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Review Article

Interventional radiologic approach to hilar malignant biliary obstruction

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ABSTRACT

Biliary obstruction due to advanced hepatic hilar malignancy is difficult to treat, both surgically and non-surgically, using endoscopic or percutaneous drainage. Since only about 10% to 20% of patients are eligible for resection of hepatic hilar malignancies, most patients receive palliative rather than curative treatment. Percutaneous palliation of advanced hepatic hilar malignancies can be accomplished in a variety of ways. Percutaneous bilateral metallic stent placement may be a reasonable option in patients with hilar malignancies to preserve the functional volume of the liver during the course of chemotherapy and to prevent procedure-related cholangitis of a contaminated undrained lobe. Percutaneous bilateral stent-in-stent placement using wide-mesh or open-cell design stents is a feasible and effective method of achieving bilateral drainage. Moreover, unilateral covered or uncovered metallic stent placement in the lobe with patent portal vein is safe and effective method for palliative treatment in patients with contralateral portal vein occlusion caused by hilar malignancies, obviating the need for bilateral stent placement in these patients.

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Keywords: Bile ducts, intrahepatic; Malignancy; Percutaneous; Stents

Introduction

Biliary obstruction due to advanced hepatic hilar malignancy is difficult to treat, both surgically and non-surgically, using endoscopic or percutaneous drainage. Since only about 10% to 20% of patients are eligible for resection of hepatic hilar malignancies,^{1,2} most patients receive palliative rather than curative treatment.

A percutaneous approach can be a reasonable option to treat malignant hilar obstruction and is often the most appropriate management. Previous studies reported that percutaneous approaches had a higher technical/clinical success rate and lower incidence of infective complications compared with endoscopic approaches.^{3–5} Percutaneous palliation of advanced hepatic hilar malignancies can be accomplished in a variety of ways.^{6–18} The author therefore reviews percutaneous techniques for the treatment of hilar malignant biliary obstruction.

Unilateral vs Bilateral Biliary Stent Placement

There have been conflicting opinions as to whether stent placement should be unilateral or bilateral.^{6,7,19–24} Some investiga-

tors have preferred bilateral stenting not only because unilateral stenting alone may not completely relieve jaundice²² and may induce acute cholangitis⁷ but also because stent patency may be longer than unilateral stenting.⁶ On the other hand, others have advocated unilateral drainage not only because the risk of complications is lower than multiple stent deployment²⁰ but also because adequate palliation can be achieved by the drainage of only 25% of the liver.²⁴ In a report by De Palma et al,¹⁹ patients with bilateral drainage had a significantly lower rate of successful stent insertion and a significantly higher rate of early cholangitis than patients with unilateral drainage. However, these previous reports have usually focused on technical or clinical outcomes of unilateral or bilateral drainage in advanced hilar obstruction according to Bismuth–Corlette classification.

Although it is unclear whether drainage of both liver lobes in patients with Bismuth type II or higher malignant hilar tumors is necessary, to preserve the functional volume of the liver during the course of chemotherapy and to prevent procedure-related cholangitis of a contaminated undrained lobe,^{6,7,19–23} bilateral drainage may be a reasonable option. Bilateral biliary drainage can be accomplished by the percutaneous placement of multiple stents.^{6–18}

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Percutaneous Bilateral Biliary Stent Placement

Palliative stent placement for advanced hilar malignancies is usually accomplished through two separate transhepatic punctures in a Y configuration, X configuration or single transhepatic puncture in a T configuration.^{6–18} Two techniques have been developed for the percutaneous placement of bilateral metallic stents, side-by-side and stent-in-stent deployment techniques. The side-by-side deployment technique results in the simultaneous insertion of two parallel metallic stents to drain the bile ducts of both hepatic lobes (Fig. 1). This parallel arrangement, however, may prevent full expansion of metallic stents at and below the hepatic confluence.⁹ Although adequate drainage may be achieved, expansion of the stents to less than their full diameter may result in stent elongation or partial collapse of one or both stents.

Recently, bilateral drainage using the partial stent-in-stent deployment procedure has been reported.^{9,10–13,15,17} In the stent-in-stent deployment technique, a second stent is placed through the mesh of the first stent to enter the common bile duct (Fig. 2). Using this technique, the entire length of the stricture can continuously expand within a single stent caliber, a result that cannot be achieved using the side-by-side stent deployment technique. Moreover, overlapping of the two stents can effectively prevent displacement of the stents. However, passing a second metallic stent through the mesh of the first stent can be technically difficult if the first stent has a tightly woven closed-cell-design.²⁵ To overcome the technical difficulties associated with the stent-in-stent deployment technique using closed-cell-design stents, some investigators adopted two types of metallic stents, of wide-mesh and open-cell design stents, as first stents and determined that both types performed equally well in bilateral stent-in-stent

deployment.^{10–13,15,17}

The wide-mesh-design stent has a wider central mesh portion, permitting easy passage of the delivery system for the second stent. In a report by Kim et al,¹⁰ the creation of a true T configuration using wide-mesh first stent was preferable to other approaches as it offered a large luminal diameter throughout the mesh of the first stent and that overlapping two stents was effective in preventing their displacement. The cells of the open-cell-design stents are connected more easily than the tight weaving and interlocking of other closed-cell-design stents.^{15,17} Thus, open-cell-design stents can be dilated easily by ballooning and remain dilated, thus permitting easy passage of the second stent during bilateral stenting and its wide expansion. Moreover, open-cell-design stents could be easily navigated through the tortuous strictures due to their low profile delivery system and high flexibility. Despite a paucity of percutaneous studies, there were no significant between group differences in stent occlusion rate and stent patency period.^{15,17} Moreover, there were no significant differences between the wide-mesh and open-cell design stent groups in technical success, complications, successful internal drainage, and patient survival.¹⁷ To achieve bilateral drainage in patients with stent occlusion, reintervention was more easily performed in patients in whom stents had been inserted in a T than in a Y configuration.¹⁷ Therefore, T-configured stent-in-stent deployment for bilateral drainage may be preferable in patients with malignant hilar biliary obstruction unless technical difficulties necessitate Y-configured stent-in-stent deployment.¹⁷

In previous studies using percutaneous bilateral stenting, the technical success rate ranged from 93% to 100%, the overall complication rate ranged from 0% to 7.7%, the successful internal drainage rate ranged from 87.5% to 92%, the median stent pa-

Fig. 1. Side-by-side deployment technique (Y configuration) for bilateral drainage. (A) Note simultaneous insertion of two stent endoprotheses from intrahepatic bile duct of both hepatic lobes to common bile ducts. (B) Cholangiogram after deployment shows successful Y-configured stent placement using two close-cell-design stents. Note right-sided stent (black arrows) and left-sided stent (white arrows).

Fig. 2. Stent-in-stent deployment technique (T configuration) for bilateral drainage. (A) Cholangiogram shows a malignant hilar obstruction. (B) After inserting the first transverse stent from right to left hepatic duct, the guide wire for second stenting was successfully inserted into common bile duct through the mesh of the first stent (arrow). (C) Cholangiogram shows successful deployment of the second stent from the left side into the common bile duct through the mesh of the first stent.

tency time ranged from 170 to 275 days, and the median patient survival time ranged from 126 to 299 days (Table 1).^{10,11,15,17} Multiple stent placement can be a reasonable option in the patients who are anicteric with a high-grade hilar stricture and cholangitic after bilateral stent placement (Fig. 3).

Percutaneous Unilateral Biliary Stent Placement

The indications for percutaneous unilateral biliary stent placement are no/little functional liver parenchyma due to huge tumor and unilateral portal vein occlusion with/without subsequent hepatic lobar atrophy due to hilar or parenchymal tumor. In general, the most important factor in regulating the volume of bile flow is the rate of bile salt synthesis by hepatocytes, which is regulated by the return of bile salts to the liver through enterohepatic cir-

ulation. When the portal vein of one liver lobe is obstructed, portal vein obstruction interrupts the cycle of enterohepatic circulation in the obstructed lobe.¹³ Previous investigators reported successfully treating bile leakage by performing selective portal vein embolization, which induces cessation of bile production.^{26,27} Thus, the liver lobe with portal vein occlusion caused by advanced hilar malignancies ceases to produce bile and becomes nonfunctional and atrophied. Hepatic lobar atrophy is a frequent accompaniment of hilar cholangiocarcinoma and has been reported to occur in 20% to 30% of patients with that diagnosis.^{28,29} Hepatic lobar atrophy usually occurs in the setting of combined biliary and portal vein occlusion, which is most frequently ipsilateral to the atrophic lobe. Moreover, previous studies have reported a significant correlation between hepatic lobar atrophy and ipsilateral portal vein occlusion and that unilateral portal vein occlusion in the at-

Table 1 Studies Involving Percutaneous Bilateral Stenting for Hilar Malignant Biliary Obstruction

Study	Number of patients	Company	Type of stent	Number of stent	Technical success (%)	Stent patency (day, median)	Patient survival (day, median)
Kim et al ¹⁰ (2004)	57	Taewoong Medical	Kim stent & Niti-S	114	100	170.3	193.6
Bae et al ¹¹ (2008)	42	Taewoong Medical	Kim stent & Niti-D	82	98	187	247
Ahn et al ¹⁵ (2012)	26	Boston Scientific	Sentinel	59	93	191.8	299
Gwon et al ¹⁷ (2013)	106	Cook, Boston Scientific	Zilver, Sentinel	212	100	319	192

Fig. 3. Multiple stent deployment due to anatomic variation. (A) After inserting of two stents in a T configuration from left side to right anterior and common bile duct, a 5-F catheter (arrowheads) was successfully inserted from right posterior duct to common bile duct. (B) Cholangiogram shows successful deployment of the third stent (arrows) from right posterior duct to common bile duct through the mesh of the first stent.

Fig. 4. Computed tomographic images obtained before percutaneous transhepatic biliary drainage (A) and two months after unilateral stent placement (B) in a 75-year-old man with cholangiocarcinoma and right portal vein occlusion show little diameter change of left intrahepatic bile duct after right-sided unilateral stent placement (arrow).

rophied lobe was present in 87% to 100% of patients.^{28,29}

To date, there has been only one radiologic comparative study of unilateral and bilateral stenting in patients with hilar biliary obstruction with unilobar portal vein occlusion caused by advanced malignancies.¹³ In a report by Gwon et al,¹³ unilateral biliary metallic stent placement in the lobe with patent portal vein seemed to be a safe and effective palliative treatment of patients with contralateral portal vein occlusion caused by advanced hilar malignancy, obviating bilateral stent placement in these patients, because the hepatic lobe with portal vein occlusion caused by advanced hilar malignancies ceases to produce bile due to interruption of enterohepatic circulation. In the study, during the follow-up period, the intrahepatic bile ducts of the undrained lobe with

portal vein occlusion in patients who underwent unilateral biliary stent placement showed a slight decrease in diameter on follow-up computed tomography, which means bile production in the undrained lobe may be functionally impaired or ceased by bile duct obstruction as well as portal vein occlusion (Fig. 4).

Percutaneous Covered Biliary Stent Placement

The use of covered stents in the biliary system was initially developed to address the issue of tumor ingrowth. Recently, the use of polytetrafluoroethylene (PTFE)-covered stents has been found to be an effective treatment method, with the PTFE material serving as an effective barrier to prevent tumor ingrowth.^{30–33} In

Fig. 5. Unilateral covered stent placement in a 83-year-old man with intrahepatic cholangiocarcinoma and right portal vein occlusion. (A) Computed tomographic image shows intrahepatic bile duct dilatation and right portal vein occlusion (arrow) caused by intrahepatic cholangiocarcinoma (asterisk). (B) Cholangiogram via the left-sided catheter shows occlusion of the left intrahepatic bile duct and upper common bile duct. Right intrahepatic bile duct is not opacified by contrast media. (C) Cholangiogram 3 days after polytetrafluoroethylene-covered stent placement shows good passage of contrast media through the stent (arrows).

Fig. 6. Author's treatment algorithm of hilar malignant biliary obstruction. CT, computed tomography; MR, magnetic resonance; PV, portal vein; PTBD, percutaneous transhepatic biliary drainage.

one comparative study of PTFE-covered and uncovered stents,³⁴ PTFE-covered stents were significantly superior to uncovered stents in terms of stent patency.

In general, one important limitation in using covered stent for treatment of malignant hilar biliary obstruction is a risk of occlusion of branching intrahepatic bile duct. Interestingly, in the previous studies, PTFE-covered stents for palliative treatment of malignant hilar biliary obstruction prevented tumor ingrowth without functional occlusion of the hepatic segmental bile ducts.^{12,14} The branching intrahepatic bile ducts blocked by the covered stents showed a significant diameter decrease on the follow-up computed tomographic images and the serum bilirubin level also decreased significantly. In a report by Yi et al.,³⁵ unilateral placement of PTFE-covered stents in the hepatic lobe with a patent portal vein was a safe and effective method for palliative treatment of patients with contralateral portal vein occlusion caused by advanced hilar malignancies (Fig. 5). Although a covered stent could effectively prevent stent dysfunction caused by tumor ingrowth, covered stent dysfunction was mainly caused by sludge incrustation. Further investigations will be required in order to determine how to decrease the incidence of sludge formation.

Conclusion

In conclusion, percutaneous bilateral stenting may be a reasonable option in patients with hilar malignancies to preserve the functional volume of the liver during the course of chemotherapy and to prevent procedure-related cholangitis of a contaminated undrained lobe. Percutaneous bilateral stent-in-stent placement using wide-mesh or open-cell design stents is a feasible and effective method of achieving bilateral drainage in patients with malignant hilar biliary obstruction. Moreover, unilateral covered or uncovered metallic stent placement in the lobe with patent portal vein is safe and effective method for palliative treatment in patients with contralateral portal vein occlusion caused by advanced hilar malignancies, obviating the need for bilateral biliary stent placement in these patients. The author's percutaneous approach to treatment of patients with hilar malignant biliary obstruction was summarized in Fig. 6.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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