# The Berne-Donovan technique for diverticulization of a severe lateral non-traumatic duodenal fistula

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BACKGROUND: *The duodenal «diverticulization» is a surgical technique described by Berne and colleagues in 1968 for the treatment of combined duodenal pancreatic injuries. It consisted of closure of the duodenal injury by suture and tube duodenostomy, gastric antrectomy with end-to-side isoperistaltic Billroth II gastrojejunostomy, and abdominal drainage. As evidenced from the literature in few reports, this technique has also been adopted for lateral duodenal lacerations in non traumatic conditions. Most biliary disease may be responsible for duodenal injury.*
CASE PRESENTATION: *Herein, we describe the application of this emergency technique for the treatment of a wide lateral duodenal laceration discovered intra-operatively during laparoscopic cholecystectomy for acute cholecystitis. A comprehensive critical review of the different surgical methods proposed for duodenal protection in case of severe duodenal lesions has been performed and discussed.*
CONCLUSION: *Duodenal injuries represent a challenging condition, especially for surgeons with limited experience in this field. The key-message of this report is to consider emergency surgical techniques in difficult unexpected intra-operative situations which may occur during routine surgical practice.*

KEY WORDS: Duodenal diverticulization, Duodenal fistula, Laparoscopic cholecystectomy, Surgical repair

## Introduction

The duodenal «diverticulization» technique was firstly reported by *Berne and colleagues* in 1968 for the surgical treatment of combined duodenal pancreatic injuries [1], in order to avoid the potential complications of simple closure of a wide duodenal laceration and the morbidity of pancreaticoduodenectomy in the emergency setting. The essential technical components of this operation consisted of closure of the duodenal injury by suture and tube duodenostomy, gastric antrectomy with end-to-side isoperistaltic Billroth II gastrojejunostomy, and abdominal drainage. Vagotomy and Kehr T-tube insertion for biliary drainage may also be advisable [1].
Herein, we describe the adoption of Berne diverticulization technique during laparoscopic cholecystectomy for acute cholecystitis to treat a wide lateral non-traumatic duodenal fistula.

## Case Presentation

An 88 years-old Caucasian man was admitted to the Emergency Department at our institution complaining of a one-month history of right upper quadrant abdominal pain, nausea and vomiting. The past medical history revealed essential hypertension, previous transitory ischemic attack, mild chronic kidney disease, urinary tract infections, and symptomatic cholelithiasis. Previous surgical procedures included appendectomy and right safenectomy. Six months before, we had hospitalized the patient for acute cholangitis and a magnetic resonance cholangiopancreatography (MRCP) showed the presence of multiple common bile duct (CBD) stones. An endo-

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ABBREVIATION

CBD: common bile duct;
MRCP: magnetic resonance cholangiopancreatography;
ERCP: endoscopic retrograde cholangiopancreatography;
AST: aspartate aminotransferase;
ALT: alanine aminotransferase; OIS: Organ Injury Scale

scopic retrograde cholangiopancreatography (ERCP) was performed but, due to the presence of multiple stacked stones, the CBD clearance was incomplete and a biliary stent was left in place. The post-procedural course was characterized by recurrent episodes of abdominal pain and fever. After six months, we hospitalized the patient for a second ERCP, the biliary stent was removed, all the CBD stones were extracted, and a laparoscopic cholecystectomy was eventually scheduled. The patient, however, presented to the Emergency Department complaining of recurrent right upper quadrant abdominal pain.

Physical examination revealed localised tenderness with guarding at the right upper quadrant and a positive Murphy's sign. At admission, the patient was apyretic. Blood tests showed white cell count 22.350 /mcL, haemoglobin level 11.8 g/dl, platelet count 457.000 /mcL, creatinine 2.79 mg/dL, aspartate aminotransferase (AST) 73 U/l, alanine aminotransferase (ALT) 73 U/l, gammaglutamil transferase 308 U/l, total bilirubin level 0.9 mg/dl, direct bilirubin level 0.3 mg/dl, C-reactive protein 33.21 mg/L. Ultrasound scanning of the abdomen confirmed the presence of multiple, small, gallbladder stones, with 6-mm gallbladder wall thickness, no perihepatic fluid, but diffuse aerobilia. At this time, the patient underwent a laparoscopic cholecystectomy.

At laparoscopy, we found diffuse inflammatory adhesions between the gallbladder and the transverse colon and duodenum with an underlying bile collection between the gallbladder infundibulum and the duodenal bulb. Because of the severe anatomic inflammatory distortion, we elected an open conversion and performed a right subcostal laparotomy. As we completely drained the collection, we found a 5-cm longitudinal laceration of the lateral duodenal wall involving 50 to 75% of its circumference (i.e., Grade III) (Fig. 1). After completing antegrade cholecystectomy and debridement, due to the wide perforation with friable duodenal wall at high risk of leakage, we elected to perform duodenal diverticulization technique in order to derive the gastro-duodenal transit. Therefore, we completed gastric antrectomy with end-to-side isoperistaltic Billroth II gastrojejunostomy, duodenal suture with Pezzer tube (caliber 32 Fr) duodenostomy, and Kehr T-tube (caliber 18 Ch) drainage of the CBD. The intervention is depicted in Fig. 2.We closed the duodenal wall defect by a single layer of interrupted 3-0 monofilament (glycolide-dioxanone-trimethylene carbonate) sutures with an omental patch. Finally, we left two Jackson-Pratt abdominal drains in the right upper quadrant close to duodenal stump and behind the gastrojejunostomy, respectively, and we sent biliary fluid for culture. The patient remained in intensive care unit for 48 hours. The postoperative course was uneventful, the cultural examinations were positive for *Citrobacter freundii* and *Candida glabrata* and we switched to targeted antibiotic and antifungal regimens once cultures and sensitivity reports were obtained. Contrast enhanced computed tomographic (CT)-scanning of the abdomen at two weeks ruled out abdominal collections and showed no duodenal spillage of contrast medium injected through the duodenostomy

Fig. 1: Intra-operative findings showing the presence of severe lateral duodenal wall laceration involving 50 to 75% of its circumference after complete debridement. The duodenal wall appears vey friable at high risk of leakage.

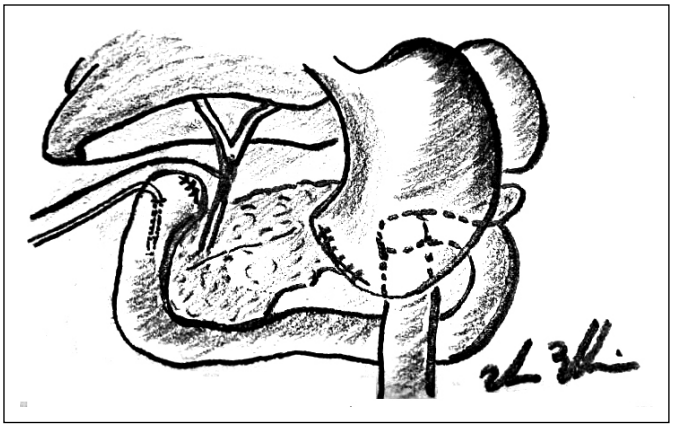

Fig. 2: Anatomic and surgical illustration of the duodenal "diverticulization" according to Berne-Donovan technique.


Fig. 3: Abdominal CT-scan ruled out abdominal collections and showed no duodenal spillage of contrast medium injected through the duodenostomy tube.

Fig. 4: Kehr-cholangiography showed regular visualization of duodenum with a short, linear, and lateral blind end Pezzer tube fistulous (white arrow).

tube (Fig. 3), which was then removed. Kehr-cholangiography after a couple of days showed psuedodiverticular duodenum with a short, linear, and lateral blind end Pezzer tube fistulous, as shown in Fig. 4. The T-tube was then removed and the patient was discharged home three weeks after the operation. Histopathological finding confirmed the diagnosis of acute cholecystitis. The patient is doing well and no complications occurred at one month and three months of follow-up.

## Discussion

Duodenal injuries are usually post-traumatic, more frequently from penetrating abdominal trauma, such as firearm lesions [2,3]. Complex duodenal lesions are uncommon and, consequently, most surgeons have little experience in this matter. The management of lateral duodenal wall injury is challenging and the surgical approach depends on the severity of the injury.

The Organ Injury Scale (OIS) classification of duodenal injury is shown in Table I. Grade I and II lacerations can be treated by a simple primary suture, whereas Grade I and II hematoma without compressive symptoms can be managed by nasogastric tube in aspiration for one week. Grade III and IV involve a large portion of the duodenum and simple suture of the defect is generally neither possible nor safe. However, longitudinal duodenal lesions should be closed transversely if only less than 50% of the circumference is involved in order to avoid duodenal narrowing. Various surgical methods have been proposed for duodenal protection in case of traumatic abdominal events [1-3].

Reportedly, lateral duodenal fistulas present poor tendency to heal spontaneously. The main factors responsible for their chronicity are: 1) increased intraduodenal pressure during peristalsis and 2) the propensity of the duodenal mucosa to extrude, once the defect has been made [1,3]. The simple debridement and duodenorrhaphy with or without tube duodenostomy are associated with greater morbidity and high mortality. The use of a jejunal loop to reinforce the duodenal suture line or the duodenal lateral defect was suggested by Kobold and Thal in 1963 [4] in humans and by Wolfman et al. [5] in an experimental study in dogs. Wolfman *et al.* [5] demonstrated that the reinforcement with a serosal jejunal loop by anastomosing a segment of jejunum creates an important progressive regeneration of duodenal mucosa at the edges of the defect. At six months post-operatively, the histological sections demonstrated complete healing of

TABLE I - *Organ Injury Scale (American Association of Surgery for Trauma – AAST): duodenal injuries.*

| Severity injury | Injury description |
|---|---|
| Grade I | Hematoma involving single portion of the duodenum. Laceration: partial thickness |
| Grade II | Hematoma involving more than one portion. Laceration: disruption <50% of duodenal circumference |
| Grade III | Laceration: disruption 50 to 75% circumference of D2; disruption 50 to 100% of circumference of D1, D3, D4 |
| Grade IV | Laceration: disruption >75% circumference of D2 involving ampulla or distal CBD |
| Grade V | Massive disruption of duodeno-pancreatic complex. Devascularization of duodenum |

the duodenal defect which was covered by duodenal mucosa of normal thickness.

Among decompression and diversion techniques, some surgical methods have been described. The so-called «three drainage technique» or triple tube ostomy [3] consists in the positioning of nasogastric tube or surgical gastrostomy, antegrade and retrograde jejunostomy for enteral nutrition and decompression, respectively. The Berg procedure [6] is characterized by gastrojejunostomy and pylorus exclusion; this technique consists in suturing the duodenal injury, closing the pylorus with absorbable yarn, through the gastrotomy, followed by gastrojejunostomy. Alternative method includes using a stapler across the pylorus. In this way the diversion of gastric contents is guaranteed for several weeks while the duodenal injury heals, the pylorus usually opens after few weeks and the gastrojejunostomy functionally closes. The duodenal «diverticulization» proposed by Berne *et al.* [1] is characterized by the transformation of a lateral active fistula in an end functionally passive fistula, which almost invariably closes spontaneously. In this way the bypassed duodenum becomes a very low pressure diverticulum, hence the name of the peculiar surgical technique.

In 1974 Berne *et al.* [7] reported their personal experience with the first 34 patients who underwent duodenal diverticulization with a mortality rate of 16%. This technique was proposed in order to avoid the great morbidity of duodenopancreatectomy, which is considered as a definitive treatment option for severe duodeno-pancreatic injuries in emergency settings' [8].

As evidenced from the literature in few reports [9,10], this technique has also been adopted for lateral duodenal lacerations in non traumatic conditions. Most biliary disease may be responsible for duodenal injury [9,10]. For instance, Malangoni *et al.* [9] reported on fourteen patients with lateral duodenal fistula occurred as complications of surgery for peptic ulcer in four cases and biliary tract disease in other three. ERCP-related perforations have also been described in the literature, classified as type I if lateral duodenal wall of the second portion is involved [11]. In our case, the patient presented a periduodenal bile collection associated with wide lateral duodenal laceration. We speculate that biliary disease was responsible for duodenal injury through the propagation of inflammation to the duodenum, which caused the duodenal lesion and consequent localized periduodenal collection. However, the diagnosis was made intraoperatively and we elected to derive the biliary and gastric secretions in consideration of the high leakage risk associated with simple suturing of the duodenum, which eventually proved to be effective.

## Conclusions

Duodenal injuries represent a challenging condition, especially for surgeons with limited experience in this field. The key-message of this report is to consider emergency surgical techniques in difficult unexpected intraoperative situations which may occur during routine surgical practice.

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## Riassunto

La "diverticolizzazione" del duodeno è una tecnica chirurgica descritta da *Berne e Coll.* nel 1968 per il trattamento di lesioni pancreatiche e duodenali associate. Consiste nella sutura della lesione duodenale ed una duodenostomia su tubo di drenaggio, antrectomia gastrica con gastrodigiunostomia termino-laterale isoperisttaltica secondo Billroth II, drenaggio del cavo peritoneale.

Come è messo in evidenza in pochi riferimenti della letteratura, questa tecnica è stata adottata anche per lacerazioni laterali del duodeno per condizioni non traumatiche.

Molte patologie delle vie biliari possono essere responsabili di danni al duodeno.

A titolo di esempio viene presentato un caso di utilizzazione di questa tecnica per il trattamento di un'ampia lacerazione laterale del duodeno scoperta durante un intervento di colecistectomia laparoscopica per colecistite acuta. Si è proceduto ad una revisione critica complessiva dei differenti metodi chirurgici proposti per proteggere il duodeno nel caso di gravi lesioni duodenali, e alla loro discussione.

In conclusione le lesioni duodenali rappresentano una condizione di sfida specie per chirurghi di limitata esperienza in questo campo. Il messaggio che si vuole inviare con questo contributo è quello di ricordare tecniche chirurgiche emergenziali nel caso di situazioni intraoperatorie difficili e inaspettate che possono manifestarsi nella pratica chirurgica routinaria.

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