted and intrahepatic stones (15).

The reduction in stone size after plastic stenting can be explained as follows: mechanical friction between the biliary stent and stone causes fragmentation, and, over time, the fragmented stone shrinks in size. Millimetric-sized fragmented stones drain with the stent. The plastic stent moves easily and is compactible with body and bowel movements; it causes more friction than expected, and

also allows for greater drainage (11). Thus, this method provides a major contribution to the fragmentation of CBD stones, as well as allowing for biliary drainage (11–14).

Biliary stenting is a practical alternative for elderly patients and other patients who are at high risk due to their comorbid conditions for endoscopic and surgical procedures (16).

In a study conducted by Chan et al., a plastic biliary stent was placed in 46 patients whose stones could not be removed by ERCP in the first session. In the second session of ERCP, the CBD stone was successfully removed from 38 (60.9%) patients (12). In another study, in the 2nd session of 20 patients who underwent a first failed ERCP session for CBD stones and had 7F plastic stenting, which was performed after 6 months, 11 cases (55%) were successful (13). In a study conducted by Katsinelos et al., among 25 patients who had an unsuccessful first session of ERCP, 11 of them had a successful second session after biliary stenting (14). In another study, among 40 patients who were observed after having a biliary stent inserted for 65 days, 37 (93%) of them had their stones cleared in the second session (11). In a study by Maxton et al., a temporary biliary stent was placed with ERCP in 79 of 283 patients with CBD stones. After an average of 4.3 months, the result was successful in 50 (63%) patients (17).

In our study, the stones were successfully removed from 53 patients out of 61 for whom a plastic stent was placed with ERCP. When we considered the number of sessions in the 53 successful patients, the success rate was 73.7% in the 2nd or 3rd session. The stent stayed an average of 73.9 days. When we compare these results with the studies in literature, we see that our success rate is above the average reported in the literature and the duration of stone removal is below the average in literature. This may be due to endoscopists' experience, features of the stent, and differences between average stone size and number among the study groups.

It was reported that the periampullary diverticulum was observed in 5%–32% of the patients examined with a duodenoscope (18). In our study, while the papilla was on the edge of the diverticulum in 12 (22.6) patients in the successful group, it was on the edge in 1 patient in the unsuccessful group. Our results were consistent with the literature and did not differ significantly between the two groups.

It has been reported that impacted CBD stones and stone sizes are important determinants of endoscopic success (19,20). As was shown in a multicenter study, while the success rate is 90%–100% in cases of small stones with a diameter of less than 2 cm, it decreases to 68%–83% in cases of larger stones with a diameter of 3 cm or more (21). It was reported in the studies by Lauri et al. that stones smaller than 10 mm were able to be extracted. However, when the diameter of the stone exceeds 15 mm, the rate of success is 12%, and this rate reduces when the stone diameter is more than 18 mm (22). The average stone size in patients with plastic stent was 20 mm in our study. Regardless of this, the success of stone removal in ERCP was rated quite high.

It is known that when the removal of CBD stones fails using the standard method, a biliary stent minimizes the impact of the stone and functions as a bridge before surgery. Surgery was also recommended to 6 patients in our study. Lifelong transient biliary stenting is an alternative method for patients whose choledochal stone cannot be removed with ERCP and who cannot undergo surgery due to comorbid diseases or due to advanced age (23). In our study, 2 patients were followed with transient biliary stenting at intervals of 2–3 months, due to comorbid diseases.

Bile duct stones are removed after sphincterotomy with a 85%–90% success rate using a basket and balloon catheter. However, some additional methods, such as endoscopic sphincterotomy expansion, wide balloon dilatation to the sphincter, and mechanic lithotripsy, are required in patients whose stone cannot be removed. In our study, some patients underwent an additional balloon dilatation, some had endoscopic sphincterotomy expansion, and some underwent both balloon dilatation and endoscopic sphincterotomy.

Mechanical lithotripsy was first described in 1982 by Riemann et al. and has been widely used in the treatment of difficult stones (24). In our study, lithotripsy was needed in 28 patients (25/53, 45.9%).

ERCP often results in certain complications, including pancreatitis and cholangitis.

In a study of 83 patients by Ang et al., plastic biliary stenting caused cholangitis, biliary pancreatitis, obstructive jaundice, and biliary colic in 71%, 3.6%, 21.4%, and 3.6% of patients, respectively, during an average period of 19 months of follow-up (25). Hui et al. reported cholangitis in 63.2% of their patients (26).

In our study, cholangitis developed in 4 patients (6.6%) and pancreatitis developed in 2 patients (3.3%) in the first 30 days among 61 patients. This rate was found to be very low compared to the rate reported in the literature. This may most likely be due to the short follow-up time or expert endoscopist.

The main limitation of our study is its retrospective and single-centered design. However, this limitation can be ignored since our ERCP unit is the largest unit in Turkey that accepts the highest number of patients.

In conclusion, in our study, stones were successfully removed in 86.9% of the patients in whom a biliary stent was placed. Our study, unlike other studies, reveals the

effect of biliary stents on stone treatment, as well as the shrinkage effect on the diameter of the choledoch. Although difficult stones constitute a problem for the endoscopist, they can successfully and endoscopically be removed to a large extent. In cases of biliary tract stones that cannot be removed by standard methods, placing a temporary plastic stent is an alternative method. We have shown in our study that stones can be completely and safely removed in a few sessions in difficult cases after a short-term plastic stent placement. In addition, endoscopic biliary stenting is a practical alternative method used for elderly patients and other high-risk patients due to their comorbid conditions for surgical procedures, also functioning as a bridge for surgery.

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