Comments on Surgical Management of Penetrating Duodenal Injuries

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ABSTRACT:

BACKGROUND:

Duodenal injury is one of the most serious abdominal traumas that should be treated properly otherwise it may result in lethal complications.

Aim:

Is to apply simplified guidelines for the surgical management of duodenal injuries so that it might reduce the incidence of morbidity and mortality.

CASE SERIES:

During the last three years, nine patients with duodenal fistula as a result of penetrating duodenal injury were referred to Gastrointestinal and Hepatology Teaching Hospital, all these patients were reviewed to determine the severity of the duodenal injury according to the Organ Injury Scale and to discuss the surgical procedure which was performed.

COMMENTS:

The recommended operative management for grades I & II duodenal injury is simple primary repair, for grade III is pyloric exclusion or jejunal serosal patch, for grade IV is duodenal diverticulization, and for grade V is Whipple's operation. In addition to that damage control surgery can be applied in certain circumstances.

CONCLUSION:

The simple primary repair is not sufficient treatment of moderate to severe duodenal laceration and the surgeons should adopt more advanced procedure.

KEYWORDS: Abdominal trauma, duodenal injury, and duodenal fistula.

INTRODUCTION:

Duodenal injury is one of the most serious abdominal traumas and it usually associated with high morbidity and mortality especially if not treated properly. Many studies were found that the incidence of duodenal fistula following duodenal injuries is 2-14 % [1,2,3,4], and the postoperative mortality is 15-25% [3,4,5,6].

The repair of these injuries must be accomplished according to many factors including: the location and severity of the injury, the time interval from the trauma to the definite treatment, and if there is associated pancreatic and /or biliary injury [3,7,8].

THE AIM:

Of this case series is to apply simplified guidelines for the surgical management of the duodenal injury according to the severity score so that it may diminish the rate of morbidity and mortality of this serious trauma.

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CASE SERIES:

During the last three years, from august 2003 to June 2006, nine patients with postoperative duodenal fistula following abdominal trauma referred to the Gastrointestinal & Hepatology Teaching Hospital for further management. There were eight male and one female. The age range from 15-42 years old, the mean age was 23.8. The operative notes, which were written by the surgeons who performed the emergency laparotomy, were reviewed thoroughly to determine the grade of severity of duodenal injury and to know the operative procedures that were performed.

Eight patients sustained penetrating duodenal injury by high velocity missile and one patient had iatrogenic duodenal injury.

The score of severity of those patients was: grade II in one patient, grade III in five patients, and grade IV in three patients. Four patients the condition was associated with pancreatic injury, two with common bile duct (CBD) injury, and 6 with other visceral injury. The site of duodenal injury was first part of duodenum (D1) in three patients, second part of duodenum (D2) in five and third part of duodenum (D3) in one patient (table 1).

Table 1 detail of operative findings and procedures of the nine patients.

Patients	Grade Of severity	The site of injury	Associated injuries	Procedure which performed
1st	II	D1*	Non	Antrectomy, gastro-jejunostomy& jejunojejunostomy
2nd	III	D1	Pancreas, liver, diaphragm	Primary closure
3rd	III	D3*	Pancreas	Primary closure
4th	III	D1	Pancreas, spleen, liver	Primary closure
5th	III	D2*	Colon, small bowel, right kidney	Primary closure
6th	III	D2	Stomach, pancreas	Primary closure
7th	IV	D2	Pancreas, CBD, colon, liver	Primary closure+ gastrojejunostomy+ pancreatojejunostomy+ cholecystojejunostomy
8th	IV	D2	IVC, liver, pancreas, colon	Primary closure+ gastrojejunostomy
9th	IV	D2	CBD, right kidney, colon	Primary closure+ cholecystojejunostomy

∗D1: first part of duodenum, D2: second part of duodenum, D3: third part of duodenum

All these patients developed high output duodenal fistula post operatively, about 1500-2500cc/24h and referred to our hospital in serious condition. The patients were treated by total parenteral nutrition in addition to eradication of the sepsis and local control of the fistula discharge. No patient required surgical intervention for repairing the fistula. In six patients, the fistulae were closed spontaneously by conservative management; and unfortunately, three patients died as a result of multiple organ failure. The mean duration of spontaneous closure was 20.3 days ranging between 6-32days. The mean duration of hospitalization was 24.8 days ranging between 6-46 days.

COMMENTS:

Recently, the American Association of the Surgery and Trauma had introduced the Organ Injury Scaling (OIS), which classified the severity of the duodenal injuries into many grads (table 2) [7,9].

Table 2 duodenum Organ Injury Scaling

Grade		Description
I	Hematoma Laceration	Involve single portion of duodenum Partial thickness, no perforation
II	Hematoma Laceration	Involve more than one portion Disruption <50% of circumference
III	Laceration Laceration	Disruption of 50-75% of circumference of D2 Disruption of 50-100% of circumference of D1, 3,or 4
IV	Laceration	Disruption of >75% of D2 Involving ampulla or distal CBD
V	Laceration Vascular	Massive disruption of duodenopancreatic complex Devascularization of the duodenum

* D1: first part of duodenum, D2: second part of duodenum, D3: third part of duodenum, D4: fourth part of duodenum. **CBD: common bile duct

At the beginning, in any case of duodenal injury, the duodenum should be completely inspected by taking down the hepatic flexure of the colon and full mobilization of the second part of the duodenum medially (Kocherization of the duodenum), and the third and fourth part of the duodenum should be inspected at the base of transverse mesocolon [2].

In case of duodenal hematoma (grade I), most of the surgeons have adopted now conservative management [2,7,10], including nothing by mouth, naso-gastric suction, and parenteral nutrition if indicated, however, if the condition does not resolve or when the hematoma was discovered during emergency laparotomy, it should be evacuated through longitudinal serosal incision with seromuscular closure of the duodenal wall [2,10].

Regarding small duodenal perforation (grade II), primary suturing of the defect in a single or two layer can treat most of them [2,10], using 3/0 absorbable monofilament sutures, which is better to be performed in oblique or transverse direction to avoid duodenal stenosis (figure 1) [5,10,11,12]. Suction decompression of the duodenum with a transpyloric nasogastric tube can be used in case of delayed repair after 6 hours [2,11].

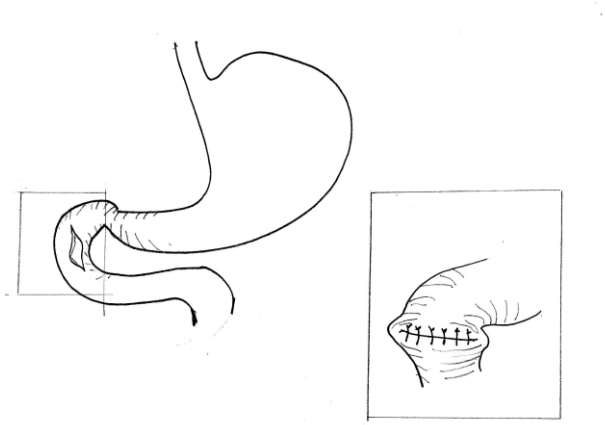

Figure 1 primary closure in transverse manner.

In case of delayed injury or large perforation, primary suturing might narrows the lumen or jeopardizes the vascularity (grade III), so it is better to be treated either by closure of the defect by jejunal serosal patch (figure2) or by primary suturing of the defect in addition to pyloric exclusion [2,7,12] (figure 3), which is performed by closure of the gastric antrum with monofilament non absorbable running suture through a gastrostomy made as near pylorus as possible which is used for gastro-jejunostomy at the same time to divert food away from the duodenum [10,12]. This procedure had been advocate first time by Vaughan in 1977 [7,13]. Many studies found that the incidence of duodenal fistula had been reduced after adoption of pyloric exclusion for the treatment of large or delayed duodenal perforation [7,14,15].

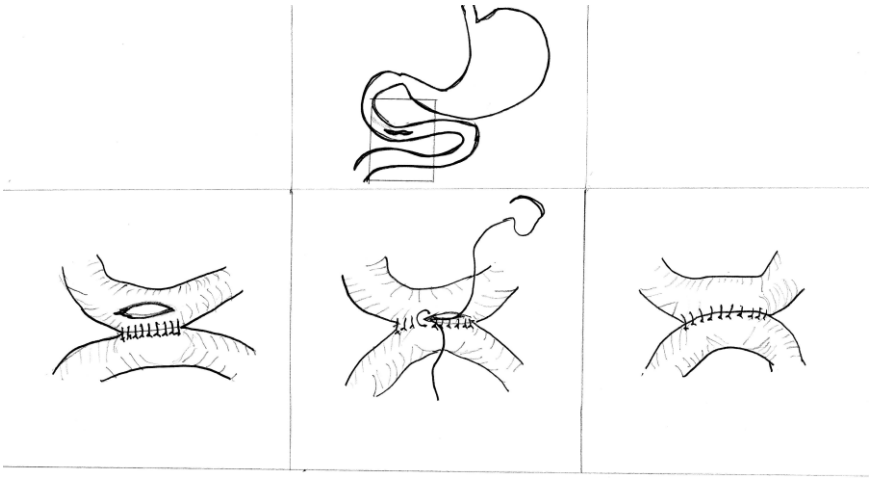

Figure2 jejunal serosal patch

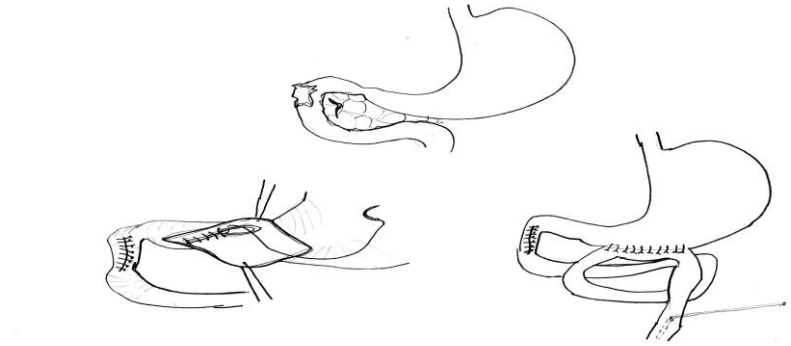

Figure3 pyloric exclusion

When there is complete transection of the duodenum or tissue loss distal to the papilla of Vater and proximal to the superior mesenteric vessels (grade III), this can be treated by trimming of both edges with end-end anastomosis if possible, otherwise Roux-en-Y duodeno-jejunostomy of the proximal end with oversewn of the distal end of the duodenum [10,11,12] (figure4).

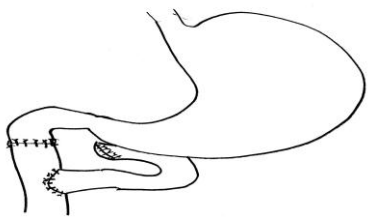

Figure 4 end-end Roux-en-Y duodeno-jejunal anastomosis

In case of severe laceration of the second part of the duodenum that involve the ampulla associated with pancreatic and/or common bile duct (CBD) injury (grade IV), this preferably to be treated by diverticulization of the duodenum [10,13] which was initially performed by Berne et al in 1968 [13]. This consist of; antrectomy, closure of the duodenal stump, tube duodenostomy, and gastro-jejunostomy, and some time t-tube insertion in CBD [13] (figure5).

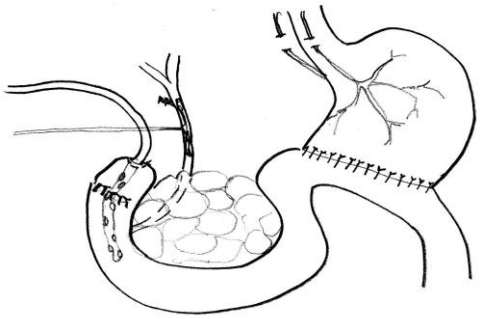

Figure5 duodenal diverticulization.

Table 3 guidelines of management of duodenal injury according to Organ Injury Scale (IOS)

Grade	Description	Type of procedures
I.	Partial thickness laceration	Simple seromuscular closure
II.	Multi segment hematoma Small laceration	Evacuation and two layer closure Simple two layer closure
III.	Large laceration Complete transection	Primary closure in addition to pyloric exclusion. Closure of the distal part with Roux-en-Y duodeno-jejunostomy
IV.	Very large laceration of D2* with ampullary and/or CBD** injury	Duodenal diverticulization
V.	Massive disruption Devascularization	Diverticulization or Pancreatoduodenectomy

* D2: second part of duodenum. **CBD: common bile duct

Rarely, when there is massive disruption of duodeno-pancreatic complex or in case of complete devascularization of the duodenum (grade V), in this situation pancreatico-duodenuctomy might be the procedure of choice [2,16], although it usually associated with high incidence of morbidity and mortality [16]. Asensio et al found that the mortality rate following this procedure was 33%[17].

These methods of surgical procedures for the management of duodenal injury according to the severity score are simplified in table 3, and the surgeon who dealing with trauma patients should be familiar with all these varieties of surgical options.

Sometime it is recommended to use feeding jejunostomy in high-risk patients who susceptible to develop duodenal fistula especially in delayed repair [7]. Previously some surgeons performed triple tube technique in severe injuries, which include; tube gastrostomy, tube jejunostomy, and tube duodenostomy; but many studies had been found that it dose not lead to diminish the incidence of postoperative leak [7].

Moreover, in case of severely injured patient, the surgeon betters to consider damage control surgery to control hypothermia, acidosis and coagulopathy by avoiding lengthy procedure. This can be performed by arresting of active hemorrhage and controlling peritoneal contamination by suturing or tying off proximal and distal to the laceration, the laparotomy is terminated by laparostomy and the definite repair delayed to the second planned procedure [5,18].

In reviewing of the operative notes of these nine patients we found that in first patient the operative procedure was outweigh the severity of the injury. That is to say in this patient the injury was iatrogenic, clean and discovered early during the operation for bleeding duodenal ulcer (grade II), but he was treated

by gastro-jejunostomy with jejuno-jejunostomy! But it may be more ideal if the injury was primarily sutured with or without pyloric exclusion if the lumen is compromised.

In the second, third, fourth, and fifth patients, they had large penetrating duodenal injury (grade III), which was treated by primary suturing only! But the recommended treatment is serosal jejunal patch or pyloric exclusion in addition to suturing of the defect.

In patients number 6th, 7th and 8th, the injury was so severe that involve the pancreas and/or bile duct (grade IV), but they were treated by primary closure with gastro-jejunostomy in 7th and 8th patients, and with cholecysto-jejunostomy in 9th patient. But the more preferable option in this situation was diverticulization of the duodenum or pyloric exclusion in addition to t-tube placement to drain the biliary tree.

CONCLUSION:

The simple primary repair is not sufficient treatment of moderate to severe duodenal laceration and the surgeons should adopt more complex procedure like pyloric exclusion, duodenal diverticulization, or Whipple's procedure to reduce the postoperative morbidity and mortality of this serious injury, if this is not possible at that time, the surgeon should applied damage control surgery and the definite repair delayed to the second planned procedure.

REFERENCES:

1. Rao R. Ivatury, Jean Gaudino, Entrico Ascer, et al. Treatment of Penetrating Duodenal Injuries: Primary Repair vs. Repair with Decompressive Enterostomy/Serosal Patch. The journal of trauma. 1985; 25:337-341.
2. David B. Hoyt, Raul Coimbra, Sandra Engelhardt, et al: Trauma-Specific Injury. In: Alfred Cuschieri, Robert J. S. Steel, Abdool Rahim Moosa, (eds). *Essential Surgical Practice*. London: ARNOLD, 2002: 1-43.
3. Rao R. Ivatury, Mnaohar Nallathambi, et al. Penetrating Duodenal Injuries, Analysis of 100 Consecutive Cases. Ann. Surg. 1985; 202: 153-158.
4. Gregory J. Jurkovich, James C. Carrico: Trauma: Treatment of the Acutely Injured Patient. In: David C. Sabiston, H. Kim Lyerly (eds) *Textbook of surgery: the biological basis of modern surgical practice*. Philadelphia: W.B. Saunders Company, 1997: 296-339
5. Matthew J. F., X. Rickard, Karim Brohi, et al. Pancreatic and Duodenal Injuries: Keep it Simple. ANZ J. Surg. 2005; 75: 581–586
6. R. Benton Adkins, John E. Keyser. Recent Experience with Duodenal Trauma. The American Surgeon.1985; 51: 121-131
7. Suvit Sriussadaporn, Rattaplee Pak-art, Sukanya Sriussadaporn, et al. Management of Blunt Duodenal Injuries. J Med Assoc Thai. 2004; 87: 1336-1342
8. McKenney MG, Nir I. Levi, Martin L. Evaluation of minor penetrating duodenal injuries. Am Surg. 1996; 62: 952-5.
9. E. E. Moore, T. H. Cogbili, M. A. Malangoni, et al. Organ Injury Scaling, II: Pancreas, Duodenum, Small bowel, Colon, and Rectum. J. Of Trauma 1990; 30: 1427-1429.
10. Charles E. Locas, Anna M. Ledgerwood: Injuries to the Stomach, Duodenum, Pancreas, Small bowel, and Colon. In: Douglas W. Wilmore, Laurency Y. Cheung, Alden H. Markan, James W. Holcroft, Jonthan L. Markins, Nathaniel J. Soper (eds). *ACS Surgery, Principles & Practice*. New York: WebMD, 2003: 280-288.
11. John M. Burch. Reginald J. Françoise, Ernest E. Moore: Trauma. In: F. Charles Bruicardi, Dana K. Andersen, Timothy R. Biliar, David L. Dunn, John J. Hunter, and Raphael E.Pollock (eds). *Schwartz's Principles of Surgery*. Philadelphia: McGraw Hill, 2004: 1187-1219
12. Robert A. Read, Ernest E. Moore, Frederick A. Moore, Jon Burch: Blunt and Pentrating Abdominal Trauma. In: Michael J. Zimmer, Seymour I. Schwartz, Harold Ellis (eds). *Maingot's Abdominal Operation*. Connecticut: Appleton and Lange, 1997: 763-786.

13. Robert M. Shorr, Gregory C. Greaney, Arthur J. Donovan. Injuries of The Duodenum. Am. J. Surg.1987; 154: 93-98

14. Degiannis E., Krawczykowski D., Velmahos G.C., et al. Pyloric exclusion in Severe Penetrating Injury of the duodenum. World J Surg. 1993; 17: 751-754.

15. Kashuk J.L., Moore E. E., CogbillT.H. . Management of the Intermediate Severity Duodenal Injury. Surgery 1982; 92: 758- 64.

16. A. Brooks, A. Shukla, I. Beckingham. Pancreatic trauma. J. Of Trauma 2003; 5: 1-8.

17. Asensio JA, Petrone P, Roldan G, et al. Pancreaticoduodenectomy: a rare procedure for the management of complex pancreaticoduodenal injuries. J Am Coll Surg. 2003; 197: 937-42

18. I. G. Finlay, T. J. Edwards, A. W. Lambert. Damage Control Laparotomy. British Journal of Surgery. 2004; 91: 83-85.