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Innovation in Surgical Technique

Ten strategies to improve the efficacy of laparoscopic biliary surgery☆

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ABSTRACT

Laparoscopic surgery is the gold standard treatment of symptomatic gallstones. For some, it is also the treatment of choice for choledocholithiasis. Certain special and rare circumstances regarding the number, size and location of bile duct stones or altered bile duct anatomy (embryonic or acquired), can be challenging to resolve with usual laparoscopic techniques. For these situations, we describe 10 surgical strategies that are relatively simple and inexpensive to apply, making them appropriate to be used in most surgical centers.

Diez estrategias para mejorar la eficacia de la cirugía biliar laparoscópica

Palabras clave:
Coledocolitiasis
Colecistectomía laparoscópica
Instrumentación transcística
Litiasis cística

RESUMEN

El abordaje laparoscópico es el método de elección para el tratamiento de la litiasis vesicular sintomática, y para muchos también lo es para la coledocolitiasis. Algunas situaciones especiales e infrecuentes en el tamaño, número y ubicación de los cálculos o en alteraciones de la anatomía biliar embriológicas o adquiridas pueden generar dificultades para la resolución de estas afecciones con técnicas laparoscópicas habituales. Para estas situaciones describimos 10 estrategias quirúrgicas de aplicación relativamente sencilla y que requieren de escasos recursos económicos, por lo que creemos que pueden adaptarse a la mayor parte de los centros quirúrgicos.

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Introduction

For decades, the laparoscopic approach has been the gold standard for the treatment of gallstones, and currently also for choledocholithiasis.[1]

When inflammation alters the normal anatomy of Calot's triangle, or rare conditions occur associated with the choledocholithiasis, resolution can be difficult. Unfavorable situations may be related to the size, number and location of the stones or anatomical variables of the biliary tree[2–4] (Fig. 1).

The objective of this study is to describe techniques used in our department to try to improve the efficacy of laparoscopic biliary surgery in unfavorable situations.

Surgical technique

Modified port placement

We use the classic American location of the ports for laparoscopic cholecystectomy, with the surgeon standing to the left of the patient. In cases where we suspect choledocholithiasis, and in anticipation of the need to perform intracorporeal stitches, we believe that the optimal location of the epigastric port is to the left of the midline and the round ligament, in the left hypochondrium, which provides better angulation for advanced maneuvers (Fig. 2A).

Cystic duct ligation and new cysticotomy

When faced with involuntary total division of the cystic duct after cysticotomy, it is often difficult to grasp with forceps in order to insert a cholangiography catheter or a basket, especially when the residual length is short. A simple way to solve this is to ligate the divided duct with a pre-made endoloop knot, pulling it to perform a new cysticotomy and subsequent reinsertion of a catheter (Fig. 2B).

Enlargement of cysticotomy over a calculus

When the cystic duct/calculus ratio is <1 (meaning that the diameter of the cystic duct is smaller than the choledochal calculus), the potential success of transcystic instrumentation is drastically lower.[4]

The maneuver we use involves snaring the stone with the basket, dragging it to the cystic duct, and expanding the cysticotomy over the stone (Fig. 2C).

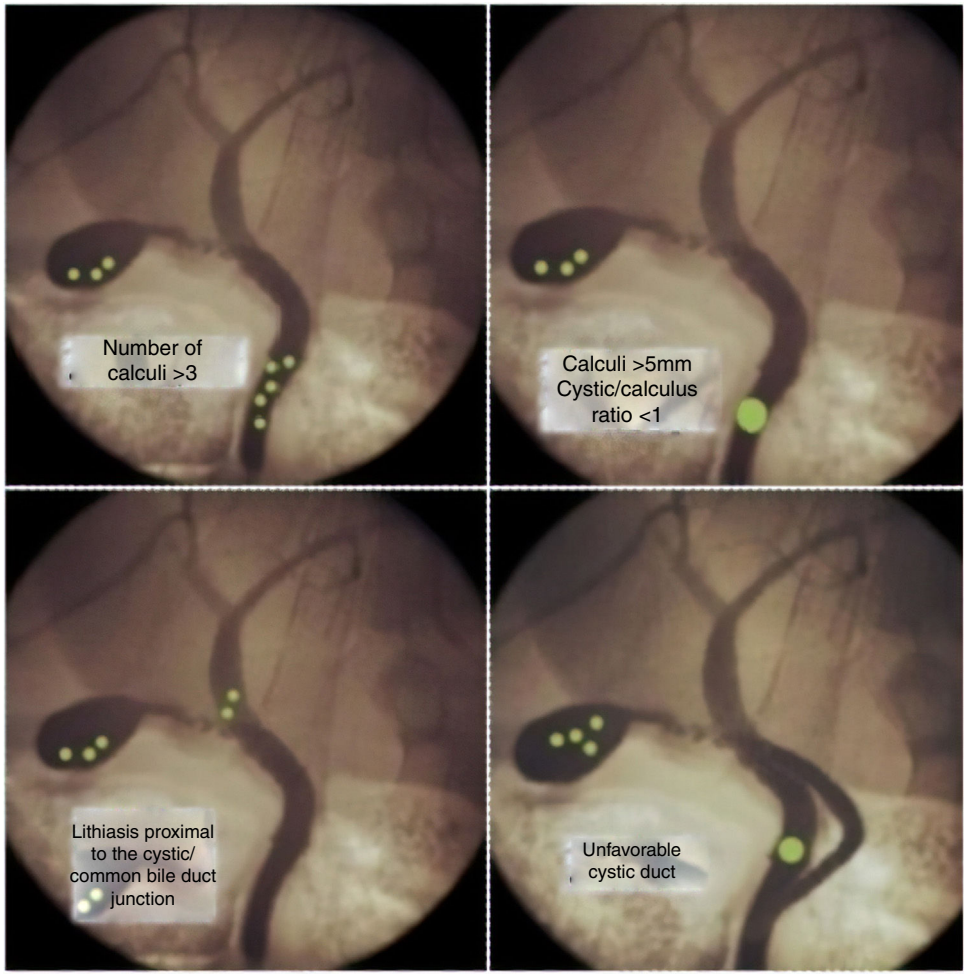

Fig. 1 – Unfavorable situations for the treatment of biliary lithiasis.

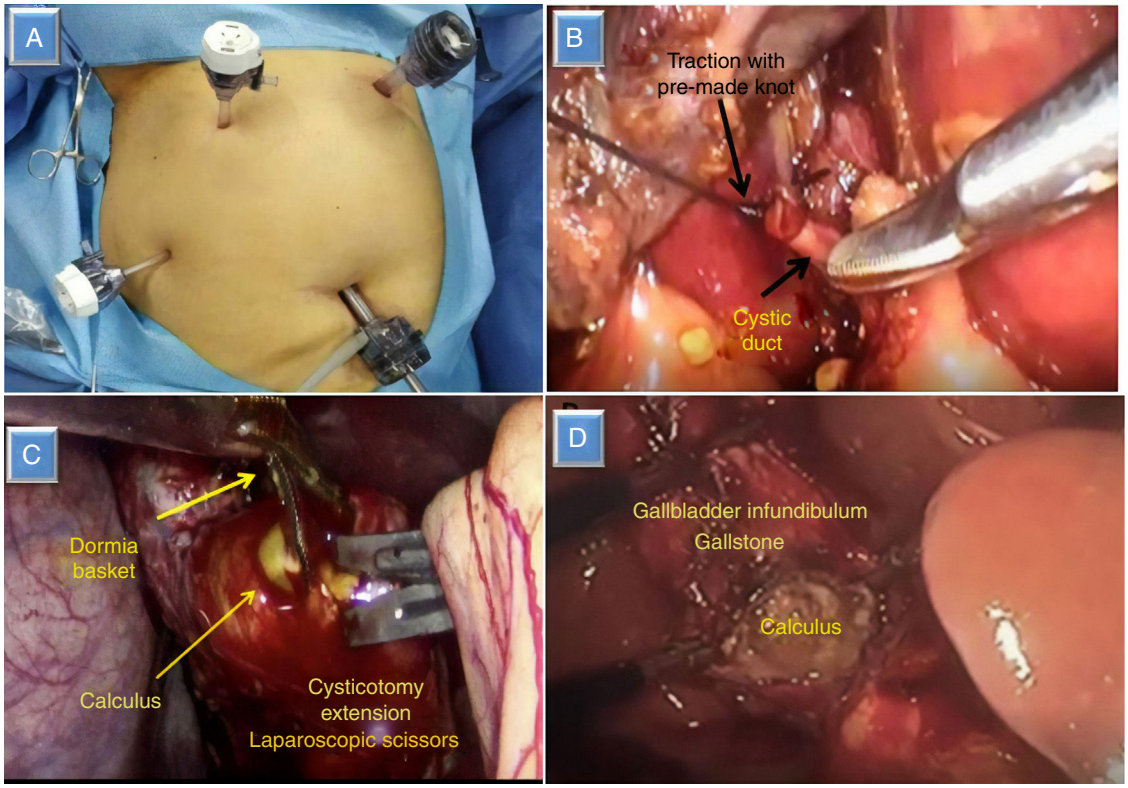

Fig. 2 – A) Placement of the port on the left; B) Ligation of the cystic duct and new cysticotomy; C) Extension of the cysticotomy over the calculus; D) Opening of the gallbladder and extraction of the calculus lodged in the infundibulum.

Opening of gallbladder and extraction of a stone embedded in the infundibulum

Adequate traction of the infundibulum of the gallbladder is one of the requirements for a safe cholecystectomy.[5,6] When a large calculus completely occupies it, adequate traction is difficult and is a limitation to achieve the critical view of safety, increasing the conversion rate.[5]

Opening the gallbladder on the surgical side allows for the stone to be removed and adequate traction is achieved (Fig. 2D). In some cases, this maneuver can create an added complication as stones can fall into the peritoneal cavity, so we only use it in selected cases of great difficulty, such as Mirizzi syndrome type I.

Reduction of the cholangiography catheter caliber

When the diameter of the cystic duct is smaller than that of the catheter used for intraoperative cholangiography, a maneuver we perform is the insertion of the plastic cap of an Abbocath-type catheter into the lumen of the cholangiography catheter. When introducing it into the cysticotomy, we use atraumatic forceps so that no leaks occur that would interfere with the sharpness of the image (Fig. 3). This resource was necessary in very few cases, but it enabled us to achieve intraoperative cholangiography in 100%.

New dissection of the cystic duct

Adequate dissection of the cystic duct provides a critical view of safety. However, in unfavorable cystic ducts (twisted or presenting cystic duct stones[7,8]), it is difficult to perform intraoperative cholangiography, and even more so transcystic instrumentation.

In these cases, a new dissection of the duct closest to the main bile duct is necessary, allowing us to straighten the pathway and perform a new cysticotomy while facilitating canalization and subsequent instrumentation (Fig. 4A and B).

Angular cysticotomy or minimal choledochotomy

The presence of intrahepatic stones is uncommon, and even more so is the impossibility of descending them beyond the cystic-choledochal junction. When faced with this exceptional situation, we perform a new cysticotomy on the lower side, close to the junction, which allows us to direct the basket snare towards the intrahepatic bile duct.[9]

In some cases, closure must be performed with stitches due to the proximity with the main bile duct (Fig. 4C).

Progressive antegrade papillary dilation controlled with percutaneous balloon

Under imaging guidance, we insert a percutaneous dilatation balloon over a 0.035'' hydrophilic guidewire (Roadrunner-Cook

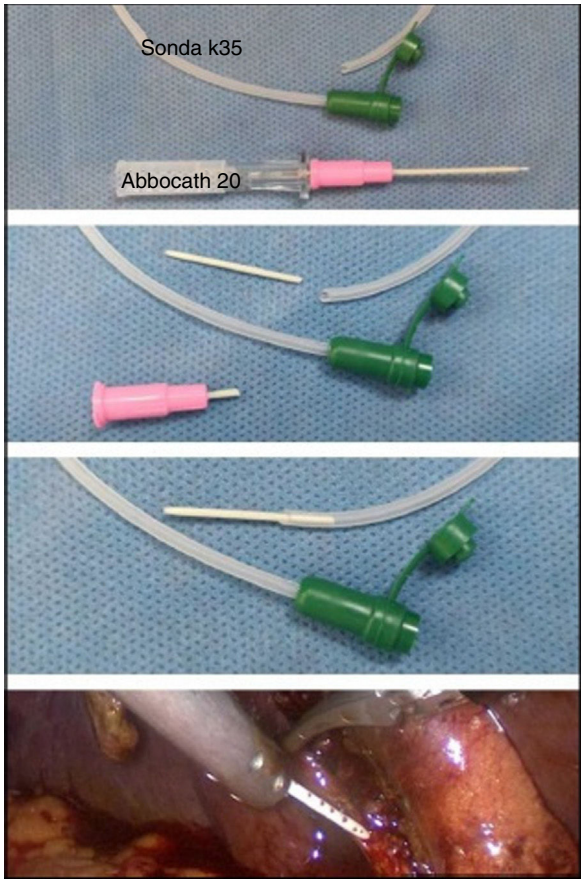

Fig. 3 – Reduction in diameter of the cholangiography catheter by introducing the plastic material cut from a catheter over a 20 needle in a k35 tube.

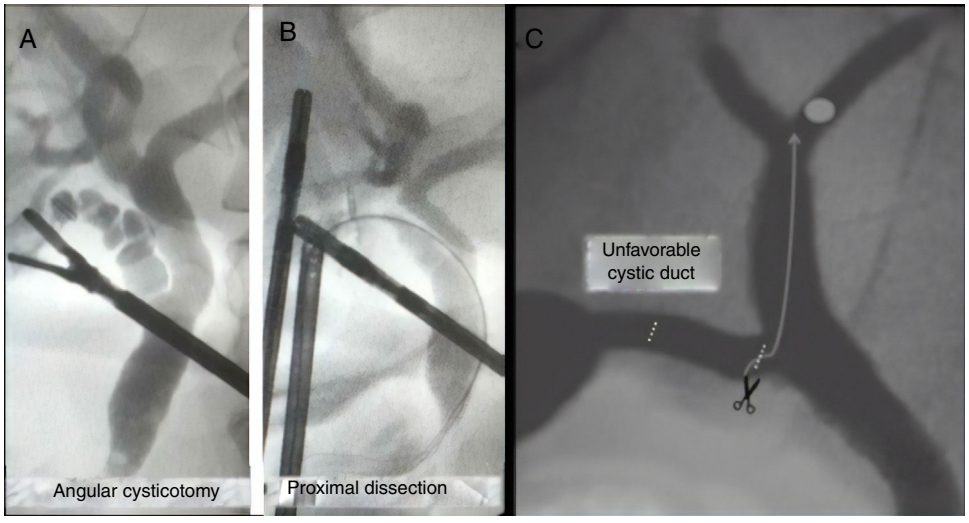

Fig. 4 – A) Unfavorable cystic duct (twisted); B) Proximal dissection of the cystic duct; C) Angular cysticotomy. TCI: transcystic instrumentation.

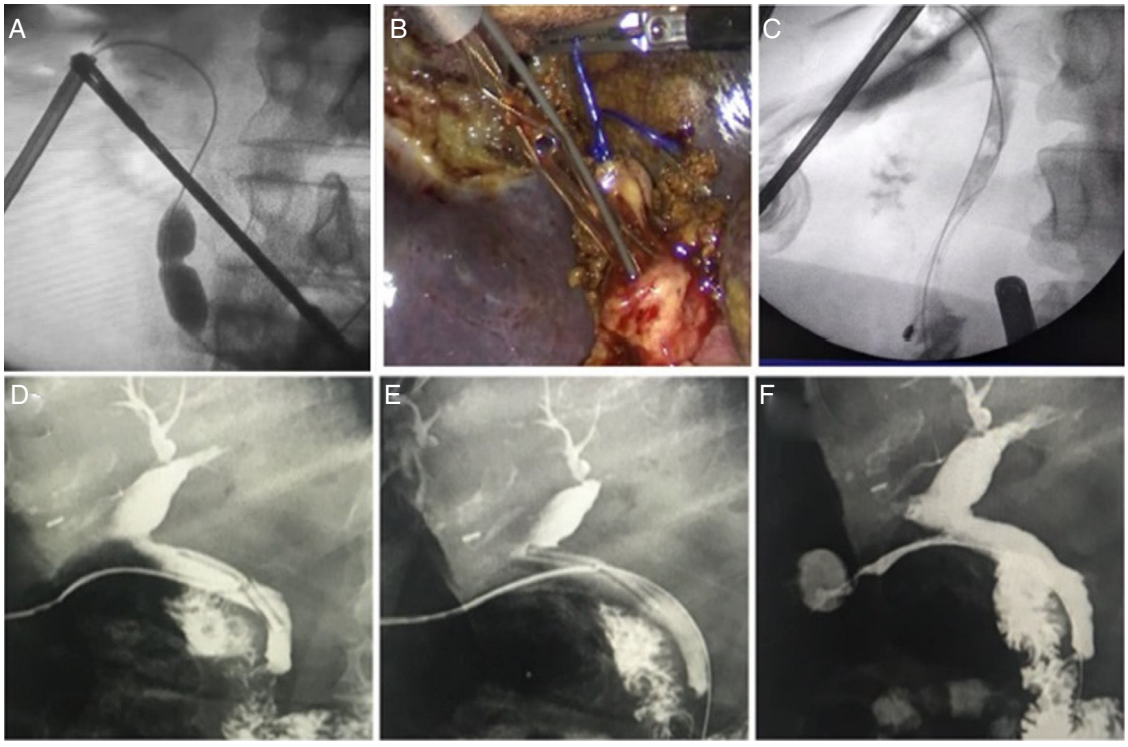

Fig. 5 – A) Progressive anterograde papillary dilatation controlled with percutaneous balloon; B and C) Wire and basket snare in tandem; D–F) Sequence of extraction with T-tube and guidewire.

Medical®) through the cystic duct, positioning it in the papilla. Dilation is conducted progressively using balloons (Quantum TTC-Cook Medical®) of 8 mm–20 mm in diameter for 20 s to a pressure of 6 atm. We have registered no morbidity with the use of hydrophilic guidewire and no false pathways. We use this strategy in the following situations:

- Choledochorrhaphy: after complete removal of the calculi by choledochotomy, and in cases with unsatisfactory or uncertain papillary evacuation, we perform papillary balloon dilation and primary closure of the common bile duct. The goal of dilation is to decrease intracholedochal pressure during the healing period and to avoid placing a T-tube or antegrade stent.
- Total acute choledochal occlusion syndrome: this uncommon and adverse situation occurs when a calculus is embedded in the mid or distal common bile duct, preventing the passage of contrast material and the basket into the duodenum. Treatment consists of trying to pass a guidewire into the duodenum to introduce a percutaneous balloon, which dislodges the stone for later extraction with a basket or progression to the duodenum[10] (Fig. 5A).

Guidewire and basket in tandem

In cases of total acute choledochal occlusion syndrome, a maneuver that we use prior to antegrade papillary dilation is the insertion of a hydrophilic 0.035'' guidewire (Roadrunner-Cook Medical®) and a Dormia basket in parallel or in tandem. The wire is able to pass between the bile duct and the stone, achieving mobilization, after which the basket is used for extraction (Fig. 5B and C).

T-tube removal with guidewire

The T-tube is extracted 6–8 weeks after its placement and after having performed a fistulogram 10 days after surgery to confirm the absence of lithiasis and correct papillary drainage. The main complication of its removal is the rupture of the tract and posterior leakage or choleperitoneum. To avoid this, we insert a 0.035'' hydrophilic guidewire (Roadrunner-Cook Medical®) through the T-tube to the duodenum under fluoroscopy, and then remove the tube, leaving the wire in the duodenum. We corroborate the integrity of the tract by performing a fistulogram through the cutaneous orifice. Then, the procedure is either concluded if there are no leaks, or a catheter is placed with the wire as a guide if there was contrast leakage due to rupture (Fig. 5D–F).

Discussion

The 10 strategies we have presented could be useful to improve the effectiveness of the laparoscopic approach in complex and uncommon situations, minimizing intraoperative and postoperative complications. They have arisen over 20 years of experience in laparoscopic surgery at a referral center for complex biliary disease and were developed respecting the precepts of surgical safety (Table 1).

Table 1 – Results of strategies to improve the efficacy of laparoscopic biliary surgery.

Strategy	N	Benefits
Placement of modified ports	200	Greater ease for choledochorraphy
Cystic duct ligation	18	Intraoperative cholangiography in 100%
Cysticotomy extension	45	Fewer choledochotomies
Gallbladder opening	25	Safe cholecystectomy
Catheter reduction	12	Intraoperative cholangiography in 100%
Angular cysticotomy	5	Fewer choledochotomies
New cystic dissection	120	Intraoperative cholangiography in 100%
Anterograde dilation	15	10 primary closures of the common bile duct without biliary leaks and 5 TACOS with complete extraction of calculi
Basket/hydrophilic guidewire in tandem	3	Complete extraction of calculi
T-tube extraction	21	No post-extraction complications

TACOS: total acute choledochal obstruction syndrome.

Table 2 – Utility and benefits of strategies to improve laparoscopic biliary surgery.

Situation	Approach	Benefits	Drawbacks	References
Choledochal lithiasis	Epigastric port to the left	Better angulation for suture	None	None
Involuntary division of the cystic duct	Endoloop ligature and new cysticotomy	100% IOC	None	None
Cystic cannot be cannulated	Adaptation of the catheter caliber	100% IOC	None	None
Cystic/calculus ratio <1	Extension of cysticotomy over calculus	Fewer choledochotomies or ERCP	None	None
Intrahepatic calculi	Angular cysticotomy or minimal choledochotomy	Fewer choledochotomies or ERCP	None	Yes[3]
Unfavorable cystic duct and choledocholithiasis	New dissection of the cystic duct	Fewer choledochotomies or ERCP	None	None
Calculus lodged in the gallbladder infundibulum	Open gallbladder	Better gallbladder traction for critical view	Potential neoplastic spread	None
TACOS	Maneuver in tandem	Fewer choledochotomies, ERCP or conversion	Pancreatitis?	None
Choledochorrhaphy	Balloon dilation	Less postoperative bile leakage	Pancreatitis?	None
T-tube extraction	Extraction with hydrophilic guidewire	Less post-extraction choleperitoneum	None	Yes[10]

IOC: intraoperative cholangiography; ERCP: endoscopic retrograde cholangiopancreatography; TACOS: total acute choledochal obstruction syndrome.

It would be difficult to compare these strategies with the literature available, and this would also exceed the objective of this paper. Nonetheless, we have found citations for only 3 of these approaches (angulated cysticotomy, antegrade papillary dilation and T-tube extraction).[9–11]

With regard to angulated cysticotomy and minimal choledochotomy, we found a publication for the resolution of choledocholithiasis in elderly patients that the authors used for the introduction of a choledochoscope, while we used it to direct a Dormia basket to the intrahepatic bile duct.[9]

Existing publications on antegrade papillary dilation evaluate its role in the management of choledocholithiasis and how to improve the effectiveness of the laparoscopic approach to achieve complete extraction. This is usually achieved by passage of multiple stones through the dilated papilla. We did not find any publications referring to its use in reducing bile leaks in the event of primary closure of the common bile duct in patients with delayed papillary evacuation. We believe that papillary dilation is a valid strategy to improve papillary evacuation, thereby avoiding the placement of a T-tube or an antegrade stent, which would later require endoscopy for its extraction[10] (Table 2).

Regarding the removal of the T-tube, there is a management strategy for immunocompromised patients in which the authors inject contrast through the skin lateral to the tube in order to verify the integrity of the tract prior to extraction. If it is not undamaged, they repeat the procedure 2 weeks later.[11] We believe that our strategy would make it possible to treat the rupture of the tract immediately and without delay, and always after and not before the removal of the T-tube. The use of a guidewire allows the T-tube to be replaced by a percutaneous catheter, thus avoiding the occurrence of bile leakage, biloma or choleperitoneum.

The rest of the strategies mentioned are technical innovations that, to our knowledge, have not yet been published. Some, such as modified port placement, have more to do with greater ease than improved outcomes, and others are strategies for very rare cases, which makes their

utility difficult to assess. The aim this document is simply to introduce and describe them, so it would be desirable for future publications to validate or contradict them.

Conflict of interests

The authors have no conflict of interests to declare.

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