Percutaneous stent placement for malignant hilar biliary obstruction: side-by-side versus stent-in-stent technique

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Abstract

PURPOSE To compare the clinical efficacy and safety between side-by-side (SBS) and stent-in-stent (SIS) deployment for malignant hilar biliary obstruction via percutaneous approach.

METHODS From July 2012 to April 2019, 65 patients with malignant hilar biliary obstruction who underwent bilateral stenting using either the SBS or SIS techniques were included in this study. Among them, 27 patients underwent stent insertion with a SIS mode (SIS group), and the remaining 38 patients with a SBS mode (SBS group). Technical success, improvement of jaundice, complications, duration of stent patency, and overall survival were evaluated.

RESULTS Technical success was achieved in all patients of the two groups. The serum bilirubin level reduced quicker at 1 week after the procedures in the SBS group compared with the SIS group (P=0.02). Although the total complication rate did not differ between the two groups, cholangitis was found to be more frequent in the SIS group (P=0.04). The median stent patency was significant longer in the SBS group (149 days) than in the SIS group (75 days; P=0.02). The median overall survival did not differ significantly between the two groups (SBS vs. SIS, 155 days vs. 143 days; P>0.05).

CONCLUSIONS Percutaneous transhepatic bilateral stenting using either SBS or SIS techniques is safe and effective in the management of malignant hilar biliary obstruction. However, SBS offers quicker improvement of jaundice, a lower incidence of cholangitis after the procedures, and a longer stent patency period than SIS.

Background

Self-expandable metal stent placement is a well-accepted palliative therapy for the treatment of malignant obstructive jaundice (1, 2). Compared with external catheter drainage, it not only improves patient’s quality of life but also avoids bile loss. However, stent placement for hilar biliary obstruction is more complicated than for distal biliary obstruction, as bilateral stenting with two or more stents is often required. Side-by-side (SBS) and stent-in-stent (SIS) are the two most commonly used techniques for bilateral stent deployment (3, 4).

The comparison of these two techniques in the literature is very limited and the results from previous studies are conflicting (5–8). There is no conclusive answer to the question of which technique is better. Moreover, all the stent deployment in the limited previous studies was performed endoscopically. Thus, it is worthy to further investigate these two techniques by the percutaneous approach.

The purpose of this study was to compare the clinical efficacy and safety between side-by-side and stent-in-stent deployment for malignant hilar biliary obstruction via bilateral percutaneous routes.

Methods

Patient Selection and Stents

The study was approved by our institutional review board. We retrospectively reviewed the medical records and images of 69 patients who underwent bilateral metallic stent placement using SBS or SIS techniques for the treatment of unresectable malignant hilar biliary obstructions between July 2012 and April 2019 in our department. Inclusion criteria of this study were: 1. diagnosis of malignant unresectable biliary hilar obstruction based on laboratory and imaging or pathological findings; 2. without any previous biliary drainage prior to the admission; 3. with a regular follow up. Four patients were excluded, three of them were lost to follow up and the other one received external drainage in other hospital. In the remaining 65 patients who met inclusion criteria, 38 patients underwent stent placement using the SBS technique (SBS group) and the other 27 patients received implantation of stents with the SIS technique (SIS group).

Two types of uncovered self-expandable metallic stents (E-Luminexx (Bard Peripheral Vascular, Tempe, AZ), Microtech (Microtech, Nanjing, China)) with a diameter of 8 mm and lengths of 60 mm-100 mm were used in this study.

Procedure

Prior to the procedure, the biliary hilar strictures were assessed on contrasted enhanced computed tomography (CT) and/or magnetic resonance cholangiopancreatography (MRCP). To relieve the pain during the procedure, intravenous sedation with oxycodone was applied.

SBS group

The procedures were carried out under fluoroscopic with/without ultrasonic guidance. After successful puncturing of the right intra-hepatic bile duct with a 22G Chiba needle (Cook, Bloomington, IN), a NEFF set was inserted into the bile duct. The outer cannula of the NEFF set was kept for cholangiography to evaluate the stricture site. Then, a 0.035-inch guidewire was advanced and the outer cannula of the NEFF set was exchanged with a 5F Headhunter or Cobra catheter (Cook, Bloomington, IN) to navigate through the obstruction. After passing through the stricture and subsequently measuring its length, a 6F or 8F sheath (Terumo, Tokyo, Japan) was inserted and the guidewire was kept inside with its tip in the distal duodenum. Then, the left bile duct was punctured and the following steps were the same as the right side. Two bare SEMSs were advanced over the two guidewires in each side and deployed on the centers of the bilateral strictures. Each end of the stent should be 1.5- to 2-cm longer than the biliary stricture. After stenting, repeat cholangiography was performed to verify the stent patency and the two puncture approaches were occluded through the sheaths using gelfoam pledgets (Fig. 1).

SIS group

The puncture technique was the same as mentioned above. After successful stenting in one side, a 0.035-inch guidewire and a 5F Headhunter or Cobra catheter (Cook, Bloomington, IN) in the other side was inserted into the duodenum through the mesh of the contralateral stent at the biliary hilum. A 6F or 8F

long sheath was inserted over the guidewire to dilate the mesh. Then, an uncovered SEMS was advanced and deployed across the stricture. Cholangiography was repeated to evaluate the bilateral stent patency and the two puncture approaches were occluded with gelfoam pledgets (Fig. 2).

Follow Up

After procedures, the patients were regularly followed up to June 2019 or until the death of the patients. The follow-up visits consisted of outpatient and telephone interviews. Outpatient interviews were performed one month later after stent placement. Telephone consultations were performed at two weeks and then every three months after stenting. If obstructive jaundice recurred which was confirmed by elevation of bilirubin level and dilatation of bile ducts on CT, the patient was encouraged to receive stent revision or external drainage.

Technical and Clinical Assessment

Technical success was defined as successful deployment of the bilateral stents in the appropriate positions and good contrast flow through the stents into the duodenum.

Clinical outcome was evaluated on the following aspects, including the improvement of jaundice at 1 week and 1 month after the procedure, complications, stent patency period, and overall survival. The significant improvement of jaundice was defined by a decrease in serum bilirubin level of more than 20% at 1 week and more than 75% at 1 month after stent placement compared with the preoperative baseline (9, 10). The complications were divided into major and minor complications according to the reporting standards of the Society of Interventional Radiology (11). Major complications were defined as those requiring major therapy, an unplanned increase in level of care or prolonged hospitalization (> 48 h), or causing permanent adverse sequelae or death. Other complications were regarded as minor. Stent patency period was defined as the time interval between the initial stent placement and recurrence of jaundice or the last follow-up or death of the patients without evidence of jaundice. If a patient ceased without recurrent jaundice, the stent patency period was considered to be the same as the duration of the survival. Survival was calculated from the time of the initial stent placement to death from any cause or the last follow-up visit. Data of stent patency and survival were censored for patients who remained alive at the time of this writing.

Statistics

The independent t-test was used for the comparison of continuous variables. The chi-squared test or Fisher’s exact test was used for comparing categorical variables, depending on the scale level. Survival curves were calculated by Kaplan–Meier method and compared by log-rank test. A two-tailed P-value lower than 0.05 was considered as statistically significant. All analyses were carried out using the SPSS version 15.0 software (SPSS, Chicago, Illinois, USA).

Results

Of the 65 patients included in this study, 37 were male and the other 28 were female, with a mean age of 64.1 years (range: 24–92). The primary causes of biliary obstruction were cholangiocarcinoma in 27 patients, gallbladder cancer in 17 patients, hepatocellular carcinoma in 11 patients, and metastatic nodes in 10 patients. According to Bismuth classification of perihilar cholangiocarcinoma, 17 patients belonged to type II, 38 patients to type III, and 10 patients to type IV. Patients' baseline characteristics of the two groups are listed in Table 1 and no significant difference was found between the two groups ($P > 0.05$).

Table 1
Patients' characteristics of the two groups

Characteristics	SBS group	SIS group	p value
Pt. No.	38	27	
Gender			0.30
Male	19 (50.0)	10 (37.0)	
Female	19 (50.0)	17 (63.0)	
Age (y)	63.0 ± 12.4	65.3 ± 13.5	0.48
ECOG			0.48
0	3 (7.7)	2 (6.2)	
1	23 (61.5)	20 (75)	
2	12 (30.8)	5 (18.8)	
Obstruction causes			0.72
Cholangiocarcinoma	18 (47.3)	9 (33.4)	
Gallbladder cancer	9 (23.7)	8 (29.6)	
HCC	6 (15.8)	5 (18.5)	
Others	5 (13.2)	5 (18.5)	
Bismuth classification			0.68
Type II	9 (23.7)	8 (29.6)	
Type III	22 (57.9)	16 (59.3)	
Type IV	7 (18.4)	3 (11.1)	
Further chemotherapy	6 (15.8)	4 (14.8)	0.91
Note-Values presented as mean ± standard deviation where applicable. Values in parentheses are percentages. ECOG = Eastern Cooperative Oncology Group; HCC = Hepatocellular Carcinoma			

Technical success was achieved in all patients. The stents with sizes of 8*80 mm and 8*60 mm were the most commonly used. At one week after the procedures, the reduction of serum bilirubin level by 20% was achieved in 89% (34/38) patients in the SBS group, while only in 67% (18/27) patients in the SIS group (P = 0.03). At one month after stenting, however, there was no significant difference in the reduction of serum bilirubin level by 75% between the two groups (SBS vs. SIS, 92% vs. 89%, P > 0.05).

Major complication only occurred in one patient in the SBS group. The patient developed acute pancreatitis and died of acute renal failure 8 days later after the procedure. Minor complications including cholangitis, cholecystitis, pancreatitis, and peritonitis occurred in 18% (7/38) patients in the SBS group and 33% (9/27) patients in the SIS group (P > 0.05). Cholangitis was found to be more frequent in the patients in the SIS group than those in the SBS group (30% vs. 8%, P = 0.04).

The median follow-up time was 6 months (range, 2–12 months) in the SBS group and 5 (range, 2–14 months) months in the SIS group. The median stent patency was significant longer in the SBS group (149 days) than in the SIS group (75 days; P = 0.02). (Fig. 3). During the follow-up period, stent occlusion occurred in seven patients in the SBS group (stent duration: 55–250 days) and ten patients in the SIS group (stent duration: 20–160 days) (P > 0.05). Among them, nine patients underwent external drainage, seven patients underwent stent revision using new stents, and one patient only received conservative therapies due to poor general conditions. The median overall survival in the SBS group was 155 days, which did not differ significantly from the 143 days in the SIS group (P > 0.05) (Fig. 4). The main results of the two groups are listed in Table 2.

Table 2
Main results of the two groups

Outcomes	SBS group (n = 38)	SIS group (n = 27)	p value
Technical success	38 (100)	27 (100)	1
Reduction of bilirubin level			
By 20% at 1 week	34 (89.5)	18 (66.7)	0.03
By 75% at 1 month	35 (92.1)	24 (88.9)	0.69
Complications			
Major complication			1
Acute renal failure	1 (2.6)	0	
Minor complications	7 (18.4)	9 (33.3)	0.24
Cholangitis	3 (7.9)	8 (29.6)	0.04
Cholecystitis	1 (2.6)	0	1
Pancreatitis	2 (5.3)	1(3.7)	1
Peritonitis	1 (2.6)	0	1
Stent occlusion	7 (18.4)	10 (37)	0.09
Note-Values in parentheses are percentages.			

Discussion

In patients with malignant hilar biliary strictures, drainage of more than 50% of the liver volume usually requires bilateral stent implantation unless there is a definite hypertrophic lobe (12). Several retrospective studies have shown that bilateral metal stent insertion has longer stent patency and patient survival compared with unilateral metal or plastic stent insertion (13–15). The bilateral stent placement can be performed endoscopically or percutaneously. Technically, percutaneous bilateral stent placement is easier than endoscopic placement for hilar strictures, since the transhepatic approach is shorter and straighter than the transgastroduodenal approach. Thus, the reported technical success of endoscopic approach is lower than that of percutaneous approach (16).

Currently, two models of stent placement are the most commonly used for hilar strictures: SBS and SIS. Previously, there are only a few studies that compare these two different techniques. In 2012, Naitoh et al(5) initially evaluated these two techniques and found that SBS technique tended to have a longer stent patency than SIS technique, though the SBS technique had more complications. However, the later studies did not find any significant differences in technical success, complications, and stent occlusion

(6–8). Thus, it is still in controversy regarding which technique is better. Additionally, all the stents in these studies were placed under endoscopy and there is no comparison of these two techniques via the percutaneous transhepatic approach.

In this study, the stents were all placed percutaneously using these two techniques. The technical success was 100% in both groups. However, in the SIS group, as passing through the mesh of the first stent is required for the second stent deployment, it usually requires a long sheath or a balloon catheter to dilate the mesh. Thus, it is more time consuming and technical demanding for the SIS technique. Besides this, we found that the bilirubin level after the procedures reduced quicker in the SBS group than those in the SIS group. This may be due to the different stent configurations in the two groups. The two parallel stents in the SBS group offer a larger caliber in the common hepatic duct than the two stents with a SIS configuration, which may allow the bile to be drained more fluently.

Besides the obstructive jaundice improved quicker in the SBS group, the duration of stent patency was also longer than in the SIS group. Theoretically, the SBS configuration provides a larger caliber than the SIS, which may delay the event of stent obstruction in the common bile duct caused by tumor ingrowth.

In this study, the procedure-related complication rates were 18.4% in the SBS group and 33.3% in the SIS group, which was similar to those papers where the procedures were performed endoscopically (5, 6). Noticeably, cholangitis was less frequently observed in the SBS group than in the SIS group. The bile may be drained more fluently in the SBS group owning to the large caliber of the common hepatic duct and therefore could decrease the rate of bile infection. This result is different from a previous study (5). It has been reported that excessive expansion of the two SBS stents might causes portal vein occlusion and increase the rate of cholangitis (5).

This study has several limitations. Firstly, it is a retrospective study with a small number of patients. Secondly, the selection of stent types and the techniques of stent deployment mainly replied on the operators' preferences in this study, which may bring bias and influence the outcome. Therefore, a prospective, randomized controlled trial with the same type of stent is warranted to further clarify the differences between the techniques of SBS and SIS through the percutaneous approach.

Conclusions

In conclusion, percutaneous transhepatic bilateral stenting using either SBS or SIS techniques is safe and effective for the treatment of malignant hilar biliary obstruction. Compared with SIS, SBS offers quicker improvement of jaundice, a lower incidence of cholangitis after the procedures, and a longer stent patency period.

Abbreviations

side-by-side (SBS)

stent-in-stent (SIS)

Eastern Cooperative Oncology Group (ECOG)

Hepatocellular Carcinoma (HCC)

Declarations

Ethics approval and consent to participate

All procedures performed in this study were in accordance with the ethical standards of ethical committee of the First Affiliated Hospital of Nanjing Medical University and with the 1964 Helsinki declaration and its later amendments. Written informed consent was obtained from individual or guardian participants included in the study.

Consent for publication

The patients gave written consent for their personal or clinical details along with any identifying images to be published in this study.

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

Z and HB. S conceived of and designed the study; WZ. Z, S. L, and ZQ. Y acquired and analyzed data. WZ. Z and S. L wrote the first draft. S. L, YT. X, JZ. W,and HD. X revised the manuscript for important intellectual content critically. All authors made substantial contributions towards drafting the manuscript, reviewing the final manuscript for intellectual content. All of the authors read and approved the final manuscript.

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Figures

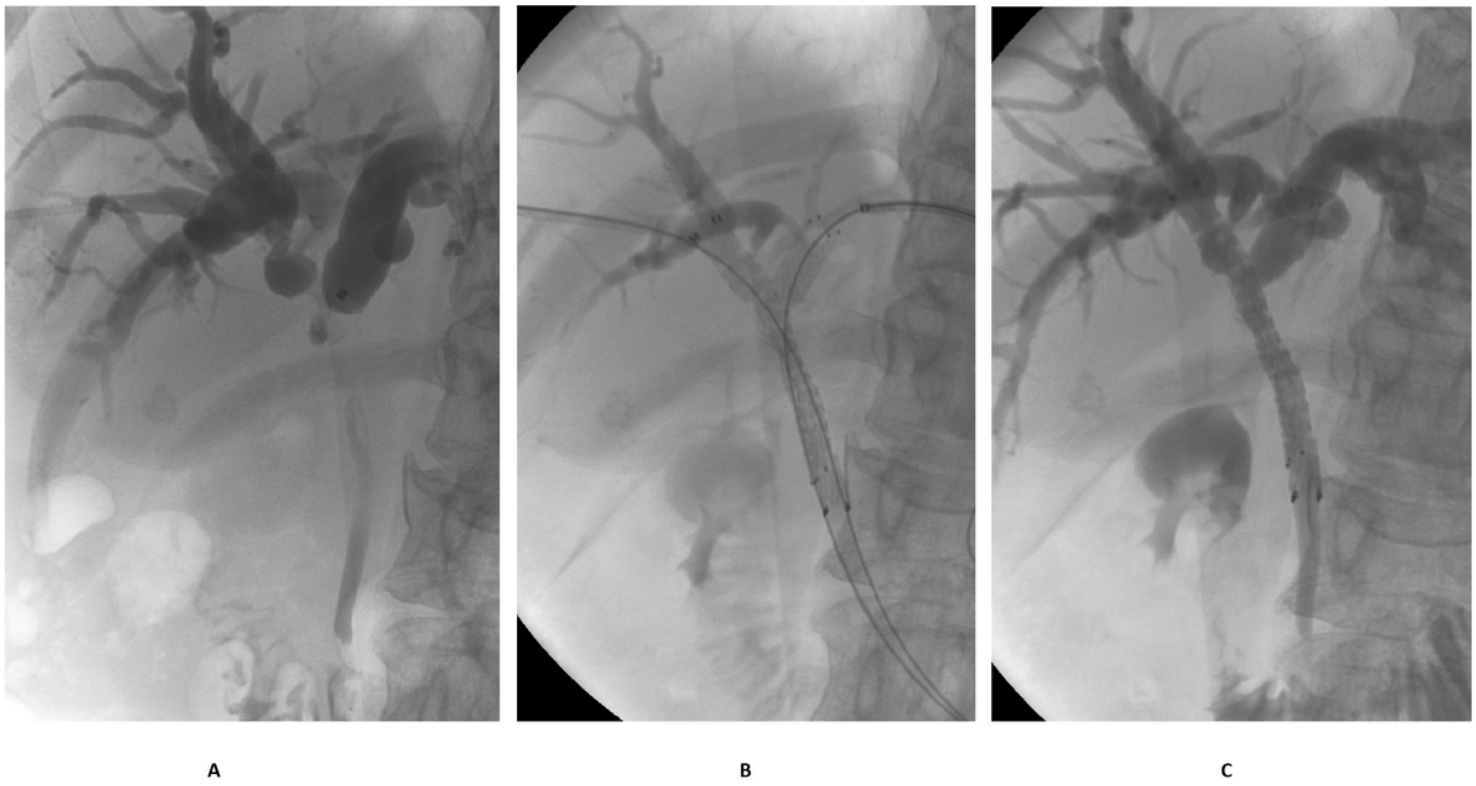

Figure 1

A 48-year-old woman with Klatskin tumor presented with obstructive jaundice. (a) The cholangiography shows a Bismuth type II hilar stricture. (b) Two 8mm*6cm self-expandable stents were successfully deployed across the stricture using the side-by-side technique. (c) The repeat cholangiography shows the good passage of contrast agent through the bilateral stents.

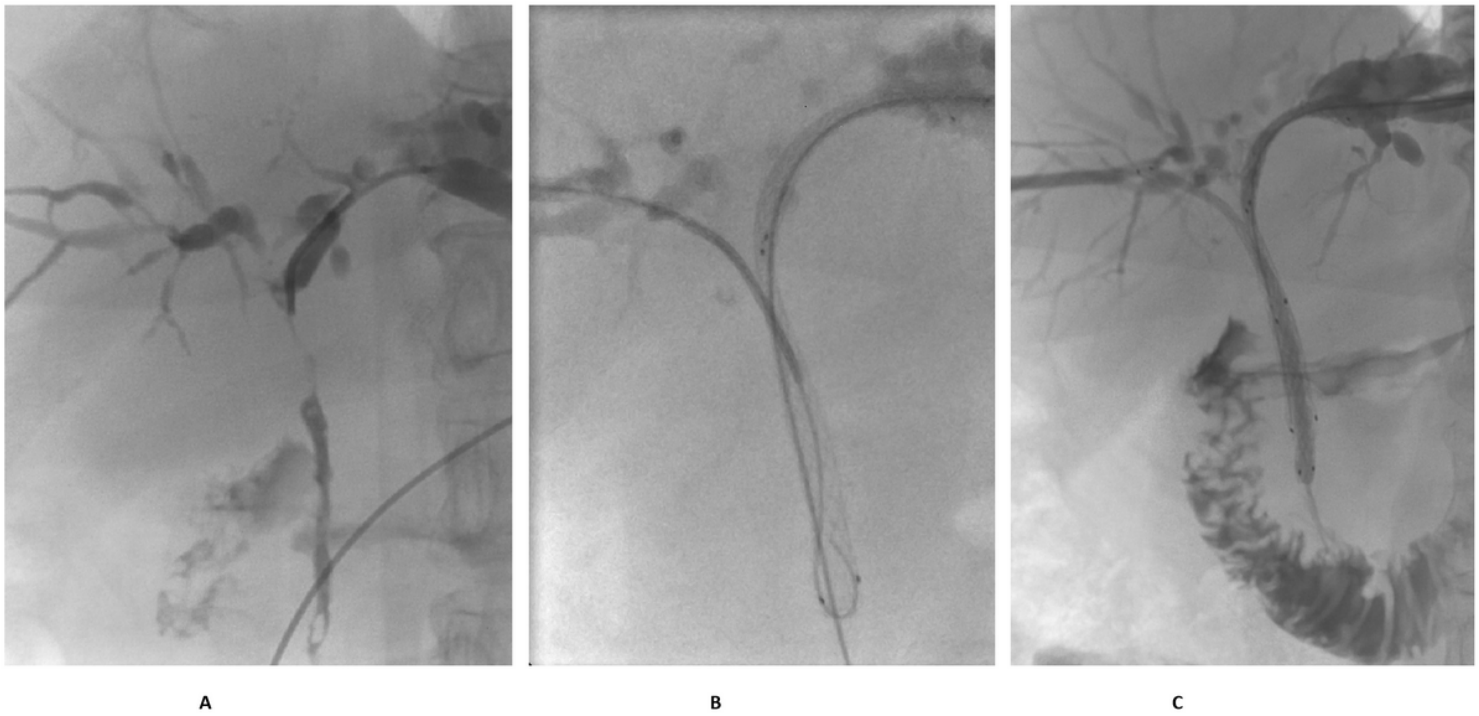

Figure 2

An 83-year-old woman had obstructive jaundice caused by gallbladder cancer. (a) A Bismuth type IIIa hilar stricture is demonstrated on the cholangiography. (b) After deployment of an 8mm*6cm stent from the left side, a 0.035-inch guidewire and a Headhunter catheter from the right side was inserted through the mesh of the stent to the duodenum. (c) Another 8mm*6cm stent was implanted from the right side with the stent-in-stent mode and the repeat cholangiography shows the good patency of the two stents.

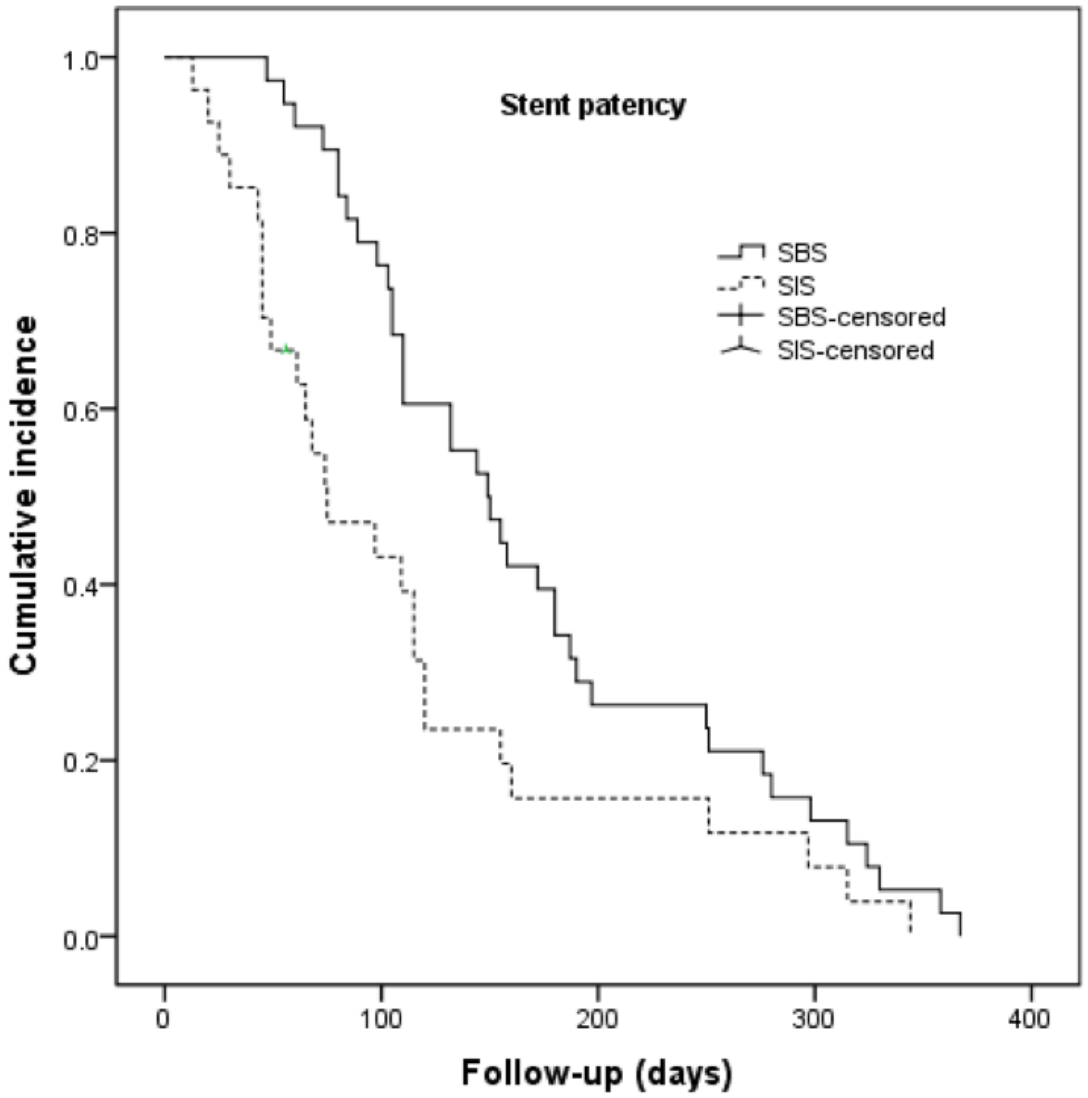

Figure 3

Kaplane-Meier estimation of stent patency. The stent patency period was significantly longer in the SBS group than in the SIS group (P=0.02).

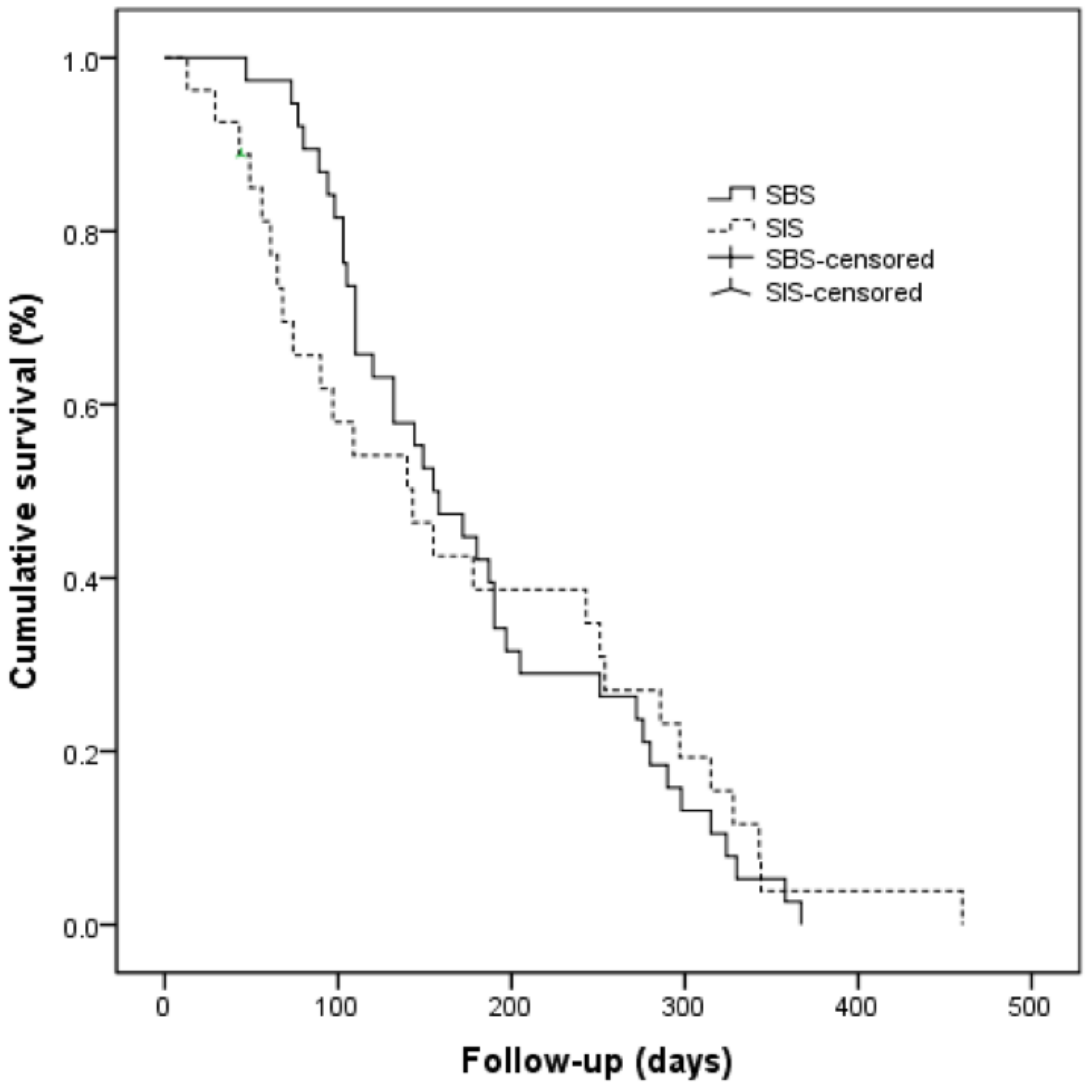

Figure 4

Kaplane-Meier estimation of patient survival. No significant difference was found between the two groups (P>0.05).