Opening Up

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An overview of balloon dilation in the management of biliary disease

Balloon dilation of a bile duct stricture facilitates access into the biliary system or beyond the obstruction for removal of bile duct stones or placement of a biliary stent to provide drainage. Because of the larger balloon diameter, they are more effective compared to the more rigid (but much smaller) graded dilation catheters.

Technique of balloon dilation

Dilation balloons or biliary balloon dilatation catheters (as some refer to) come in different sizes and in general, range from 4 to 10 mm in diameter and 2 to 4 cm in length, e.g. Hurricane (Boston Scientific, Natick, MA) or Fusion Titan Biliary Dilation Balloon (Cook Endoscopy, Winston Salem, NC). They are mostly made of nylon or polyethylene terephthalate (PET) and are minimally-compliant balloons. It is recommended to use a regular .035" wire guide to provide rigidity for effective dilation. The balloon is inserted over a pre-positioned wire guide placed within the bile duct or across the bile duct stricture. The two ends of the balloon are indicated by radiopaque ring markers to help positioning of the balloon across the stricture (usually with the stricture located at the midpoint of the balloon for effective dilation). Inflation of the balloon is performed using a pressure insufflator by injecting diluted contrast to fill the balloon. The appearance of initial waist formation on the balloon denotes the level of the obstruction. The balloon is inflated slowly to the recommended pressure (per manufacturer) and the obliteration of the waist indicates effective dilation of the stricture/papilla. Depending on individual physicians, the balloon is kept inflated for between 15 seconds to a minute to allow proper stretching of the stricture.

Recent improvement to balloon design

The earlier balloons (e.g., Quantum Balloon Dilators) were designed with only one proximal side-hole (or inflation port) that connects to the balloon, which allows inflation and deflation of the balloon. However, the limitation to the flow of contrast (especially for normal or dense contrast) with a single side-hole meant that the balloon is inflated from the proximal end which often predisposes the balloon to migration (especially in case with a tight biliary stricture). Proper positioning of the balloon is maintained sometimes by pulling or pushing on the balloon catheter, especially during early balloon inflation, to resist its migration. Furthermore, the single side-hole limits return (free flow) of contrast, making deflation of the balloon more difficult. This happens more often when the partially

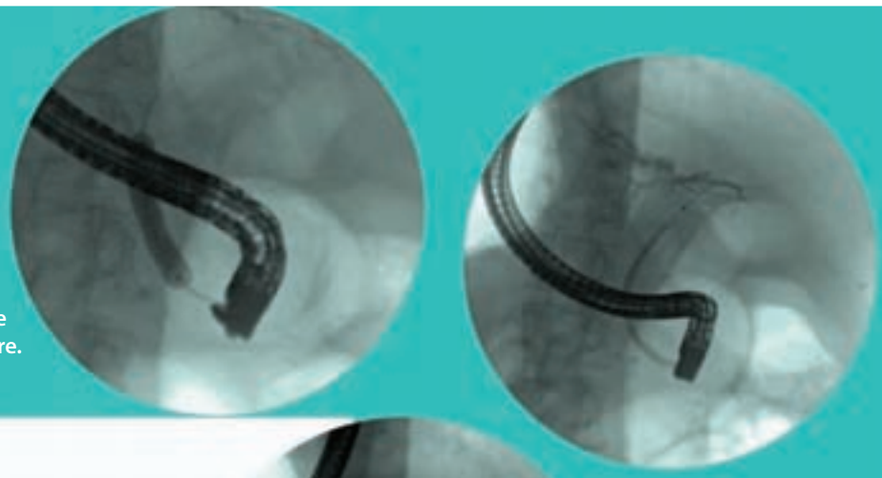

Figure 1
Balloon dilation after endoscopic sphincterotomy to facilitate removal of CBD stones through a distal bile duct sricture.

Figure 2a - b
Multiple biliary stenting using the Fusion OASIS after balloon dilation of CHD stricture.

deflated balloon is pulled back into the scope channel, further restricting the return flow of contrast. A partially deflated balloon makes it more difficult to be withdrawn into the scope channel and increases the difficulty with wire guide exchange. Although the use of more diluted contrast is helpful, there are still limitations in rapid inflation and deflation of the balloon related to a single side-hole.

The new Fusion Titan Biliary Dilation Balloons (Cook Endoscopy, Winston Salem, NC) have an improved design, which incorporates two sets of side-holes at either end of the balloon. This design allows efficient insufflation and deflation of the balloon and minimizes the risk of balloon migration because both sides of the balloon can be inflated, holding it in position like a "dog-bone appearance," especially in the case of a tight stricture. Furthermore, the balloon can be efficiently and completely deflated, making withdrawal of the balloon and subsequent wire guide exchange more easily without losing the wire position.

Application in bile duct stricture management and stone extraction

Endoscopic sphincterotomy (ES) is an established treatment for the removal of common bile duct stones. Removal of stones proximal to a relative distal bile duct narrowing can be challenging. In order to facilitate stone removal, the bile duct obstruction is dilated before balloon sweep. Although transient post-dilation bleeding has been reported, surprisingly the incidence of post-dilation pancreatitis from prolonged balloon dilation has not increased significantly. This however, may be related to the use of prophylactic pancreatic stenting in some cases to prevent post-ERCP pancreatitis.

Patients with intrahepatic stones pose a challenge to endoscopic removal, and effective dilation of the associated stricture is necessary to facilitate stone removal. Indeed, the persistence of waist formation on the balloon despite full insufflation would signify difficulties in removing the stone(s) without resorting to lithotripsy. The Fusion Titan Balloon, which resists migration during insufflation, is more effective in dilating the intrahepatic stricture.

Application in bile duct strictures

In the management of patients with malignant biliary obstruction or benign post-operative bile duct strictures such as post liver transplantation, balloon dilation facilitates the placement of biliary stents for drainage. In the case of post-surgical changes, we recommend initial stenting for drainage only without any balloon dilation until the injury or stricture is set. We usually wait three months before contemplating balloon dilation of the stricture. Insertion of multiple biliary stents is technically difficult although, when successful, provides more effective drainage as well as splinting for the stricture. In choosing the right size balloon, it is important to assess the diameter of the normal part of the bile duct (usually the distal CBD below the level of the obstruction). Excess balloon size poses a risk of perforation from overzealous balloon dilation. The placement of multiple stents can be facilitated using the Fusion OASIS system (Cook Endoscopy, Winston Salem, NC), which allows intraductal exchange of the wire guide above the obstruction thus maintaining access across the bile duct stricture after initial stent deployment. This allows subsequent double or triple stent placement without having to recannulate or renegotiate the stricture.

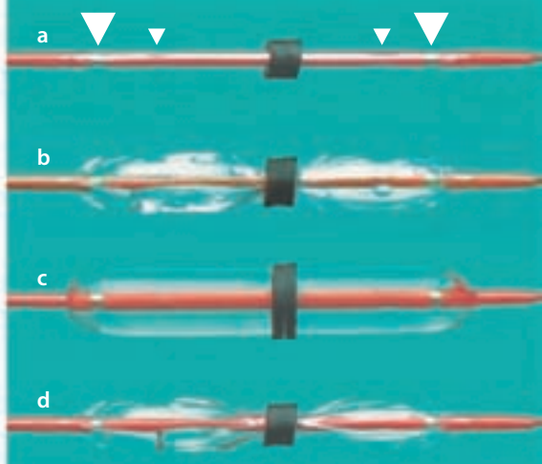

Figure 3
a. Balloon with simulated stricture (O-ring). Note radiopaque ring markers (large arrows) on either end of the balloon and side-holes (small arrows).
b. Partial filling of the balloon. Note that the proximal half of the balloon is filling first but the distal portion also fills, keeping the balloon (waist formation) in a stable position in relation to the stricture.
c. Complete obliteration of the waist.
d. Rapid collapse of the balloon on either side of the stricture upon deflation.