

Tube Duodenostomy to Treat Large Duodenal Perforation: Our Experience and Literature Review

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Rezumat

Duodenostomia dirijată cu tub pentru tratarea perforației duodenale de dimensiuni mari: experiența noastră și review de literatură

Context: Perforația duodenală este o afecțiune cu risc vital. O abordare ideală a perforațiilor duodenale nu a fost până în prezent clar stabilită, așadar trebuie luate în considerare numeroase variabile. Ulcerul peptic este cea mai frecventă cauză de perforație duodenală, însă pot exista și alte cauze mai puțin frecvente.

Metode: Acest studiu analizează retrospectiv toți pacienții care s-au prezentat la departamentul de Chirurgie Generală, din septembrie 2018 până în decembrie 2019, cu diagnosticul de perforație duodenală. Dintre aceștia, au fost selectați pacienții care au necesitat o duodenostomie dirijată cu tub. Astfel, au fost incluși în studiu un număr de cinci pacienți.

Rezultate: Au fost analizate datele provenite de la cinci pacienți diagnosticați cu perforație duodenală. În toate cele 5 cazuri s-a practicat duodenostomie dirijată cu tub, excluderea pilorului și gastro-entero-anastomoză cu ansă în omega. Duodenostomia este îndepărtată la patru săptămâni după operație. Toți pacienții au suferit complicații postoperatorii, de la infecția plăgii până la pneumonie; incidența complicațiilor severe a fost mai mare la pacienții mai în vârstă. Nu a fost înregistrat niciun deces la patru luni de la operație.

Concluzii: Duodenostomia cu tub este o procedură învechită, dar simplu de implementat, care poate necesita o creștere a spitalizării postoperatorii dar care, subzistă ca o modalitate eficientă și sigură de a trata pacienții în stare critică.

Cuvinte cheie: Duodenostomie; perforație duodenală; gastro-entero-anastomoză, intervenție chirurgicală de urgență

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Abstract

Background: Duodenal perforation is a life-threatening condition and ideal approaches for the management of duodenal perforations are nowadays unclear, so numerous variables must be considered. Peptic ulcer disease is the most common disease determining a duodenal perforation, however, there may be other less common causes.

Methods: We retrospectively analyzed all the patients who presented at our Division of General Surgery for a Duodenal Perforation, from September 2018 to December 2019. We focused on patients requiring a tube duodenostomy. Five patients were included in this study.

Results: Five patients suffering from a duodenal perforation were analyzed and their data collected. All patients were treated with tube duodenostomy, pyloric exclusion and omega loop gastro-enteroanastomosis. The duodenostomy was removed four weeks after surgery. All patients suffered postsurgical complications ranging from wound infection to pneumonitis; the incidence of severe complications was greater in the older patients. We did not record any deaths four months after the operation.

Conclusions: The tube duodenostomy is an old and dated procedure but simple to implement, which may require an increase in post-operative hospitalization, but which subsists as an effective and safe way to treat patients in critical conditions.

Key words: duodenostomy, duodenal perforation, gastroenteroanastomosis, emergency surgery

Introduction

Thanks to the introduction of an effective medical therapy (proton pump inhibitors and antibiotics to *Helicobacter pylori* eradication), duodenal perforation (DP) is actually a rare but nonetheless life-threatening condition (1). The mortality rate range is described between 8% and 25% (2,5).

Anatomically, the duodenum consists of four segments: 1. the duodenal bulb, 2. the second part, or descending segment which surrounds the pancreas head, 3. the third segment, which is the horizontal part 4. the last segment that is followed by the jejunum.

When a DP occurs, it is most commonly located in the first part of the duodenum, with more sporadic perforations in the second and in the other parts (1,4).

Peptic ulcer disease (PUD) is the most common cause of DP (5), however autoimmune conditions [scleroderma (6), Crohn's disease (7)], duodenal ischemia, chemotherapy, foreign body ingestion and tumors represent other possible causes (8,9). Iatrogenic origins are becoming more common because of the

widespread use of endoscopic procedures, especially in therapeutic processes like ERCP (Stapfer classification) (10-12).

The ideal approaches in the management of DP are still unclear. Several variables must be considered, such as the type of perforation, cause, diameter, clinical condition of the patient, availability of Operative Endoscopic Unit, and the involved duodenal segment.

Despite medical therapy, early diagnosis, endoscopy, and new surgical evidences there are still some cases in emergency surgery that require a Tube duodenostomy (TD).

The aim of our study is to elucidate what are the factors indicating the necessity of a duodenostomy and which postoperative course is needed by these patients.

Methods

We retrospectively analyzed all the patients who presented at our Division of General Surgery for a DP, from September 2018 to December 2019. We focused on patients requiring a tube duodenostomy and we analyzed the main features that influenced

the surgical choices. Patients treated by medical therapy, endoscopic techniques, or other surgical techniques were excluded. We included five patients in this study.

In all patients, bowel perforation was diagnosed using an ordinary set of blood and radiologic investigations confirming the evidence of pneumoperitoneum.

Informed consent was obtained from all participants in the study.

The study was registered on Clinicaltrial with the following ID NCT05359029.

Surgical and Clinical Details

All the described patients were treated with an open laparotomy approach. Inside the abdominal cavity abundant yellowish purulent material was found, and after the lavage of the entire peritoneal cavity, the first phase was the Kocherisation of the duodenum, in order to allow a better manipulation and decrease any tension to the repair site. The next step was to clean the edges of the perforation and an excision with scissors of 2-3 mm of the margin would grow the diameter of the injury.

The repair of the DP using 2/0 polyglactin (Vicryl; Ethicon, Somerville, NJ, USA) sutures was then performed.

The next step was the Pyloric exclusion followed by Duodenotomy upstream of the lesion with the introduction of a large diameter Foley catheter bringing it out as a duodenostomy.

Finally, the formation of a transmesocolic gastrojejunal anastomosis on omega loop and downstream entero-entero anastomosis were executed, placing abdominal drainages near the duodenum and gastrointestinal anastomosis (*Fig. 1*).

All tubes were initially kept unclamped to drain abdominal liquids, and duodenal contents were drained through the duodenostomy. On the fifth postoperative day, the patients resumed eating and the day after the drain close to the gastrointestinal anastomosis was removed. Between the sixth and ninth postoperative day the duodenostomy is clamped, and an evaluation of the drain near to

duodenum was made. If the volume of the drainage is moderate the drain can be removed, the duodenostomy is slightly mobilized and superficialized and the patient discharged. The duodenostomy tube can be removed four weeks after the surgery during a checkup visit.

Results

Five patients treated with TD due to DP were analyzed and their data collected (*Table 1*).

In cases of GDU (Giant Duodenal Ulcer) for PUD (Peptic ulcer disease), the excessive size of the perforation associated with a septic involvement of the operative field due to a peritonitis that in one of the cases lasted for more than 48 hours, meant that the operative choice leaned towards a duodenostomy. Furthermore, although not common, in both cases the ulcer site was located on the second part of the duodenum (*Fig. 2*).

The case of intraoperative duodenal damage occurred during a drainage operation of the retroperitoneal loggia and right nephrectomy, caused by a rupture of a voluminous complex cyst, performed by the team of Urologists. The lesion involved the lateral wall of the second duodenal portion, and the

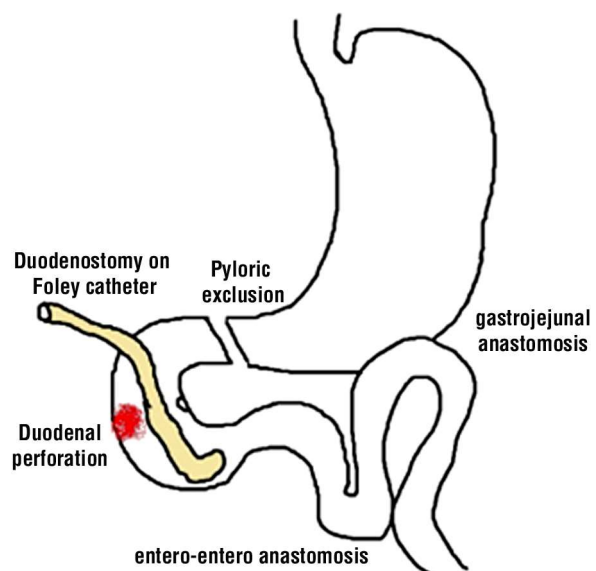


Figure 1. Surgical procedure

Table 1. Clinical preoperative details. (GDU Giant Duodenal Ulcer, PUD Peptic ulcer disease, Type 1 refers to Stapfer Classification)

Duodenal injury	Underlying pathology	Sex	Age (Y)	Duration of peritonitis (H)	Septicemia	Hemodynamic instability (Shock class)
GDU	PUD	F	46	<48	Yes	No
GDU	PUD	M	71	>48	Yes	Yes (Class I)
Operative injury	Surgical retroperitoneal drainage	M	45	<48	No	No
Endoscopic perforations (Type 1)	Malignant jaundice in bile duct cancer	F	73	<48	No	No
Endoscopic perforations (Type 1)	Duodenal diverticulum in choledocholithiasis	M	89	>48	No	Yes (Class II)

**Figure 2.** Foley's catheter in duodenal stump**Figure 3.** Abundant retroperitoneum

presence of abundant purulent material contra-indicated primary repair, so a duodenostomy approach was chosen.

Perforations occurred during endoscopic procedures involving biliary stenting in the case of unresectable biliary tract cancer, and perforation of duodenal diverticulum in a very elderly patient with obstructive jaundice due to choledocholithiasis. In the first patient, the adhesions due to the neoplastic mass did not allow an optimal and safe approach to the edges of the perforation (*Fig. 3*).

In the second patient the advanced age, and the onset of hemodynamic instability also secondary to the patient's comorbidities, made reparative techniques impossible. In both these latter cases the perforation was sutured around a Foley catheter introduced into the lesion, aiming to develop directed fistulation of the perforation.

All patients suffered postsurgical complications ranging from wound infection to pneumonitis; the incidence of severe complications was greater in the older patients (*Table 2*).

Table 2. Postoperative outcomes and complications. (POD Post-operative days)

Duodenal injury	Resumption of feeding (days)	Clamping duodenostomy (days)	Wound infection	Pneumonitis	Hospital stay (days)	Mortality
GDU	5 POD	6 POD	Yes	No	10	No
GDU	7 POD	9 POD	Yes	Yes	16	No
Operative injury	5 POD	7 POD	No	No	22	No
Endoscopic perforations (type 1)	6 POD	8 POD	Yes	Yes	18	No
Endoscopic perforations (type 1)	6 POD	8 POD	No	Yes	18	No

Thanks to the gastrojejunal anastomosis, patients can resume feeding quite early. Recovery occurs initially only administering liquid food. Clamping of the duodenostomy is done a day or two after resumption of feeding, and the day after the periduodenal drain is removed. The complications observed had a proportional impact on the duration of hospitalization, as patients had to complete courses of antibiotics, for exclusive hospital use, to battle the condition of sepsis. One day before discharge, the duodenostomy tube is mobilized and superficialized. The duodenostomy is removed four weeks after surgery. We did not record any deaths four months after the operation.

Discussion

Duodenal perforation remains a surgical emergency. Features such as old age, comorbid conditions, shock, sepsis, large size of perforation, and delay in treatment have been identified as adverse factors in the management of this disorder (13).

Most DP can successfully be treated by simple repair, while complicated procedures are needed for complex injuries or large perforations of the duodenum secondary to peptic ulcer disease (14,15).

Two types of DP can be considered according to the presence or the absence of a free leakage: contained and non-contained perforations (8).

In contained perforations, (in which free leakage is avoided by contiguous structures) a conservative management is feasible (16). Conservative management consists of nil per os (NPO), intravenous fluid therapy, intravenous proton pump inhibitors (PPIs), broad-spectrum antibiotics, and eventually H. pylori eradication (9,17).

In non-contained perforations, bowel contents leak into the abdominal cavity, and an operative management is mandatory. In DP with minimal demonstrated leakage (Minor Non-Contained Perforations), the endoscopic approach can be contemplated [through-the-scope clips (TTSC), over-the-scope clips (OTSC), detachable snare loops with clips, and

self-expandable metal stents (SEMS)] (9). Alternatively simple surgical repair choice with or without omental coverage might be considered (18). In major non-contained perforation, a reconstructive surgery is mandatory.

TD is a damage control procedure, for large DP when further repair techniques are not recommended due to duodenal damage, hemodynamic instability of the patient or the absence of surgical expertise for complex reconstruction (19,20). In fact, TD is easy to learn, teach, and perform.

The role of tube decompression of the duodenum was already proven in 1950s, and for many years, TD has been an effective method to manage duodenum difficile in complex duodenal lesions and in duodenal stumps after gastrectomy. However, this technique is still used, as shown in several recent studies.

In 2006 van Ginhoven et al. analyzed three patients in whom the injury of the duodenum could not be repaired in a tension-free fashion. Therefore, a Foley balloon catheter was used to close the rupture and after a few weeks, the patients were fed through the Foley catheter duodenostomy until a fistular track was formed. On removal of the catheter the fistula connection closed spontaneously including the perforation of the duodenum (21).

Even in the case of blunt abdominal trauma, involving combined gastric and DP, Singh et al. suggest a primary repair of duodenal transection over Malecot catheter (22).

Nobori C et al. performed a Gastric disconnection, involving antrectomy including the resection of the ulcerated portion, tube duodenostomy, and tube gastrostomy due to a giant duodenal ulcer after neurosurgery for brainstem tumors that required reoperation for gastric disconnection (23).

Dubecz et al. made a review about management of ERCP-related small bowel perforations, and duodenostomy was proposed in a case of DP in a difficult to manage duodenum (24), while Bharathi suggest a TD as a safe procedure to manage an intra-peritoneal DP caused by delayed migration of endobiliary stent (25).

Hatzigeorgiadis et al. suggest a tube

pancreatico-duodenostomy for the management of a severe penetrating pancreatico-duodenal injury as an option in pancreatico-duodenal trauma when the inner medial duodenal wall cannot be repaired (26).

Finally Clinch D. et al in a 2021 review stated that existing evidence does not support any surgical technique being superior to any one in terms of morbidity or mortality, but the choice of technique should be guided by several factors, including the position of the perforation, the degree of duodenal tissue loss, Hemodynamic patient stability and surgeon expertise (14).

The limitations of this study are that it is a retrospective, single-center, non-randomized study so that only five patients could be registered in our unit. Duodenostomy on Foley is an emergency procedure reserved only for the most severe cases of duodenal injury, therefore it is an infrequent technique.

Duodenostomy is still a reliable procedure, especially in extreme circumstances, in the presence of giant ulcers with severe tissue inflammation, or in very extensive injuries in life threatening situations.

We believe that the success of this method depends on some key steps in the procedure, as the Kocherization of the duodenum, which ensures a tension-free repair, good vascularization of the injury site and big size duodenostomy to be placed downstream of the second part of the duodenum. The critical point is keeping the duodenum empty and without tension by decompressing all fluids enter or are secreted into the region. The pyloric exclusion and the realization of a gastro-jejunum anastomosis is not always performed by the surgeons, but allow an early resumption of feeding, as the duodenum is excluded from food transit.

Conclusions

TD is a damage control procedure, for large DP when further repair techniques are not recommended. The TD is an old and dated procedure simple to implement, which may require an increase in post-operative hospitali-

zation but subsists as an effective and safe way to treat patients in critical conditions.

Conflict of Interest

The authors have no conflicts of interest to declare.

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Data Availability

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Ethical approval

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. Informed consent was obtained by all participants in the study.

Consent

Informed consent was obtained from all participants in the study.

Trial registry number

This study is registered on ClinicalTrials.gov. Unique Identifying number ID NCT05359029.

Author Contributions

Mario Pacilli and Nicola Tartaglia Draft the work and revising it critically, Giovanna Pavone and Alberto Fersini, give Substantial contributions to the acquisition, analysis, and interpretation of data for the work, Piercarmine Panzera and Antonio Ambrosi approved the final version to be published.

References

1. Yuan Y, Padol IT, Hunt RH. Peptic ulcer disease today. *Nat Clin Pract Gastroenterol Hepatol*. 2006;3(2):80–89.
2. Machado NO. Management of duodenal perforation post-endoscopic retrograde cholangiopancreatography. When and whom to operate and what factors determine the outcome? A review article. *JOP*. 2012;13(1):18–25.
3. Møller MH, Adamsen S, Thomsen RW, Møller AM. Peptic Ulcer Perforation (PULP) trial group. Multicentre trial of a perioperative protocol to reduce mortality in patients with peptic ulcer perforation. *Br J Surg*. 2011;98(6):802–10.
4. Di Lascia A, Tartaglia N, Pavone G, Pacilli M, Ambrosi A, Buccino RV, et al. One-step versus two-step procedure for management procedures for management of concurrent gallbladder and common bile duct stones. Outcomes and cost analysis. *Ann Ital Chir*. 2021;92:260–267.
5. Behrman SW. Management of complicated peptic ulcer disease. *Arch Surg*. 2005;140(2):201–8.
6. Ebert EC, Ruggiero FM, Seibold JR. Intestinal perforation. A common complication of scleroderma. *Dig. Dis. Sci*. 1997;42(3):549–53.
7. Katz S, Talansky A, Kahn E. Recurrent free perforation in gastroduodenal Crohn's disease. *Am. J. Gastroenterol*. 1983;78(11):722–5.
8. Negoi I, Paun S, Hostiuc S, Stoica B, Tanase I, Negoi RI, et al. Most small bowel cancers are revealed by a complication. *Einstein (Sao Paulo)*. 2015;13(4):500–5. English, Portuguese
9. Di Lascia A, Tartaglia N, Petruzzelli F, Pacilli M, Maddalena F, Fersini A, et al. Right hemicolectomy: laparoscopic versus robotic approach. *Ann Ital Chir*. 2020;91:478–485.
10. Ansari D, Torén W, Lindberg S, Pyrhönen HS, Andersson R. Diagnosis and management of duodenal perforations: a narrative review. *Scand J Gastroenterol*. 2019;54(8):939–944.
11. Turner RC, Steffen CM, Boyd P. Endoscopic duodenal perforation: surgical strategies in a regional centre. *World J Emerg Surg*. 2014;9(1):11.
12. Tartaglia N, Di Lascia A, Cianci P, Vovola F, Pacilli M, Zita A, et al. Surgical management of non-parasitic hepatic cysts A single center experience and a review of the literature. *Ann Ital Chir*. 2019;90:514–519.
13. Tarasconi A, Coccolini F, Biffl WL, Tomasoni M, Ansaloni L, Picetti E, et al. Perforated and bleeding peptic ulcer: WSES guidelines. *World J Emerg Surg*. 2020;15:3.
14. Clinch D, Damaskos D, Di Marzo F, Di Saverio S. Duodenal ulcer perforation: A systematic literature review and narrative description of surgical techniques used to treat large duodenal defects. *J Trauma Acute Care Surg*. 2021;91(4):748–758.
15. Gupta S, Kaushik R, Sharma R, Attri A. The management of large perforations of duodenal ulcers. *BMC Surgery*. 2005;5:15.
16. Berne TV, Donovan AJ. Nonoperative treatment of perforated duodenal ulcer. *Arch Surg*. 1989;124(7):830–832.
17. Tartaglia N, Pacilli M, Pavone G, Fersini A, Lizzi V, Vovola F, Facciorusso A, Neri V, Ambrosi A. Functional results of surgical treatment of low-ultralow rectal cancer. *Ann Ital Chir*. 2021;92:521–530.
18. Pai D, Sharma A, Kanungo R, Jagdish S, Gupta A. Role of abdominal drains in perforated duodenal ulcer patients: a prospective controlled study. *Aust N Z J Surg*. 1999;69(3):210–3.
19. Tartaglia N, Pacilli M, Di Lascia A, Pavone G, Pasquale C, Vovola F, et al. Management of bile duct injuries after cholecystectomy: Therapeutic approach and examination of possible sources of error. report of 2 cases. *Surg Chronicles* 2020;25(3):264–8.
20. Kutlu OC, Garcia S, Dissanaik S. The successful use of simple tube duodenostomy in large duodenal perforations from varied etiologies. *Int J Surg Case Rep*. 2013;4(3):279–282.
21. van Ginhoven T, Schepers T, Obertop H, van Eijck CH. Delayed closure of complex duodenal injuries by a Foley balloon catheter duodenostomy. *Dig Surg*. 2006;23(3):150–153.
22. Singh B, Kaur A, Singla AL, Kumar A, Yadav M. Combined gastric and duodenal perforation through blunt abdominal trauma. *J Clin Diagn Res*. 2015;9(1):PD30–PD32.
23. Nobori C, Kimura K, Ohira G, Amano R, Yamazoe S, Tanaka H, et al. Giant duodenal ulcers after neurosurgery for brainstem tumors that required reoperation for gastric disconnection: a report of two cases. *BMC Surg*. 2016;16(1):75.
24. Dubecz A, Ottmann J, Schweigert M, Stadlhuber RJ, Feith M, Wiessner V, et al. Management of ERCP-related small bowel perforations: the pivotal role of physical investigation. *Can J Surg*. 2012;55(2):99–104.
25. Bharathi RS, Rao PP, Ghosh K. Intra-peritoneal duodenal perforation caused by delayed migration of endobiliary stent: a case report. *Int J Surg*. 2008;6(6):478–480.
26. Hatzigeorgiadis A, Boulas KA, Baretas N, Papageorgiou I, Blouhos K. Tube pancreaticoduodenostomy for management of a severe penetrating pancreaticoduodenal injury. *JOP*. 2014;15(3):250–253.