Transluminal antegrade drill dilation technique for hepaticojejunostomy stricture with cholangioscopic evaluation (with video)


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Conflict of Interest: The authors declare that they have no conflict of interest.

Abstract:
Background and aim
Balloon dilation and plastic stent deployment have been performed as hepaticojejunostomy stricture (HJS) treatment techniques by EUS guidance. Although these techniques have shown favorable clinical results, the treatment period can be long because stent deployment is required. In addition, HJS may recur even after treatment because the scar tissue itself remains. To overcome these challenges, we developed an EUS-guided antegrade drill dilation technique for treating HJS. The aim of this study was to evaluate the technical feasibility and safety of this technique in terms of the pre- and post-cholangioscopic findings.

Method
This retrospective study included consecutive patients who were complicated with symptomatic 22 HJS between November 2022 and February 2023. Transluminal antegrade drill dilation (TAD) using a novel drill dilator was attempted within 14 days after EUS-HGS. HJS was diagnosed by cholangioscopy before TAD, and resolution was evaluated after TAD using cholangioscopy.

Result
TAD was attempted at around 11 days after EUS-HGS. The cholangioscope was inserted successfully in all patients after this procedure. Cholangioscopy revealed stricture without evidence of malignancy in 19 patients. In the remaining three patients, stricture was not observed and these patients underwent stent exchange rather than TAD. Among the 19 patients, passage of the guidewire across the HJS into the intestine was unsuccessful in 4 patients, and the technical success rate of this procedure was 78.9%. TAD was successful in all 15 patients in whom passage of the guidewire was achieved.

Conclusions
In conclusion, TAD appears to be technically feasible and safe.

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Transluminal antegrade drill dilation technique for hepaticojejunostomy stricture with cholangioscopic evaluation (with video)

Introduction

Hepaticojejunostomy stricture (HJS) can occur as a complication after pancreatic or biliary surgery, with frequency ranging from 4% to 10% [1]. As recent technological developments in diagnostic tools such as endoscopic ultrasound (EUS) begin to have an impact on the early detection of pancreato-biliary cancer and on patients considered eligible for neoadjuvant chemotherapy, the number undergoing pancreaticoduodenostomy (PD) or pylorus-preserving PD may increase, and therefore the number complicated with HJS may also increase [2-6]. HJS is traditionally treated by the percutaneous transhepatic approach (PTBD) [7, 8], however, PTBD has several limitations, including external drainage, which may lead to prolonged hospitalization, and the risk of self-removal of the tube. Double balloon enteroscopy endoscopic retrograde cholangiopancreatography (DB-ERCP) has also been reported as a treatment option for HJS [8-11] but has the disadvantages of prolonged procedure time and a relatively low technical success rate. Endoscopic ultrasound-guided biliary drainage (EUS-BD) has recently been reported as an alternative technique for failed ERCP and patients contraindicated for PTBD [12, 13]. This technique has a high technical success rate; however, it has not been fully evaluated for HJS [14-17].

Balloon dilation and plastic stent deployment have been performed as HJS treatment techniques by PTBD or under DB-ERCP guidance, and fully covered self-expandable metal stent (FCSEMS) deployment has also been attempted with the aim of improving the efficacy of HJS resolution [2, 15, 18]. Although these techniques have shown favorable clinical results, the treatment period can be long because stent deployment is required. In addition, HJS may recur even after treatment because the scar tissue itself remains [19]. To overcome these challenges, we developed an EUS-guided antegrade drill dilation technique for treating HJS. The aim of this study was to evaluate the technical feasibility and safety of this technique in terms of the pre- and post-cholangioscopic findings.

Patients and Methods

This retrospective study included consecutive patients who were complicated with symptomatic HJS between November 2022 and February 2023. In this study, symptomatic HJS such as obstructive
jaundice or cholangitis was included. Exclusion criteria comprised contraindications for endoscopic biliary drainage due to conditions such as massive ascites, or Eastern Cooperative Oncology Group (ECOG) performance status of 3 or 4, other severe organ failure, combined with other biliary drainage such as PTBD, or lack of consent for participation.

In our hospital, as 1st line treatment strategy for HJS, EUS-guided approach was performed. If this procedure was failed, other biliary drainage technique such as PTBD or DB-ERCP was attempted. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in the a priori approval given by the human research committee at Osaka Medical College (IRB No. 2022-210).

Technical tips for EUS-HGS and antegrade drill dilation technique (Video)

An echoendoscope (UCT260; Olympus Optical, Tokyo, Japan) was inserted into the stomach and the left hepatic lobe was identified. The intrahepatic bile duct was punctured using a 19G or 22G needle (EZ Shot 3 Plus, Olympus), according to the diameter of the intrahepatic bile duct. After successful puncture of the duct, contrast medium was injected to obtain cholangiography (Fig 1a) and a 0.025-inch (VisiGlide 1; Olympus) or 0.018-inch (Fielder; Olympus) guidewire was inserted into the biliary tract through the needle (Fig 1b). The intrahepatic bile duct and stomach wall were then dilated using a 4-mm balloon catheter (REN biliary balloon catheter; Kaneka, Osaka, Japan) or an ultra-tapered mechanical dilator (ES dilator; Zeon Medical Inc., Tokyo, Japan) (Fig 1c). Finally, a partially covered self-expandable metal stent (PCEMS) (8mm diameter, Spring Stopper; Taewoong Medical, Seoul, Korea) was deployed from the intrahepatic bile duct to the stomach using the intra-scope channel release technique (Fig 1d).

The tract was easily dilated by clockwise rotation of a drill dilator device (Tornus ES; Asahi Intecc, Aichi, Japan) (Fig 2) without needing to apply pushing force. Transluminal antegrade drill dilation (TAD) was attempted within 14 days after EUS-HGS. First, a standard ERCP catheter was inserted into the biliary tract through the EUS-HGS stent after dilation of the mesh of the EUS-HGS stent using balloon dilation or the trimming technique (Fig 3a, b). A cholangioscope (SpyGlass DS; Boston Scientific, Marlborough, MA, USA) was then inserted through the mesh into the biliary tract (Fig 3c) to evaluate the HJS site. If malignancy was suspected based on the cholangioscopic findings, antegrade biopsy was performed and the patient was excluded from the present study. Also excluded were those in whom stricture was not observed, because of the possibility that the symptoms might
have been caused by reflux cholangitis. If stricture was confirmed by cholangioscopy (Fig 4a), a
guidewire was inserted into the jejunum across the HJS site and TAD was performed using a drill
dilator (Fig 4b). Finally, the cholangioscope was reinserted to evaluate the HJS site (Fig 4c), the
PCSEMS was removed, and a plastic stent was deployed (REGULUS Biliary Tube Stent System; Japan
Lifeline Co., Ltd. Tokyo, Japan) (Fig 4d).

**Definitions and statistical analysis**

The primary outcome of this study was the technical success rate of TAD using a drill dilator.
Technical success was defined as resolution of the HJS, based on the cholangioscopic findings. The
secondary outcome was adverse events associated with TAD such as bleeding or perforation. The
cholangioscopic findings were classified as stricture, non-stricture, or malignancy. Bleeding
associated with TAD was defined as visible continuous bleeding on cholangioscopy for a period of 60
seconds. The severity of bleeding associated with TAD was defined according to the lexicon of the
American Society for Gastrointestinal Endoscopy [20]. Moderate bleeding was defined as that
requiring transfusion, intensive care unit admission, angiographic intervention, or prolonged
hospitalization for 4 to 10 days. Severe bleeding was defined as that requiring surgical intervention,
prolonged hospitalization for > 10 nights, or an intensive care unit stay of > 1 day. Bleeding that could
not be categorized as either of these was defined as mild bleeding. Perforation associated with TAD
was defined as contrast medium observed in the abdominal cavity. Procedure time of EUS-HGS was
measured from bile duct puncture to stent deployment. Also, procedure time of TAD was measured
from duodenoscope insertion to removal. As we exchange plastic EUS-HGS stents every 3–4 months
in our clinical practice, we checked for recurrence of HJS during this procedure. A lack of flow of
contrast medium across the HJS from the biliary tract to the intestine was considered to indicate
recurrence of HJS.

Descriptive statistics are presented as the mean ± standard deviation (SD) or median and range
for continuous variables, and as the frequency for categorical variables. All data were statistically
analyzed using SPSS version 13.0 statistical software (SPSS, Chicago, IL).

**Results**

Table 1 lists the patients’ characteristics. A total of 22 patients (median age, 75 years; 14 males,
8 females) were enrolled in this study. The clinical symptoms associated with HJS were cholangitis
(n=16) and obstructive jaundice (n=6). The primary disease was pancreatic carcinoma (n=8), cholangiocarcinoma (n=6), chronic pancreatitis (n=1), intraductal papillary mucinous adenoma (n=4), and common bile duct stones (n=4). B3 was mainly selected as the puncture site, and a 19G needle was used most commonly. Mean diameter of the intrahepatic bile duct at the puncture site was 3.85 mm. EUS-HGS was successfully performed in 20/22 patients. In the two failed cases, intrahepatic bile duct puncture itself was not performed because of insufficient bile duct dilatation, but EUS-HGS was successful when re-attempted several days later. Therefore, the final technical success rate of EUS-HGS was 100% (22/22). Mean procedure time of EUS-HGS was 15.0 min. Adverse events were observed in 3/22 patients (13.6%; abdominal pain, n=2; cholangitis, n=1), all of which were treated conservatively.

Table 2 shows the results of the procedures. TAD was attempted at around 11 days after EUS-HGS. Prior to insertion of the cholangioscope into the biliary tract, the mesh of EUS-HGS stent was dilated by balloon catheter in most cases (n=20). The cholangioscope was inserted successfully in all patients after this procedure. Cholangioscopy revealed stricture without evidence of malignancy in 19 patients. In the remaining three patients, stricture was not observed and these patients underwent stent exchange rather than TAD. Among the 19 patients, passage of the guidewire across the HJS into the intestine was unsuccessful in 4 patients, and the technical success rate of this procedure was 78.9%. TAD was successful in all 15 patients in whom passage of the guidewire was achieved. After TAD, cholangioscopy identified no bleeding or perforation in any patient. Mean procedure time of TAD was 22.8 min. Finally, in our strategy, after HJS treatment, plastic stent exchange was performed every 3 months. After 12 months, HGS stent might be removed if HJS recurrence was not observed. However, in our study, because of short follow-up period, clinical outcome could not be evaluated.

Discussion

In the case of surgically altered anatomy, there are two access routes to a biliary lesion: percutaneous and endoscopic. In a recent study, Choi et al evaluated the outcomes of patients with HJS who underwent PTBD or DB-ERCP [8]. Among these patients, 82 underwent DB-ERCP for suspected HJS, in whom the endoscope could reach the desired site in 63 (technical success rate, 77%); and 41 patients were diagnosed with HJS. The clinical success rate of DB-ERCP and/or PTBD was 71% (29/41). Among the clinically successful cases, only 20 patients underwent DB-ERCP, and
adverse events were observed in 7%. They concluded that DB-ERCP is an effective diagnostic and therapeutic tool for HJS, with low complication rates. However, the technical success rate was not as high in the present study; in fact, PTBD was required in 49% (20/41). In addition, the procedure time of DB-ERCP can be prolonged. As an alternative approach, EUS-guided techniques have recently emerged. Khashab et al conducted an international comparative study between EUS-guided (n=49) and enteroscopic access (n=49) among 98 patients with surgically altered anatomy [21]. Regarding the technical success rate, that of EUS-BD (48/49, 98%) was significantly higher than that of DB-ERCP (32/49, 65.3%) (OR 12.48, P=0.001). In addition, procedure time was significantly shorter in EUS-BD compared with DB-ERCP (55 min vs 95 min, P<0.01). Although adverse events were observed more frequently in EUS-BD compared with DB-ERCP (20% vs 4%, P=0.01), the majority of adverse events were mild/moderate. Therefore, EUS-BD may be increasingly attempted for patients with surgically altered anatomy.

As HJS treatment techniques, balloon dilation, plastic stent, and metal stent deployment have been reported [2, 8-11,15-19, 22-24]. Although balloon dilation is a simple procedure with a high technical success rate, the restenosis rate has been reported to range from 34.3% to 52.2% [22, 23]. In contrast, Tomoda et al conducted a prospective evaluation study of balloon dilation with plastic stent deployment for HJS under DB-ERCP guidance [9]. Of the 40 patients enrolled in the study, cholangiography was successful and both balloon dilation and plastic stent deployment across the HJS were achieved in 39 patients without severe adverse events. Kawasaki et al described double FCSEMS deployment for the left and right hepatic bile ducts under DB-ERCP guidance [2], which was successful in all 20 patients with safe procedure results. We have also previously described transluminal antegrade FCSEMS deployment through EUS-HGS [15], but our technique has the critical limitation of the risk of bilateral bile duct obstruction due to FCSEMS depending on the distance between the HJS and bifurcation of the right and left hepatic bile ducts; therefore, the technique of Kawasaki et al may be useful. However, despite encouraging results, their study had several limitations, including prolonged procedure time due to DB-ERCP, high costs, and a high rate of adverse events.

We developed TAD for treatment of HJS after EUS-HGS using PCSEMS. In case of non-bile duct dilatation, because the gap between PCSEMS and bile duct is observed, hyperplasia or stent ductal induced change can be complicated [25]. However, in our study, PCSEMS is removed within 14 days. Therefore, this adverse event were not seen in any patients. In addition, stent dislocation is
sometimes critical adverse events. If fully covered SEMS is used as EUS-HGS stent, stent dislocation should be considered. Therefore, in our study, PCSEMS was used although there are possibility of difficult stent removal.

Also, our technique should be discussed in several points. First, the time required for TAD is short due to the simplicity of the technical step for HJS dilation. However, before TAD, EUS-HGS should be firstly performed, and several days are needed until fistula creation between hepatic parenchyma and stomach. Therefore, overall procedure time may be prolonged.

Second, the cost is less than that for balloon dilation combined with FCSEMS deployment for HJS site, as previous our study [15]. However, our technique needs high cost compared with DB-ERCP because EUS-HGS was performed using metal stent and balloon catheter, and after fistula creation, cholangioscope was used. Third, HJS dilation was performed by compression effect in previous studies. In our technique, scar tissue can be scraped off, which may play an important role in preventing recurrence of HJS. Drill dilator may be effect for not only objective site but also around site. Therefore, rotating force by drill dilator may scrap off not only HJS site but also scar tissue around HJS site. As a similar technique, HJS dilation using a Soehendra stent retriever (SSR) has been reported [26]. Although SSR may be useful for HJS dilation, technical success may not be obtained in all patients because of the large gap between the tip and the screw. In addition, SSR may not be suitable for antegrade dilation because the gap may become lodged in a bile duct branch during device insertion. In contrast, the tip of the drill dilator used in the present technique tapers to the 0.025-inch guidewire, and the diameter of the shaft of the device gradually increases; therefore, these matters may not be needed to be considered. We previously reported similar technique for HJS using fine gauge electrocautery dilator [27]. Antegrade electrocautery dilation for HJS can penetrate severe tight stricture. However, as mentioned above, scraping off scar tissue may be important to prevent recurrence of HJS. Electrocautery dilation might not be able to scrap of scar tissue, and in addition, electrocautery dilation itself might lead to stenosis due to burn effect. Therefore, compared with electrocautery dilation, the presented technique may be favorable although these scenarios should be evaluated comparison study.

There are several limitations of the present study, including the small sample size, the lack of a control group, and a short period of follow up.

In conclusion, TAD appears to be technically feasible and safe. Although it is necessary to conduct a randomized trial in comparison with other methods, with long-term follow up, TAD may be
a useful option for the treatment of HJS.
References


hepaticojejunostomy anastomotic strictures and predictive factors for treatment success. Surg Endosc. 2020;34:1612-1620


**Figure legends**

**Figure 1**

a. The intrahepatic bile duct is punctured using a 19G needle and contrast medium is injected.
b. A 0.025-inch guidewire is deployed in the biliary tract.
c. Tract dilation is performed using a balloon catheter.
d. A partially covered self-expandable metal stent is deployed from the intrahepatic bile duct to the stomach.

**Figure 2**

a. The drill dilator used in the described technique (Tornus ES; Asahi Intecc, Aichi, Japan).
b. The tapered tip of the drill dilator is shown with a 0.025-inch guidewire.

**Figure 3**

a. EUS-HGS stent is broken using an electrocautery device.
b. The hole is made after trimming technique.
c. A standard ERCP catheter is inserted into the biliary tract through the EUS-HGS stent.
d. A cholangioscope (SpyGlass DS; Boston Scientific, Marlborough, MA, USA) is inserted through the mesh into the biliary tract.

**Figure 4**

a. Cholangioscopy confirms the presence of stricture.
b. Transluminal antegrade drill dilation is performed.
c. After dilation, the stricture is resolved without bleeding or perforation.
d. A plastic stent is deployed after removal of the metallic stent.

**Video Legend**

The mesh of the metal stent is broken using an electrocautery device. An ERCP catheter is inserted into the biliary tract through the mesh, followed by antegrade insertion of a cholangioscope. Cholangioscopy confirms the presence of stricture, and antegrade dilation is performed using a drill dilator. After dilation, the cholangioscope is re-inserted and the stricture is resolved without bleeding or perforation. Finally, a plastic stent is deployed from the intrahepatic bile duct to the stomach.
Table 1. Patient characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients (n)</td>
<td>22</td>
</tr>
<tr>
<td>Median age (y, range)</td>
<td>75 (56-88)</td>
</tr>
<tr>
<td>Sex (male / female)</td>
<td>14 / 8</td>
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<tr>
<td>Clinical symptom</td>
<td></td>
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<tr>
<td>Cholangitis</td>
<td>16</td>
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<tr>
<td>Obstructive jaundice</td>
<td>6</td>
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<tr>
<td>Primary disease, n</td>
<td></td>
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<tr>
<td>Pancreatic carcinoma</td>
<td>8</td>
</tr>
<tr>
<td>Cholangiocarcinoma</td>
<td>6</td>
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<tr>
<td>Chronic pancreatitis</td>
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</tr>
<tr>
<td>Intraductal papillary mucinous adenoma</td>
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</tr>
<tr>
<td>Common bile duct stone</td>
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</tr>
<tr>
<td>Puncture site</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>19</td>
</tr>
<tr>
<td>B2</td>
<td>3</td>
</tr>
<tr>
<td>Puncture needle</td>
<td></td>
</tr>
<tr>
<td>19G</td>
<td>20</td>
</tr>
<tr>
<td>22G</td>
<td>2</td>
</tr>
<tr>
<td>Mean diameter of intrahepatic bile duct at puncture site, mm (±SD)</td>
<td>3.85 ± 1.50</td>
</tr>
<tr>
<td>WBC (/μL, mean ± SD)</td>
<td>9129 ± 1112</td>
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<tr>
<td>CRP (mg/dL, mean ± SD)</td>
<td>3.0 ± 2.9</td>
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<tr>
<td>Hb (mg/dL, mean ± SD)</td>
<td>11.0 ± 2.0</td>
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<td>T-Bil (mg/dL, mean ± SD)</td>
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<td>PLT (×10^3/μL, mean ± SD)</td>
<td>25.1 ± 11.5</td>
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<tr>
<td>PT-INR (mean ± SD)</td>
<td>1.1 ± 0.1</td>
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<tr>
<td>Initial technical success rate of EUS-HGS, % (n)</td>
<td>90.9 (20/22)</td>
</tr>
<tr>
<td>Mean procedure time of EUS-HGS, min ± SD</td>
<td>15 (7 - 37)</td>
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<tr>
<td>Adverse events associated with EUS-HGS (n)</td>
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<td>Cholangitis</td>
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Table 2. Results of procedures

<table>
<thead>
<tr>
<th>Description</th>
<th>Drill dilator</th>
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<tr>
<td>Period of transluminal antegrade drill dilation after EUS-HGS, days (median, range)</td>
<td>11 (7–19)</td>
</tr>
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<td>Type of SEMS dilation device, n</td>
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<tr>
<td>Balloon catheter</td>
<td>20</td>
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<tr>
<td>Electrocautery dilator</td>
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<td>Technical success rate of cholangioscope insertion into the biliary tract, % (n)</td>
<td>100 (22/22)</td>
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<td>Cholangioscopic findings</td>
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<tr>
<td>Stricture</td>
<td>19</td>
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<tr>
<td>Non-stricture</td>
<td>3</td>
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<tr>
<td>Malignancy</td>
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<tr>
<td>Technical success rate of guidewire passage across HJS, % (n)</td>
<td>78.9 (15/19)</td>
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<tr>
<td>Mean procedure time of transluminal antegrade piecemeal drill dilation, min ± SD</td>
<td>22.8 ± 8.2</td>
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<tr>
<td>Cholangioscopic findings after antegrade drill dilation, % (n)</td>
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<tr>
<td>Bleeding</td>
<td>0</td>
</tr>
<tr>
<td>Perforation</td>
<td>0</td>
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<tr>
<td>Fistula formation, % (n)</td>
<td>100 (19/19)</td>
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<tr>
<td>Adverse events associated with procedure, n</td>
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<tr>
<td>Cholangitis</td>
<td>1</td>
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<td>Recurrence of HJS after antegrade dilation, % (n)</td>
<td>0 (0/19)</td>
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<tr>
<td>Mean follow-up period, days ± SD</td>
<td>127.4 ± 25.8</td>
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