

# Refining the intraoperative measurement of the distal intrapancreatic part of a choledochal cyst during laparoscopic repair allows near total excision

Hiroyuki Koga<sup>1</sup> · Manabu Okawada<sup>1</sup> · Takashi Doi<sup>1</sup> · Go Miyano<sup>1</sup> · Geoffrey J. Lane<sup>1</sup> · Atsuyuki Yamataka<sup>1</sup>

Accepted: 6 August 2015 / Published online: 18 August 2015  
© Springer-Verlag Berlin Heidelberg 2015

**Abstract** During surgery for choledochal cyst (CC), any intrapancreatic CC (IPCC) must also be excised to prevent postoperative pancreatitis and stone formation. We report our technique for laparoscopic total IPCC excision ( $n = 16$ ; mean age 6.0 years). We insert a fine ureteroscope with a light source into the opened CC through an extra 3.9-mm trocar placed in the epigastrium through a minute incision to identify the pancreatic duct orifice. By pulling the end of the ureteroscope emerging from the trocar gently to withdraw the tip from the pancreatic duct to where distal dissection was ceased under laparoscopic view, the IPCC can be measured. If longer than 5 mm, the distal CC is dissected further caudally until it is less than 5 mm. For accuracy, the distal CC is elevated with a suture that is exteriorized and clamped to provide constant traction. The IPCC was able to be measured in 11/16 (68 %). Initial lengths measured were 3–10 mm ( $5.2 \pm 2.7$  mm). Final IPCC were all 5 mm or less. Surgery was uncomplicated without any pancreatic duct injury and postoperative recovery was unremarkable. Follow-up MRI at 32 months showed no IPCC in any case. Measuring the IPCC enables total CC excision, thus reducing the potential for postoperative complications.

**Keywords** Choledochal cyst · Intrapaneatic choledochal cyst · Postoperative pancreatitis · Postoperative stone formation

## Introduction

Since Farello et al. reported laparoscopic repair of choledochal cyst (CC) and Roux-en-Y reconstruction [1], many cases of successful laparoscopic excision of CC (lapCC) have been reported [2–6]. Although these reports indicate lapCC is feasible and safe, postoperative complications including bile leakage, cholangitis, and pancreatitis have been reported. Most are associated with surgery involving hepaticojejunostomy and ductoplasty. Here, we report our technique for the total laparoscopic excision of the intrapancreatic part of a CC (IPCC) which we believe may reduce complications because there is no remnant CC. To the best of our knowledge, this is the first report describing a technique for complete excision of the IPCC during lapCC.

## Materials and surgical technique

Since 2011, we have treated 16 CC patients using lapCC. All surgeries were performed either under the direct supervision of or by two board certified pediatric surgeons (HK and AY) both with full accreditation for endoscopic surgery by the Japan Society for Endoscopic Surgery. LapCC was performed according to a technique described previously elsewhere [7]. Briefly, the CC is dissected free from surrounding structures, such as the portal vein and hepatic artery, then the distal 1/3 of the CC is identified, dissected free, and encircled with a thick silk traction suture. By applying traction, the CC can be dissected caudally with safety up to the IPCC. At this stage, an opening is made in the distal 1/3 of the CC, and a 7F, 6-degree ureteroscope (Karl Storz Int, Tuttlingen, Germany) equipped with a light source at its tip is inserted into

✉ Hiroyuki Koga  
h-koga@juntendo.ac.jp

<sup>1</sup> Department of Pediatric General and Urogenital Surgery, Juntendo University School of Medicine, 2-1-1 Hongo, Bunkyo-ku, Tokyo 113-8421, Japan

the opened CC through an additional 3.9-mm trocar placed in the left epigastrium by another surgeon through a minimal incision. Its tip is then inserted into the common channel to wash away any protein plugs under direct ureteroscopic view.

### Measuring the IPPC during lapCC

The ureteroscope is used to identify the pancreatic duct orifice, and the part of the ureteroscope emerging externally from the trocar is held with mosquito forceps and pulled very gently from the pancreatic duct to the level where distal dissection was ceased under laparoscopic view (Fig. 1). Because there is a light source at the tip of the ureteroscope, the laparoscopic surgeon can measure the actual length of the IPCC from the pancreatic duct orifice to the point where dissection was ceased. If the IPCC is longer than 5 mm, the distal CC end is dissected further caudally toward the intrapancreatic duct orifice. This procedure is repeated until the IPCC is 5 mm or less in length. During measurement, an exteriorized silk suture is fixed by clamping with a pair of mosquito forceps to ensure constant tension is maintained on the CC to prevent erroneous measurement. Thus, the laparoscopic surgeon can continue to dissect toward the common channel to excise the IPCC, confident there is no risk for injuring the pancreatic duct because the exact length of the IPCC is known. The IPCC is ligated and excised once 5 mm or less in length.

Following excision of the IPCC, a Roux-en-Y jejunojunctionostomy is constructed extracorporeally by extending

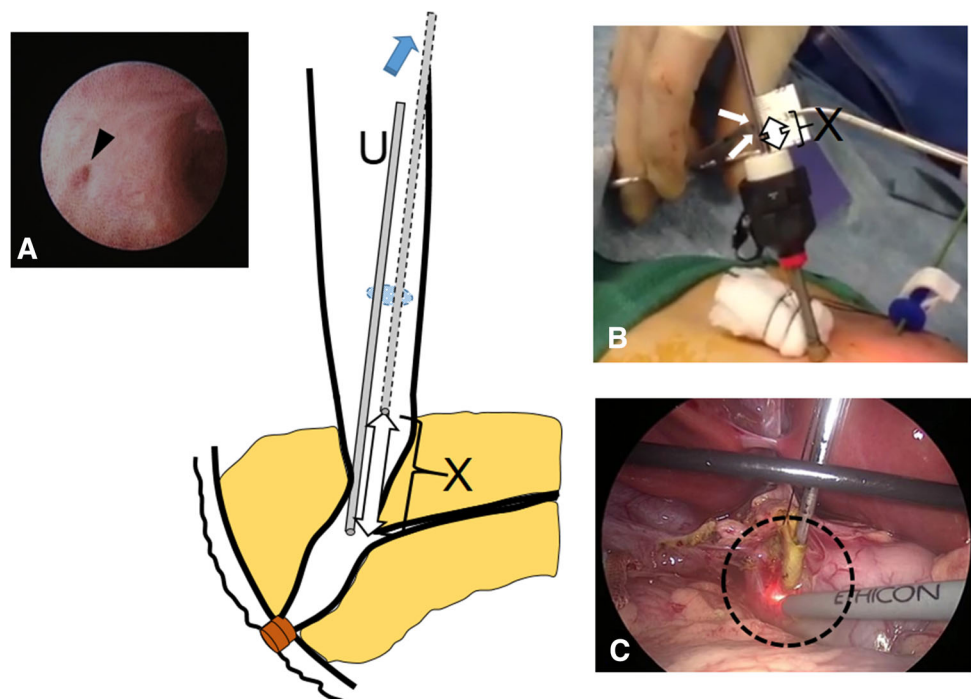
the umbilical port incision. Finally, a hepaticojejunostomy is performed to complete lapCC.

### Results

This series comprised 12 girls and 4 boys. Mean age at lapCC was 6.0 years (range 0.6–14.1), and mean weight at lapCC was 19.3 kg (range 8.0–43.0). CC was fusiform ( $n = 13$ ) or cystic ( $n = 3$ ). The opening of the distal CC was found to be too small to allow insertion of the ureteroscope in one cystic case and two fusiform cases, while in two fusiform cases with a common channel large enough for insertion of the ureteroscope, the pancreatic duct orifice could not be identified. In these cases, intraoperative cholangiography (IOC) using a thin cut-down tube measuring 1.5 mm in diameter was performed conventionally using a surgical clip as a landmark to identify the anatomy of the junction of the CC, pancreatic duct, and common channel. In cases of cystic CC with a narrow segment, dissection was performed until the distal end of the CC was identified safely, then the narrow bile duct was ligated. Otherwise measurement of IPCC was performed using a 6-degree ureteroscope.

When measured initially, IPCC ranged from 3 to 10 mm ( $5.2 \pm 2.7$  mm) which was longer than expected and 10 cases required further dissection because the IPCC was more than 5 mm in length. All dissections were uncomplicated without any injury to the pancreatic duct. We also used the ureteroscope inserted for measuring the IPCC

**Fig. 1** After opening the distal CC, an ureteroscope (*U*) is inserted to identify the orifice of the pancreatic duct (**a** arrowhead). The part of the ureteroscope emerging externally from the trocar is held with mosquito forceps (**c** white arrows) and pulled very gently from the pancreatic duct to the level where distal dissection was ceased under laparoscopic view (**b**). The laparoscopic surgeon can measure the length *X* represented by the double-headed arrow in **c** which is the length of the IPCC



during laparoscopic CC excision to examine the IPCC for protein plugs and debris and identified IPCC protein plugs in six cases (5 fusiform, 1 cystic). These IPCC protein plugs were successfully washed out with isotonic sodium chloride solution in all cases, although one required use of a thin cut-down tube instead of the ureteroscope because the distal end of the CC was too narrow to insert the ureteroscope sufficiently. Mean duration of surgery was 6.8 h. Estimated mean intraoperative blood loss was minimal at 8 mL. There were no conversions to open surgery and no intra- or postoperative complications. Postoperative recovery was uneventful, and hospital discharge was possible after a mean of 8.5 days. All cases are well after a mean follow-up of 32 months (range 9–48 months). Postoperative magnetic resonance cholangiopancreatography (MRCP) at a mean 14.2 months (range 9–22 months) after surgery showed no evidence of residual IPCC in any case.

## Discussion

Residual IPCC is a risk factor for postoperative pancreatitis and stone formation [8], but complete excision is complicated because some degree of blind dissection is necessary to reach the IPCC and if too aggressive may result in injury to the pancreatic duct. Most pediatric surgeons would concede that it is better to risk the sequelae of incomplete excision rather than cause injury, leakage, or stenosis by dividing the IPCC too close to the pancreatic duct. However, a recent report of biliary malignancy developing in a residual CC after inadequate excision [9, 10] emphasizes we cannot afford to be so complacent. Thus, complete excision is essential in all cases for the prevention of postoperative complications and biliary malignancy.

To dissect the IPCC more accurately, we previously reported the use of intraoperative endoscopy (IE) during CC excision [11]. Using this technique, it was possible to determine the level of resection of the IPCC and irrigate the IPCC to wash out any debris or protein plugs. We attributed our lower incidence of postoperative complications to IE [11, 12] and found a ureteroscope was best for IE because the IPCC could be observed at the same time as debris could be washed away because the flow of normal saline through a ureteroscope is constant. We adapted this concept for use during lapCC using an extra trocar inserted through a minimal incision to measure the exact length of the IPCC in the same way as we routinely measure the length of rectourethral fistulas intraoperatively during laparoscopic anorectoplasty for male imperforate anus [13]. Surprisingly, 10/16 cases had IPCC we considered problematic and required further dissection which we would have been unaware of if we had just relied on

conventional dissection and experience to decide where to cease dissection. The ureteroscope we use for measuring the IPCC is a rigid type of standard size and design, which we believe to be superior to a fine flexible endoscope in terms of maneuverability and stability to measure the IPCC and allow good washout of debris and protein plugs. In fact, a rigid ureteroscope could not be inserted into the IPCC in one cystic case and two fusiform cases of CC because of the small size of the bile duct. However, the light source at tip of the ureteroscope was valuable for as an indicator of where to dissect under laparoscopic view.

To the best of our knowledge, this is the first report about measuring the length of the IPCC under laparoscopic control to reduce postoperative complications by ensuring complete excision. The number of cases in this series is too small and the follow-up period is too short to make any definitive conclusions about the ultimate effectiveness of this technique, but complications caused by residual CC tissue should be reduced because the accuracy of excision during lapCC is improved by measuring the IPCC.

**Acknowledgments** This work was supported by a Japanese Foundation for Research and Promotion of Endoscopy (JFE) grant.

## References

1. Farello GA, Cerofolini A, Rebonato M et al (1995) Congenital choledochal cyst: video-guided laparoscopic treatment. *Surg Laparosc Endosc* 5:354–358
2. Hong L, Wu Y, Yan Z et al (2008) Laparoscopic surgery for choledochal cyst in children: a case review of 31 patients. *Eur J Pediatr Surg* 18:67–71
3. Laje P, Questa H, Bailez M (2007) Laparoscopic leak-free technique for the treatment of choledochal cysts. *J Laparoendosc Adv Surg Tech Part A* 17:519–521
4. Lee KH, Tam YH, Yeung CK et al (2009) Laparoscopic excision of choledochal cysts in children: an intermediate-term report. *Pediatr Surg Int* 25:355–360
5. Li L, Feng W, Jing-Bo F et al (2004) Laparoscopic-assisted total cyst excision of choledochal cyst and Roux-en-Y hepatoenterostomy. *J Pediatr Surg* 39:1663–1666
6. Ure BM, Schier F, Schmidt AI et al (2005) Laparoscopic resection of congenital choledochal cyst, choledochojejunostomy, and extraabdominal Roux-en-Y anastomosis. *Surg Endosc* 19:1055–1057
7. Miyano G, Koga H, Shimotakahara A et al (2011) Intralaparoscopic endoscopy: its value during laparoscopic repair of choledochal cyst. *Pediatr Surg Int* 27:463–466
8. Ando H, Kaneko K, Ito T et al (1996) Complete excision of the intrapancreatic portion of choledochal cyst. *J Am Coll Surg* 183:317–321
9. Mabrut JY, Partensky C, Gouillat C et al (2007) Cystic involvement of the roof of the main biliary convergence in adult patients with congenital bile duct cysts: a difficult surgical challenge. *Surgery* 141:187–195
10. Takeshita N, Ota T, Yamamoto M (2011) Forty-year experience with flow-diversion surgery for patients with congenital choledochal cysts with pancreaticobiliary maljunction at a single institution. *Ann Surg* 254:1050–1053

11. Miyano T, Yamataka A, Kato Y et al (1995) Choledochal cysts: special emphasis on the usefulness of intraoperative endoscopy. *J Pediatr Surg* 30:482–484
12. Takahashi T, Shimotakahara A, Okazaki T et al (2010) Intraoperative endoscopy during choledochal cyst excision: extended long-term follow-up compared with recent cases. *J Pediatr Surg* 45:379–382
13. Koga H, Kato Y, Shimotakahara A et al (2010) Intraoperative measurement of rectourethral fistula: prevention of incomplete excision in male patients with high-/intermediate-type imperforate anus. *J Pediatr Surg* 45:397–400