CASE REPORT

Patient History and Assessment

A 37-year-old female was admitted acutely to the hospital with nausea, vomiting and progressive abdominal pain over the previous 48 hours. Past medical history was pertinent for a laparoscopic cholecystectomy six years earlier. There was no other significant medical history. Admission laboratories revealed a total bilirubin of 8 g/dL, with a normal white count. Transabdominal imaging revealed a markedly dilated intra and extrahepatic biliary system with the presence of calculi noted.

Description of Procedure

ERCP was chosen as the initial therapeutic maneuver. Injection of contrast after selective biliary cannulation revealed a dilated duct (13 mm). Multiple CBD calculi up to 1 cm were identified (Image 1).

Biliary sphincterotomy was performed over a wire to facilitate further therapeutic interventions. A 5-cm x 2.1-cm Trapezoid® RX Lithotripsy Compatible Basket was utilized to entrap and fragment the calculi (Images 2 and 3). The Trapezoid RX Basket as well as a 12-15 mm Extractor™ RX Retrieval Balloon were subsequently utilized to clear the duct of the smaller calculi and fragmented stone debris.

Procedure Outcome and Follow-up

The patient was able to be discharged home within 24 hours in stable condition.

Image 1  Image 2  Image 3
Many techniques are utilized to facilitate removal of bile duct calculi, including sphincterotomy, hydrostatic balloon dilatation of the ampulla, stone retrieval balloons, baskets, and electrohydraulic, mechanical and laser lithotripsy. Basket assisted techniques have generally been less favored due to concern of entrapment. This concern is prudent in cases where the calculus is larger than the distal duct diameter or under conditions where only a small sphincterotomy may be performed (i.e. coagulopathy, perianampullary diverticulum). However, proper selection and use of baskets will allow successful extraction of most calculi without difficulty. This paper is designed to allay unwarranted concerns and provide advice on proper use of this technique.

**Gaining Access**

Standard access to the endoscopic retrograde duct system is obtained. Guidewire placement is appropriate to facilitate balloon dilatation of the ampulla or sphincterotomy or use of wire-guided instruments.

Performance of an adequate sphincterotomy is critical to successful stone extraction. Traditionally, sphincterotomy is performed at the 12 o’clock position over a wire though it is easier to lose the sphincterotome without the guidewire (Figure 2). Extending the cut through the entire sphincter muscle until free flow of bile is optimal but not always feasible. In situations such as coagulopathy, stuck fracture or bifurcational location of the papilla, a small sphincterotomy with adjacent papillary balloon dilation may be advantageous.

It is important for the proximal wire to be at the papilla. Placement too distal may result in loss of access to the biliary tree. Advancing into the peripheral intrahepatic ducts may result in determination of the wire’s extent over the more difficult part of the duct (Figure 2). Lithotripter baskets are usually advanced over a wire into the ductal system. The technique is similar to advancing a stent or catheter using this wire as a guide. Some endoscopists prefer to pass the basket without using the wire. This is technically more challenging but the endoscopist can easily and quickly remove the basket. Our technique is to engage the basket within the ampullary opening if free cannulation is difficult due to the angle of approach. Applying forward pressure on the basket while dropping the elevator will create a “C” loop. Once the “C” loop is created, the basket tip may be directed towards the 12 o’clock position to facilitate balloon dilation of the ampulla or force the elevator out of the duct. If passed “free”, the wire will not be present within the confines of the open basket which may allow easier entrapment of calculus. Alternatively, carefully withdrawing the wire while the basket is in the duct will also remove the wire from the basket confines.

**Basket Selection and Sizing**

Choice of basket is determined by a number of factors including: stone size, duct diameter, and ability to perform an adequate sphincterotomy. Stones that are of similar diameter or smaller than the distal duct are easily managed with a standard stone retrieval basket after sphincterotomy (Figure 1). Through the Scope (TTS) lithotripter baskets are chosen for situations where the calculus is larger than the more distal duct or situations where sphincterotomy is not feasible or of inadequate size to allow passage of the calculus.

In general, basket size should be chosen based on the maximum ductal diameter. Choice of a basket larger than the duct diameter may result in incomplete opening making stone capture difficult. Once captured, mechanical lithotripsy may be performed. Removal of fragments may proceed with the lithotripter balloon basket, standard stone basket or stone retrieval balloon.

**Stone Extraction: Entrapping the Stones**

Lithotripter baskets add to the endoscopist’ ability to deal with a variety of stone cases. While all lithotripter baskets are effective in the management of medium and large calcii, additional safety issues may warrant special considerations. Infrequently, stones may not respond to the forces generated by mechanical lithotripsy. In these situations, the patient may require surgical exploration if the stones cannot be removed or released. Fortunately, some lithotripter baskets have a built-in safety feature allowing for severe fractures and removal of the basket if specific tensile forces are exceeded. While the residual ductal calculus still need to be dealt with the need for urgent surgery is avoided.

In cases of medium (CBD) calculus, it is essential to open the basket entrapping the distal most calculus and proceeding to the more proximal stones. Opening the basket proximal to the calculus and attempting removal may result in multiple calculus becoming entwined within the basket and the inability to remove the basket from the duct (Figure 3 and 4). We favor using the basket in an “open” position when removing stones. This allows one to release a stone if it is determined to be too large to remove. This release can often be accomplished by advancing the basket into the proximal hepatic ducts which usually “fractures” the stone into smaller pieces.

If a nonfracture capable basket is closely fit, it is preferable to advance the scope in a clockwise direction. The stone may be irreversibly compressed and trapping it in the basket is the safest maneuver. After papillary balloon dilatation, position the scope behind the ampulla with a withdrawn endoscope (Figure 5). This allows access to the ampullary opening if complete removal of the calculus is not possible.

Figure 1 Making a loop just proximal to the ampulla

Figure 2 Proper scope positioning above papilla

Once the duct is filled to the level of free calculus, we routinely use a basket or stone retrieval balloon to inject contrast from the proximal duct. This will “fracture” the duct close of debris as well as push residual fragments to the distal duct facilitating subsequent clearance (Figure 8).

**Duct Clearance**

One the duct is filled to the level of free calculus, we routinely use a basket or stone retrieval balloon to inject contrast from the proximal duct. This will “fracture” the duct close of debris as well as push residual fragments to the distal duct facilitating subsequent clearance (Figure 8).

**Stent Placement**

Stents are infrequently required with bile duct calculi. Stents are placed under fluoroscopic guidance using an injection teaching catheter (Figure 9). If a stone is not retrieved, it is prudent to leave a stent in place until the calculus is removed. A small over-the-wire nasobiliary tube may be placed through the papilla to allow bile drainage and decrease the risk of post procedure inflammation.

**Complications**

Entrapment of calculi is rare. While some calculi may be unobtainable, the endoscopist can use the above techniques to deal with the problematic calculus. In case of severe duct injury, the endoscopist should be comfortable with the placement of a retrograde catheter or trans-hepatic stent.

**Summary**

Basket assisted techniques can be utilized to successfully remove bile duct calculi, with proper technique and experience. This summary should provide the endoscopist with a technique to avoid unexpected complications in dealing with bile duct calculi of various sizes.
many techniques are utilized to facilitate removal of biliary ductal calculi, including sphincterostomy, hydrostatic ductal dilation, and stone retrieval balloons. Baskets, stones, and hydrophilic wires are employed to remove biliary stones. This paper is designed to aid in the successful removal of biliary stones. Introduction

BASKET ASSISTED STONE EXTRACTION

In general, basket size should be chosen based on the maximum ductal diameter. Choice of a smaller basket than the duct diameter may result in incomplete opening of the ductal system. Our technique is to engage the basket within the ampullary opening if free cannulation is difficult due to the angle of approach. Applyingforward pressure on the basket while dropping the elevator will create a ‘C’ loop. Once the ‘C’ loop is created, the basket tip may be directed towards the 12 o’clock position to facilitate deep cannulation. In addition, if passed “free,” the wire will be present within the confines of the open basket which may allow easier entrapment of calculi. Alternatively, carefully withdrawing the wire while the basket is in the duct will also remove the wire from the biliary tree.

Lithotripter baskets add to the endoscopists’ ability to deal with a variety of stone cases. While all lithotripter baskets are effective in the management of medium to large calculi, additional safety issues may warrant special considerations. Infrequently, stones may not respond to the forces generated by mechanical lithotripsy. In these situations, the patient may require surgical exploration if the stones cannot be removed or released. Fortunately, some lithotripter baskets have a built-in safety feature allowing for wire/tip occlusion. If resistance is met, retract basket and rotate duodenoscope to allow clearance of the calculus. Once the duct is felt to be free of calculi, we routinely use a basket or stone retrieval balloon to inject contrast from the proximal duct. This will “flush” the duct clear of debris as well as push residual fragments to the distal duct.

Figure 1: Proper scope positioning to facilitate deep cannulation.

Figure 2: Procedure of the open basket case when removing a calculus.

Figure 3: Proper scope positioning when using a lithotripsy balloon to crush the calculus and remove the basket.

Figure 4: Final occlusion cholangiogram.

Figure 5: Final cholangiogram of the proximal case when removing a calculus.

Figure 6: Final occlusion cholangiogram of the distal case when removing a calculus.

Figure 7: Mechanical lithotripsy balloon after removing a calculus.

Figure 8: Lithotripsy balloon after removing a calculus.

Figure 9: Mechanical lithotripsy balloon after removing a calculus.

Figure 10: Stone Extraction - Scope Positioning.

This technique is to facilitate deep cannulation by utilizing the elevator. In addition, if passed “free,” the wire will be present within the confines of the open basket which may allow easier entrapment of calculi. Alternatively, carefully withdrawing the wire while the basket is in the duct will also remove the wire from the biliary tree.

STEP 1: Gaining Access

Standard access to the endoscopic ductal system is obtained. Guideewire placement is appropriate to facilitate balloon dilation of the ampulla or strictures, sphincterotomy, or use of wire-guided instruments.

Performance of adequate sphincterotomy is critical to successful stone extraction. Traditionally, sphincterotomy is performed at the 12 o’clock position over a wire; however it is easier to lose the sphincterotomy without the de-judicating effect. Extending the cut through the entire sphincter muscle until free flow of bile is optimal but not always feasible. In situations such as coagulopathy, drainage of the intrabiliary location of this papilla, a small sphincterotomy with adjacent balloon dilation may be advantageous.

It is important for the proximal wire to be at the papilla. Placement too distal may result in loss of access to the biliary tree. Advancing into the peripheral intrahepatic ducts may result in downward pressure on the wire making passage of instruments over the wire more difficult (Figure 2).

Lithotripter baskets are usually advanced over a wire into the ductal system. The technique is similar to advancing a wire or catheter using this wire as a guide. Some endoscopists prefer to pass the basket without using the wire. This is technically more challenging due to the stiffness of the basket. Our technique is to engage the basket within the ampullary opening if free cannulation is difficult due to the angle of approach. Applying forward pressure on the basket while dropping the elevator will create a ‘C’ loop. Once the ‘C’ loop is created, the basket tip may be directed towards the 12 o’clock position to facilitate deep cannulation. In addition, if passed “free,” the wire will be present within the confines of the open basket which may allow easier entrapment of calculi. Alternatively, carefully withdrawing the wire while the basket is in the duct will also remove the wire from the biliary tree.

Figure 2: Initial stone localization with guidewire placed at papilla.

Figure 3: Lithotripsy balloon after removing a calculus.

Figure 4: Final occlusion cholangiogram.

Figure 5: Final cholangiogram of the proximal case when removing a calculus.

Figure 6: Final occlusion cholangiogram of the distal case when removing a calculus.

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STEP 2A: Stone Extraction - Entrapning the Stones

Lithotripter baskets add to the endoscopists’ ability to deal with a variety of stone cases. While all lithotripter baskets are effective in the management of medium to large calculi, additional safety issues may warrant special consideration. Infrequently, stones may not respond to the forces generated by mechanical lithotripsy. In these situations, the patient may require surgical exploration if the stones cannot be removed or released. Fortunately, some lithotripter baskets have a built-in safety feature allowing for wire/tip occlusion. If resistance is met, retract basket and rotate duodenoscope to allow clearance of the calculus. Once the duct is felt to be free of calculi, we routinely use a basket or stone retrieval balloon to inject contrast from the proximal duct. This will “flush” the duct clear of debris as well as push residual fragments to the distal duct.

Figure 1: Step 2A: Stone Extraction - Entrapning the Stones.

Figure 2: Stone Extraction - Scope Positioning.

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STEP 2B: Duct Clearance

Once the duct is felt to be free of calculi, we routinely use a basket or stone retrieval balloon to inject contrast from the proximal duct. This may “flush” the duct clear of debris as well as push residual fragments to the distal duct.

Figure 3: Step 2B: Duct Clearance.
BASKET ASSISTED STONE EXTRACTION

Many techniques are utilized to facilitate removal of biliary duct calculi, including sphincterotomy, hydrostatic balloon dilatation of the ampulla, stone retrieval balloons, baskets, and endoscopic mechanical lithotripsy. Basket-assisted techniques have generally been less favored due to concern of inadvertent entrapment. This concern is prudent in cases where calculi are larger than the distal duct diameter or under conditions where only a small sphincterotomy may be performed (i.e. coagulopathy, perianastomotic diverticulum). However, proper selection and use of baskets will allow successful extraction of most calculi without difficulty. This paper is designed to ally unwarnted concerns and provide advice on proper use of this technique.

INTRODUCTION

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Standard access to the endoscopic or lithotripsy device is obtained. Guidewire placement is appropriate to facilitate balloon dilation of the ampulla or sphincterotomy for use of wire-guided instruments.

Gaining Access

Success of adequate sphincterotomy is critical to successful stone extraction. Traditionally, sphincterotomy is performed at the 12 o’clock position over a wire though it is easier to lose the sphincterotomy without the guidewire interfering. Extending the incision through the entire sphincter muscle until free flow of bile is optimal but not always feasible. In situations such as coagulopathy, dilated ducts, or intrahepatic location of the papilla, a small sphincterotomy with adjacent papillary balloon dilation may be advantageous.

It is important for the proximal wire tip to be at the bifurcation. Placement too distal may result in loss of access to the duct. Advancing into the peripheral intrahepatic ducts may result in downstream pressure on the wire making passage of instruments over the wire more difficult (Figure 2).

Many techniques are utilized to facilitate removal of biliary duct calculi, including sphincterotomy, hydrostatic balloon dilatation of the ampulla, stone retrieval balloons, baskets, and endoscopic mechanical lithotripsy. Basket-assisted techniques have generally been less favored due to concern of inadvertent entrapment. This concern is prudent in cases where calculi are larger than the distal duct diameter or under conditions where only a small sphincterotomy may be performed (i.e. coagulopathy, perianastomotic diverticulum). However, proper selection and use of baskets will allow successful extraction of most calculi without difficulty. This paper is designed to ally unwarnted concerns and provide advice on proper use of this technique.

Proper size of basket entrapping the distal most calculus and then proceeding to the more proximal stones. Opening the basket proximal to the calculus and attempting removal may result in multiple calculus becoming entrapped within the basket and inability to retrieve the basket from the duct (Figure 2 and 6). We favor leaving the basket in an “open” position when removing stones. This allows one to release a stone if it is determined to be too large to remove. This release can often be accomplished by advancing the basket into the proximal hepatic ducts which usually “hides” the stone from the endoscopist.

If a non-lithotripsy compatible basket is closely situated to the ampulla, the stone may embolize making it very difficult to open and release the calculi. In these rare instances of stone entrapment the safest maneuver is to cut the basket at the level of the calculus and remove the calculus and the basket (Figure 3). A definitive method to ensure baskets do not result in stone entrapment is to use a wire-guided basket. This allows one to release a stone if it is determined to be too large to remove. This release can often be accomplished by advancing the basket into the proximal hepatic ducts which usually “hides” the stone from the endoscopist.

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Description of Procedure

ERCP was chosen as the initial therapeutic maneuver. Injection of contrast after selective biliary cannulation revealed a dilated duct (13 mm). Multiple CBD calculi up to 1 cm were identified (Image 1).

Biliary sphincterotomy was performed over a wire to facilitate further therapeutic interventions. A 4.5 cm x 2.1 cm Trapsid® RX_Ultraplay Compatible Basket was utilized to entrap and fragment the calculi (Images 2 and 3). The Trapezoid RX Basket as well as a 12-15 mm Extractor™ RX Retriever Balloon were subsequently utilized to clear the duct of the smaller calculi and fragmented stone debris.

Procedure Outcome and Follow-up

The patient was able to be discharged home within 24 hours in stable condition.
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