Journal of Robotic Surgery (2019) 13:713–716
https://doi.org/10.1007/s11701-019-00957-8

REVIEW ARTICLE

Robotic choledochoduodenostomy for benign distal common bile duct stricture: how we do it

Annie Laurie Benzie[1] · Iswanto Sucandy[1,2] · Janelle Spence[1] · Sharona Ross[1] · Alexander Rosemurgy[1]

Received: 2 December 2018 / Accepted: 9 April 2019 / Published online: 15 April 2019

Abstract

Benign bile duct stricture poses a significant challenge for gastroenterologists and general surgeons due to the inherent nature of the disease, difficulty in sustaining long-term solutions and fear of pitfalls in performing biliary tract operations. Operative management with an open biliary bypass is mainly reserved for patients who have failed multiple attempts of endoscopic and percutaneous treatments. However, recent advances in minimally invasive technology, notably in the form of the robotics, have provided a new approach to tackling biliary disease. In this technical report, we describe our standardized method of robotic choledochoduodenostomy in a 59-year-old woman with history of Roux-en-Y gastric bypass who presents with benign distal common bile duct stricture following failure of non-operative management. Key steps in this approach involved adequate duodenal Kocherization, robotic portal dissection and creation of a side-to-side choledochoduodenal anastomosis. The operative time was 200 min with no intraoperative complications and estimated blood loss was less than 50 mL. No abdominal drains were placed. The patient was discharged home on postoperative day 1 tolerating regular diet and able to resume her usual activities within 1 week of her operation. A video is attached to this report.

Keywords Robotic choledochoduodenostomy · Distal bile duct stricture · Roux-en-Y gastric bypass

Introduction

Biliary ductal disease in patients after Roux-en-Y gastric bypass (RYGB) poses a significant challenge, even at specialized centers with multidisciplinary teams of advanced endoscopists, interventional radiologists and hepatobiliary surgeons. Patients with prior RYGB face an increased risk of developing primary common bile duct stones, retained stones, bile duct stricture, biliary pancreatitis, and other biliary pathologies that are traditionally addressed with endoscopic retrograde cholangiopancreatography (ERCP) [1, 2]. Many bariatric surgeons advocate for a routine cholecystectomy as a part of RYGB in recognition of the future technical difficulty in transoral biliary access secondary to altered foregut anatomy. Available alternatives for biliary access include percutaneous transhepatic approaches, double balloon enteroscopy, and laparoscopic-assisted endoscopy through the remnant stomach; however, these methods entail multiple interventions, increased risks of complications, and are frequently prone to failure due to inability of definitively addressing the underlying pathology to correct poor biliary drainage.

Choledochoduodenostomy was first described by Riedel in 1888 as a method to relieve biliary obstruction in patients with retained common bile duct stones following cholecystectomy [3, 6]. Indications for this approach include failure of bile duct stone clearance, multiple or large primary common bile duct stones, and recalcitrant benign distal biliary stricture. This operation is historically notorious for its high complication rate and risk of sump syndrome, in which the enteric contents reflux retrogradely into the biliary tree leading to biliary stasis, chronic inflammation, and cholangitis. However, in a recent review of 75 open biliary bypass operations with 6 year post-operative follow-up period, none of the patients developed cholangitis. Postoperative

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s11701-019-00957-8) contains supplementary material, which is available to authorized users.

✉ Iswanto Sucandy
iswanto.sucandy@ahss.org

[1] Digestive Health Institute, Florida Hospital Tampa, Tampa, USA

[2] Advanced Minimally Invasive and Robotic Surgery, Digestive Health Institute, Florida Hospital Tampa, 3000 Medical Park Drive, Suite #500, Tampa, FL 33613, USA

complications were reported as high as 19%, but no mortality was seen [3]. In the era of minimal access surgery, advanced laparoscopists have safely demonstrated that choledochoduodenostomy is an excellent option for the treatment of distal bile duct obstruction in a variety of situations, including choledocholithiasis and benign biliary stricture in patients with a history of RYGB [4].

The advent of robotic technology has allowed for further refinement of minimally invasive techniques with the advantage of better three-dimensional visualization, stable platform, increased dexterity, tremor filtering, ease of suturing, and improved access to the critical portal structures in comparison to conventional laparoscopy. Robot-assisted choledochoduodenostomy has been described previously in the literature for the management of benign distal biliary obstruction [4], however, detailed reports with an operative video describing the surgical techniques are limited and it has yet to be applied to patients with RYGB. As described in this technical report and accompanying video, we propose that robotic choledochoduodenostomy is an effective, safe, technically feasible, and elegant procedure to definitively treat benign biliary obstruction in patients with RYGB anatomy.

Technical report

A 59-year-old woman with history of open cholecystectomy and remote laparoscopic RYGB for morbid obesity presented to our clinic with a 2 year history of right upper quadrant abdominal pain and hyperbilirubinemia. On computed tomography (CT) scan imaging, she was noted to have a significant dilatation of the common bile duct up to 11 mm with evidence of intraductal debris, consistent with primary common bile duct stones. Subsequent MRCP did not show any evidence of pancreatic head mass or extrinsic compression of the distal common bile duct (Fig. 1). Our patient had multiple percutaneous biliary dilations without success and endoscopic intervention was not technically feasible due to the altered foregut anatomy. The impressive distal narrowing within the head of pancreas, the presence of chronic inflammation, and history of multiple prior transhepatic attempts in our patient alerted us that an endoscopic approach would unlikely be of benefit over the long term. Gastroenterology consultants in our department did not feel that transgastric ERCP with sphincterotomy will be technically successful in resolving the relatively long intrapancreatic common bile duct stricture. After careful consideration, a plan was made for minimally invasive robotic biliary tree exploration, clearance of intraductal debris, and choledochoduodenostomy to allow for definitive biliary decompression.

The operation was undertaken using the da Vinci Xi Surgical System® (Intuitive Surgical, Sunnyvale, CA, USA).

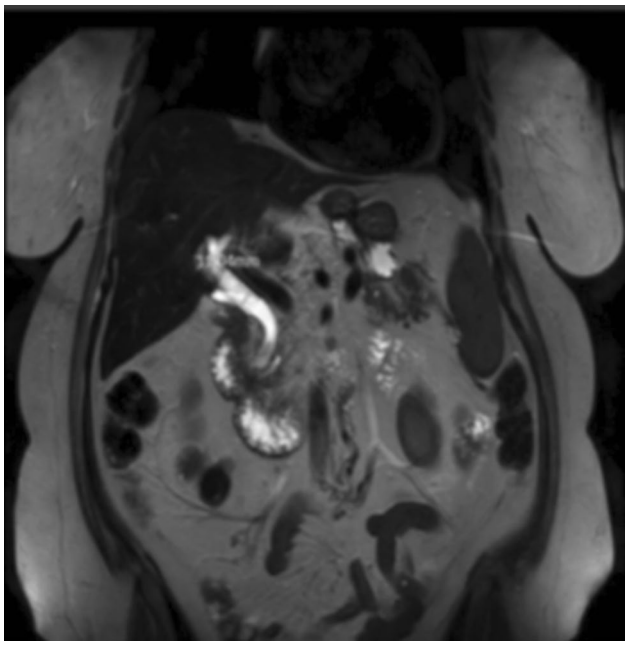

Fig. 1 Coronal view of MRCP

The patient was positioned supine on the operating table in a slight reverse Trendelenburg position prior to docking the robotic system over the patient's right shoulder. Abdominal access was attained through an 8-mm vertical incision in the umbilicus without insult to the umbilical ring and 15 mmHg of pneumoperitoneum was established. Diagnostic celioscopy was undertaken revealing no evidence of malignancy; however, extensive adhesive disease was notable in the right upper abdomen related to her prior operations. Three additional 8-mm robotic trocars were placed along the right midclavicular line, left midclavicular line, and left anterior axillary line all cephalad to the umbilicus. An AirSeal® 5 mm insufflation trocar (Surgiquest, Milford, CT, USA) was placed through a Gelpoint® Advanced Access Platform (Applied Medical, Rancho Santa Margarita, CA) in the right lower quadrant caudal to the umbilicus (Fig. 2). The bedside surgeon utilizes the Gelpoint® as an abdominal access trocar to provide laparoscopic retraction, suctioning, and linear stapling when necessary.

The operation began with lysis of the previously noted adhesions in the infrahepatic fossa using a combination of robotic hook cautery and bipolar forceps. The falciform ligament was taken down and the hepatic flexure of the colon was mobilized caudally to obtain wide access and unobstructed view into the porta hepatis, which was approached from the anterolateral aspect. Robotic ultrasonography can be very helpful in confirming the location of the dilated common bile duct while ensuring exclusion of its neighboring vascular structures. The Kocher maneuver was performed to adequately mobilize the c-loop of the duodenum medially

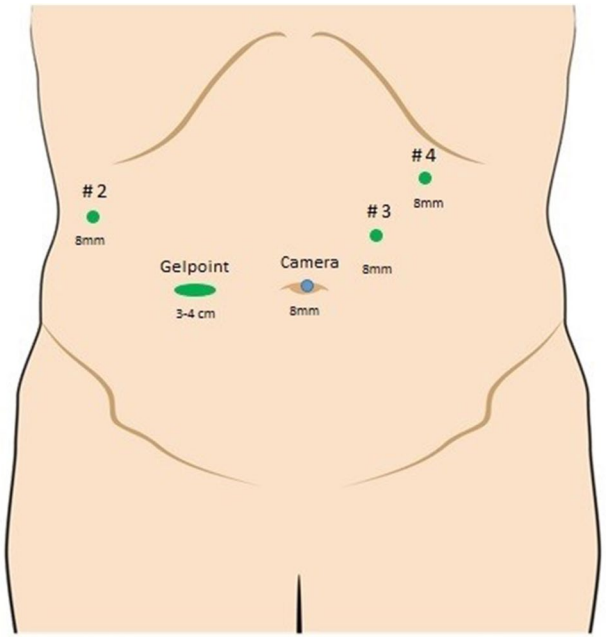

Fig. 2 Robotic port placement

to avoid mechanical tension across the choledochal-enteric anastomosis.

The distal common bile duct was cleared of its surrounding lymphatic and connective soft tissues, with careful attention to preserve blood supply by avoiding excessive lateral dissection. An approximately 1-cm vertical choledochotomy was created on the most distal anterior surface of the dilated common bile duct using the robotic scissors as a point of access for bile duct exploration and later anastomosis. Via the Gelpoint®, a # 3 French Fogarty catheter was passed into the abdomen by the bedside surgeon and inserted into the choledochotomy using a robotic bipolar grasper to undertake balloon sweeps of the biliary tree. To further ensure clearance, a choledochoscope was introduced in a retrograde fashion into the left and right hepatic ducts, as well as antegradely into the duodenum beyond the ampulla of Vater. No evidence of residual materials within the biliary tree were seen.

A longitudinal duodenotomy was made on the superior border of the duodenum using the robotic scissors, visually confirming a full-thickness opening of the duodenal wall. A side-to-side choledochoduodenostomy was created using 3-0 barbed V-lock sutures beginning in the middle of the posterior wall of the anastomosis. The initial suture was placed from the 6 o'clock toward the 3 o'clock position of the bile duct to construct the posteriomedial aspect of the anastomosis. The second suture was begun on the posterior wall adjacent to the initial stitch at the 6 o'clock position and carried around laterally toward the 9 o'clock position. The anterior wall of the anastomosis was finally completed with both sutures tied at 12 o'clock position. A watertight diamond-shaped anastomosis was completed using this technique, ensuring a widely patent bilioenteric anastomosis. Tacking sutures were placed adjacent to the lateral (9 o'clock) and medial (3 o'clock) aspects of the anastomosis to allow for dispersal of tension and to ensure a watertight seal. An omental pedicle flap was developed and placed over the anastomosis to minimize the chance of postoperative bile leak.

The operative time was 200 min with no intraoperative complications. Estimated blood loss was less than 50 mL. No drains were placed. The patient was discharged home tolerating a regular diet on postoperative day 1. She was able to return to baseline activity within 1 week and liver function tests were normal at 2 weeks postoperatively.

Discussion

Operations that entail handling and manipulation of the biliary tree and duodenum are technically complex with potential for postoperative and long-term complications. For this reason, referrals to a high-volume tertiary hepatobiliary center with technical expertise in the field are common, with a more recent transition to minimally invasive approach. The benefits of minimally invasive techniques are obvious when compared to the traditional open approach: decreased pain, lower estimated blood loss, earlier initiation of oral diet, shorter length of hospital stay, decreased postoperative wound complications, and better cosmesis. In our hepatobiliary center in Tampa, we routinely undertake robotic major liver resection and pancreaticoduodenectomy for hepatopancreatobiliary cancers. We have performed a small series of five patients requiring robotic choledochoduodenostomy for benign distal common bile duct stricture. The operation described above is our technique of choice which we had improved and finally standardized.

In a retrospective review of 20 patients over 10 years, Khajanchee et al. noted that laparoscopic choledochoduodenostomy was a feasible and useful treatment for benign biliary disease, yet the complication rate was still elevated at 20% although not directly related to the procedure itself [5]. Approximately 25% of the planned minimally invasive operations in their report required conversion to celiotomy mainly due to severe adhesive disease with an overall 60% complication rate. Notably, one of the patients in this study had a robotic procedure and the authors agreed that the robotic platform provided significantly greater technical dexterity in completing the anastomosis. In a more recent retrospective study of 11 patients undergoing laparoscopic choledochoduodenostomy after RYGB by DuCoin et al, excellent clinical outcomes were reported with no open conversions. Only one patient developed bile leak managed by a

percutaneous drain alone and no other postoperative complications were noted [4]. This demonstrates that a minimally invasive choledochoduodenostomy is not fraught with the historical morbidity risk attributed to its open equivalent.

Sump syndrome is a reported risk of side-to-side choledochoduodenostomy. To avoid this complication, creation of a widely patent anastomosis of approximately 2 cm is advocated [5, 6]. In our patient, her RYGB anatomy results in a negligible risk of enteric reflux into the biliary tree, as there is no passage of gastric content through the biliopancreatic limb. For this reason, a wide choledochoduodenostomy for biliary bypass was chosen in lieu of a hepaticojejunostomy that would have otherwise required an additional lysis of adhesions, bowel manipulation and a second jejuno-jejunal anastomosis.

An editorial comment responding to DuCoin's description of laparoscopic choledochoduodenostomy suggested that this technique was likely too complex to be a first line approach for the majority of surgeons [7]. They also note that balloon enteroscopy and percutaneous access are not universally available to all hospitals, advocating for laparoscopically guided transgastric ERCP as a reliable and effective method of treating choledocholithiasis. While this technique may be effective in treating stone-related disease, patients with extremely tight intrapancreatic distal common bile duct stricture may not achieve long-term clinical success, despite good outcome reported after ERCP with sphincterotomy in most patients. We believe that choledochoduodenostomy provides a definitive solution for poor biliary drainage in this situation. We have a significant experience of performing major liver and pancreatic resection requiring vessel and bile duct dissection [8–10], however, application of robotic platform significantly facilitates safe periduodenal dissection by less experienced minimally invasive surgeons. The use of robotic system over conventional laparoscopy for this type of operation is technically beneficial and more reproducible.

Conclusion

Distal common bile duct stricture in patients with history of Roux-en-Y gastric bypass requires a thoughtfully designed treatment approach with good coordination among gastroenterologists, interventional radiologists and hepatobiliary surgeons to achieve optimal outcomes. The application of robotic technology to construct advanced bilioenteric anastomoses, such as choledochoduodenostomy, provides a technically elegant, safe, durable and effective solution while minimizing potential postoperative morbidities.

Funding This paper was not funded in part or in whole by any organization.

Compliance with ethical standards

Conflict of interest Annie Laurie Benzie MD, Iswanto Sucandy MD, Janelle Spence BA, Sharona Ross MD and Alexander Rosemurgy MD declare that they have no conflict of interest to report with this study.

Ethical standards All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed consent Written informed consent was obtained from the patient for publication of this study. A copy of the written consent is available for review upon request.

References

1. Frederiksen NA, Tveskov L, Helgstrand F, Naver L, Floyd A (2017) Treatment of common bile duct stones in gastric bypass patients with laparoscopic transgastric endoscopic retrograde cholangiopancreatography. Obes Surg 27(6):1409–1413
2. Malherbe V, Badaoui A, Huybrecht H, De Ronde T, Michel L, Rosière A (2009) Management of common bile duct stone late after laparoscopic Roux-en-Y gastric bypass for obesity. Acta Chir Belg 109(6):820–823
3. Leppard WM, Shary TM, Adams DR, Morgan KA (2011) Choledochoduodenostomy: is it really so bad? J Gastrointest Surg 15:754–757
4. DuCoin C, Moon RC, Teixeira AF, Jawad MA (2014) Laparoscopic choledochoduodenostomy as an alternate treatment for common bile duct stones are Roux-en-Y gastric bypass. Surg Obes Relat Dis 10:647–653
5. Khajanchee YS, Cassera MA, Hammill CW, Swanstrom LL, Hansen PD (2012) Outcomes following laparoscopic choledochoduodenostomy in the management of benign biliary obstruction. J Gastrointest Surg 16:801–805
6. De Almeida ACM, Dos Santos NM, Aldeia FJ (1996) Choledochoduodenostomy in the management of common duct stones or associated pathology—an obsolete method? HPB Surg 10:27–33
7. Overby DW, Richardson W, Fanelli R (2014) Choledocholithiasis after gastric bypass: a growing problem. Surg Obes Relat Dis 10(4):652–653
8. Rosemurgy A, Ross S, Bourdeau T et al (2019) Robotic pancreaticoduodenectomy is the future: here and now. J Am Coll Surg 228(4):613–624
9. Sucandy I, Schlosser S, Bourdeau T et al (2019) Robotic hepatectomy for benign and malignant liver tumors. J Robot Surg. https://doi.org/10.1007/s11701-019-00935-0
10. Gravetz A, Sucandy I, Wilfong C et al (2019) Single-institution early experience and learning curve with robotic liver resections. Am Surg 85(1):115–119