Review of Pancreaticoduodenal Trauma with a Case Report

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Abstract Complex anatomical relation of the duodenum, pancreas, biliary tract, and major vessels plays to obscure pancreaticoduodenal injuries. Causes of pancreaticoduodenal injuries are blunt trauma (traffic accidents, sport injuries) in 25 % of cases and penetrating abdominal injuries (stab wounds and firearm injuries) in 75 % of cases. Duodenal injuries are reported to occur in 0.5 to 5 % of all abdominal trauma cases and are observed in 11 % of abdominal firearm wounds, 1.6 % of abdominal stab wounds, and 6 % of blunt trauma. Retroperitoneal and deep abdominal localization of duodenum as an organ contribute to the difficulty in diagnosis and treatment. There are three important major points regarding treatment of duodenal injuries: (1) operation timing and decision, (2) Intraoperative detection, and (3) post-operative care. Therefore, it is difficult to diagnose and treat duodenal trauma. We would like to present a 21-year-old male patient with pancreaticoduodenal injury who presented to our emergency service after firearm injury to his abdomen and discuss his treatment with a short review of related literature.

Keywords Pancreaticoduodenal trauma · Difficult diagnosis · Surgical treatment · Penetrating abdominal injury

Introduction

Complex anatomical relation of the duodenum, pancreas, biliary tract, and major vessels, difficulties in diagnosis, and in determination of treatment strategies all play part in making the management of pancreaticoduodenal injuries problematic. These injuries are often accompanied by colon, liver, intestinal, gastric, and vascular injuries [1–4]. Causes of pancreaticoduodenal injuries are blunt trauma (traffic accidents, sport injuries) in 25 % of cases and penetrating abdominal injuries (stab wounds and firearm injuries) in 75 % of cases. Regarding duodenal injuries, second segment (36 %) is the most prone to traumatic injuries, followed by third segment with 18 %, fourth segment with 15 %, and first segment with 13 %. Multiple injuries are detected in 18 % of cases [5, 6]. In this paper, we would like to present a 21-year-old male patient with pancreaticoduodenal injury presented to our emergency service after firearm injury to his abdomen and his treatment progress with a short review of related literature.

Case Report

Twenty-one year old male patient was admitted to our emergency service following an abdominal firearm injury with an entry wound observed at epigastric region. He was conscious, had full orientation and cooperation. His blood pressure was 80/50 mmHg; pulse rate was 120 bpm and had rhythmical pulse. The patient was not stable hemodynamically. The entry wound was observed just below right costal arch at epigastric region, and the exit wound was observed at right subscapular region. Intestinal segments and omentum were partly eviscerated from the bullet entry wound (Fig. 1).

Intravenous fluids were given via wide bore cannulae. Nasogastric tube was placed. Oxygen was started, and the

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Fig. 1 Intestinal segments and omentum were partly eviscerated from the wound

patient was catheterized. Plain X-rays showed no rib fracture or lung injury. His lab workout was as follows: Hb: 7.4 g/dl, Htc: 20 %, Na:141 mEq, K:4.4 mEq.

He underwent emergency laparotomy. Initially, the abdominal organs and major vascular structures were inspected. The duodenum and pancreas were determined to be massively injured according to the American Association for The Surgery of Trauma-Organ Injury Scaling Committee (AAST-OIS). There was grade 5 injury at the head of the pancreas and duodenum and grade 1 injury of hepatic segments 1, 5, and 6. Exploratory laparotomy+total duodenal resection+primary pyloric exclusion+tube choledochostomy+pancreatic head repair+right nephrectomy+jejunal exclusion at Treitz level+cholecystectomy was performed.

As the patient's general condition improved, he was transferred to GMMA General Surgery Department. There, the patient underwent completion Whipple procedure. Having no complications, his drains were removed on postoperative ninth day, and T-tube was withdrawn on the 40th day.

Discussion

Clinical Features and Diagnostic Methods

Duodenal injuries are rare in all abdominal injuries, but 75 % of these is penetrating. They are reported to occur in 0.5 to 5 % of all abdominal trauma cases and are observed in 11 % of abdominal firearm wounds, 1.6 % of abdominal stab wounds, and 6 % of blunt trauma [7]. It is sometimes encountered incidentally. They are especially difficult to diagnose [8]. Retroperitoneal and deep abdominal localization of duodenum as an organ contributes to this difficulty [9, 10]. Guarding and rebound tenderness may not be observed during physical examination.

There is no biochemical marker directly related with severity of the injury. Increasing serum amylase levels and continued elevation are of significance to suggest

duodenal injury, but they have no importance with regard to decision to operate [11, 12].

It is possible to detect intraperitoneal free gas with X-ray, more often in penetrating duodenal injuries. Observation of free gas at upper pole of the right kidney is especially common in duodenal trauma [13]. Additionally, serial radiograms with barium contrast may again reveal duodenal hematomas and wall injuries. The radiographic appearance described as “coiled spring sign” is observed in duodenal injuries [14, 15]. Although ultrasonography (USG) is inadequate for examination of this area, it should be the first test to be performed in order to rule out other pathologies [16]. The best test to visualize retroperitoneal area is contrast computed tomography (CT). Thin slice CT examination is important especially for decision on urgent operation, but has the disadvantage of not being applicable to unstable patients [17].

Duodenal perforation can also be detected with radiograms following administration of gastrografin via nasogastric tube [18]. As a longstanding method, diagnostic peritoneal lavage (DPL) is a diagnostic procedure used in duodenal injuries [19]. DPL is controversial if there will be a necessity for CT examination later, since it can lead to false positivity and gives negative results in 50 % of cases [20].

Treatment

Throughout the years, different management strategies have been developed for penetrating pancreaticoduodenal injuries. There are three important major points regarding treatment of duodenal injuries:

1. Operation timing and decision on operation is very important especially during the first 24 h of duodenal injuries. Mortality rate for operations performed after the 24 h of duodenal injuries is increased to 40 % from 11 % [21]. This rate increases up to 50 % in blunt trauma [22].
2. Intraoperative detection of bleeding, trauma scoring (Table 1), detection of injuries at other organs, and abdominal exploration in detail.
3. Post-operative care.

Accurate management of these three steps contributes in improved morbidity and mortality rates. Therefore, patients with these kinds of trauma should be monitored and treated in multi-disciplinary centers.

Intraoperatively, a thorough exploration is essential to detect bleeding and other organ injuries, and to prevent bacterial contamination. All segments of the duodenum should be inspected via Kocher or Cattell Braasch maneuvers. Presence of any biliary leakage (observation of biliary staining), crepitation in periduodenal tissues, petechiae at neighboring tissues, and fat necrosis should be inspected. The entire abdomen should be examined in detail [23, 24].

Table 1 Duodenal injury scale (AAST-OIS) [11]

Grade	Injury	Description
I	Haematoma	Only one duodenal portion damaged
	Laceration	Partial, without perforation
II	Haematoma	More than one portion of duodenum damaged
	Laceration	Less than 50 % disruption of the circumference
III	Laceration	50–75 % disruption D2 circumference or 50–100 % disruption other parts circumference
	Laceration	>75 % disruption D2
IV	Laceration	Ampulla or the distal part of the common bile duct damaged.
	Laceration	Massive disruption of the duodenopancreatic system
V	Laceration	Massive disruption of the duodenopancreatic system
	Vascular	Duodenal devascularization

Retrograde duodenal decompression with nasogastric catheter is important in complex injuries to preserve the repair that has been made. In addition, tube jejunostomy can be beneficial as it enables early enteral feeding and helps to avoid complications of total parenteral nutrition (TPN) in case of complications like fistula [20, 25].

Penetrating injuries of duodenum may be treated by debridement and primary repair or resection with anastomosis. For grade 1 cases, if there is intramural hematoma present and does not get resorbed within 2–4 weeks via conservative approach (nasogastric tube and parenteral nutrition), gastroduodenostomy + primary repair is recommended [18]. It is more common in patients who have bleeding diathesis or receive anticoagulant therapy [26, 27].

For grade 1 and 2 injuries of second and third duodenal segments, serosal or mucosal patch methods are recommended [28]. Transverse repair has importance in duodenal injuries for maintenance of adequate duodenal vascularity, to avoid obstruction and for tension-free repair. For grade 1 and 2 injuries in which the elapsed time is longer than 24 h, pyloric exclusion should also be considered.

Grade 3 injuries get a little more complicated. Although there have been various recommendations, resection + primary anastomosis or pyloric exclusion + vagotomy are the most frequently performed surgeries. Tube jejunostomy and gastrojejunostomy are also performed as required [29].

Grade 4 and 5 injuries are quite complex, and surgery is performed as necessary. Pyloric exclusion + gastroenterostomy and pancreatectomy can be performed after the patients are made stable [30, 31]. These injuries carry a high mortality rate.

Although contrast abdominal CT is the best method, García Santos et al. reported that none of the radiological tests were helpful for diagnosis in 5 out of their 7 patients, and those patients underwent laparotomy due to clinical suspicion [12, 24]. In related literature, more than 75 % damage to the duodenum and its surrounding structures,

first or second segment injuries, neighboring organ injuries, operation delay longer than 24 h, and grade 3 or more duodenal injuries are defined as complex duodenal injury [32, 33]. Complex duodenal reconstruction methods are not ideal treatment methods for these cases [14, 34–36]. Authors have proved that 60 to 80 % of most duodenal injuries could be treated with simple methods. Roughly 75 % of injuries has been determined as grade 1 and 2, 15 % as grade 3, and 10 % has been determined as grade 4 and 5 [22, 37, 38]. The most frequently performed technique in complex injuries has been determined as primary exclusion + gastroenterostomy [39]. During our exploration in our case, we found grade 5 injury; additionally, there was damage to the common bile duct, and the right kidney was divided to three at the hilar level. We performed primary exclusion + gastroenterostomy, and as his condition improved, Whipple procedure was performed in a comprehensive health center.

Complications and Prognosis

The most common post-operative complications, in decreasing order, are duodenal fistula (2–16 %), intraabdominal abscess (15 %), obstruction (5–8 %), and pancreatitis (0.5 %) [40, 41]. The most frequent cause of duodenal fistula development is inadequate surgery [12]. Factors most commonly associated with mortality are neighboring organ injury and delayed diagnosis [42, 43]. Varying rates of mortality have been reported between 6 and 50 % [22, 32, 44, 45]. The most frequent causes of mortality are bleeding for the early period and sepsis and multi-organ failure at the late period [44, 45].

According to Los Angeles County and the University of Southern California Trauma Center, mortality rates are 8.3 % for grade 1, 18.7 % for grade 2, 27.6 % for grade 3, 30.8 % for grade 4, and 58.8 % for grade 5 injuries [12].

Conclusion

- 1- Duodenal injuries should be kept in mind in all abdominal trauma cases, since it has a high mortality and morbidity rate when the diagnosis is delayed.
- 2- During operation, pancreaticoduodenal region should be inspected thoroughly, and presence of other organ injuries should be examined, particularly the common bile duct and pancreas which have a direct influence on mortality rate.
- 3- Radical surgical methods should be considered in the second plan. Damage control surgery in contrast to definitive surgery with short operating time was aimed in treatment of our case.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interests.

References

1. Feng XF, Fan W, Shi CX, Li JH, Liu J, Liu ZH (2013) Simplified pancreatoduodenectomy for complex blunt pancreaticoduodenal injury. *Chin J Traumatol* 16(5):311–313
2. Degiannis E, Glapa M, Loukogeorgakis SP, Smith MD (2008) Management of pancreatic trauma. *Injury* 39(1):21–29
3. Sharma AK (2012) Management of pancreaticoduodenal injuries. *Indian J Surg* 74(1):35–39
4. Lin BC, Chen RJ, Fang JF, Hsu YP, Kao YC, Kao JL (2004) Management of blunt major pancreatic trauma. *J Trauma* 56:774–778
5. Girgin S, Gedik E, Yagmur Y, Uysal E, Bac B (2009) Management of duodenal injury: our experience and the value of tube duodenostomy. *Ulus Travma Acil Cerrahi Derg* 15:467–472
6. Pandey S, Niranjana A, Mishra S et al (2011) Retrospective analysis of duodenal injuries: a comprehensive overview. *Saudi J Gastroenterol* 17:142–144
7. Tacyildiz IH, Akinci OF, Yilmaz G et al (1999) The effectiveness of tube gastroduodenostomy in primary repair of duodenal injuries. *Eur J Emerg Surg Intensive Care* 22(2):66–69
8. Coyne ER, Witkowski ER, Chau Z et al (2014) National trends in pancreaticoduodenal trauma: interventions and outcomes. *HPB* 16: 275–281
9. Asensio JA, Petrone P, Roldán G, Pak-art R, Salim A (2002) Pancreatic and duodenal injuries. Complex and lethal. *Scand J Surg* 91(1):81–86
10. Aucar JA, Losanoff JE (2004) Primary repair of blunt pancreatic transection. *Injury* 35(1):29–34
11. Blocksom JM, Tyburski JG, Sohn RL et al (2004) Prognostic determinants in duodenal injuries. *Am Surg* 70(3):248–255
12. García Santos E, Soto Sánchez A, Verde JM, Marini CP, Asensio JA, Petrone P (2015) Duodenal injuries due to trauma: review of the literature. *Cir Esp* 93(2):68–74
13. Corley RD, Nocross WJ, Shoemaker WC (1974) Traumatic injuries to the duodenum: a report of 98 patients. *Ann Surg* 181:92–98
14. Stone HH, Fabian TC (1979) Management of duodenal wounds. *J Trauma* 19:334–339
15. Felson B, Levin EJ (1954) Intramural hematoma of the duodenum: a diagnostic roentgen sign. *Radiology* 63:823–831
16. Lam JP, Eunson GJ, Munro FD, Orr JD (2001) Delayed presentation of handlebar injuries in children. *Br Med J* 322:1288–1289
17. Brofman N, Atri M, Hanson JM, Grinblat L, Chughtai T, Brennen F (2006) Evaluation of bowel and mesenteric blunt trauma with multidetector CT. *Radiographics* 26:1119–1131
18. Camera L, Calabrese M, Romeo V et al (2013) Perforated duodenal ulcer presenting with a subphrenic abscess revealed by plain abdominal X-ray films and confirmed by multi-detector computed tomography: a case report. *Med Case Rep* 7:257
19. Ballard RB, Badellino MM, Eynon CA, Spott MA, Staz CF, Buckman RF Jr (1997) Blunt duodenal rupture: a 6-year statewide experience. *J Trauma* 43(2):229–232
20. Caboglu AS, Cetinkaya Z, Dogru O, Bulbul N, Akkuş MA (1999) An interesting sport injury: duodenal trauma. *Turk J Trauma Emerg Surg* 3(5):219–222
21. Lucas CE, Ledgerwood AM (1975) Factors influencing outcome after blunt duodenal injury. *J Trauma* 15:839–840
22. Ozkan S, Akinoglu A, Alabaz O, Ozkan FC (1997) Duodenal injuries. *Turk J Trauma Emerg Surg* 3:191–194
23. Wilson TS, Costaulas LB (1971) Retroperitoneal injury to the duodenum by blunt abdominal trauma: report of eight cases. *Can J Surg* 14:114–115
24. Kowalewski P, Najdecki ME, Trojanowski P, Paśnik K (2015) Retroperitoneal perforation of duodenum—surgical approach. *Pol Merkur Lekarski* 38(226):219–221
25. Singh B, Kaur A, Singla AL, Kumar A, Yadav M (2015) Combined gastric and duodenal perforation through blunt abdominal trauma. *J Clin Diagn Res* 9:1
26. Jones WR, Hardin WJ, Davis JT, Hardy JD (1971) Intramural hematoma of the duodenum: a review of the literature and case report. *Ann Surg* 173:534–544
27. Fullen WD, Selle JG, Whitely DH (1974) Intramural duodenal hematoma. *Ann Surg* 179:549–556
28. Yin WY, Huang SM, Chang TW et al (1996) Transverse abdominis musculoperitoneal flap for the repair of large duodenal defects. *J Trauma* 6:973–976
29. Berne CJ, Donovan AJ, Hagen WE (1968) Combined duodenal pancreatic trauma: the role of end-to-side gastrojejunostomy. *Arch Surg* 96:712–722
30. Thal AP, Wilson RF (1964) A pattern of severe blunt trauma to the region of the pancreas. *Surg Gynecol Obstet* 119:773–778
31. Asensio JA, Petrone P, Roldan G, Kuncir E, Demetriades D (2003) Pancreaticoduodenectomy: a rare procedure for the management of complex pancreaticoduodenal injuries. *J Am Coll Surg* 197:937–942
32. O'Reilly DA, Bouamra O, Kausar A, Malde DJ, Dickson EJ, Lecky F (2015) The epidemiology of and outcome from pancreatoduodenal trauma in the UK, 1989–2013. *Ann R Coll Surg Engl* 97(2):125–130
33. Ivatury RR, Nassoura ZE, Rj S, Rodriguez A (1996) Complex duodenal injuries. *Surg Clin North Am* 76:797
34. Gogbill TH, Moore EE, Feliciano DV et al (1990) Conservative management of duodenal trauma: a multicenter perspective. *J Trauma* 30:1469
35. Griffin CC, Raina S, Marchiedo GW (1985) A simplified technique for gastric and duodenal decompression for duodenal injuries. *Am Surg* 51:604–605
36. Ivatury RR, Nallathambi M, Gaudino J, Rohman M, Stahl WM (1985) Penetrating duodenal injuries—analysis of 100 consecutive cases. *Ann Surg* 2:153–158

37. Moore EE, Cogbill TH, Malongoni MA et al (1990) Organ injury scaling. II. Pancreas, duodenum, small bowel, colon and rectum. *J Trauma* 30:1427–1429
38. Ivatury RR, Gaudino J, Ascer E et al (1985) Treatment of penetrating duodenal injuries: primary repair vs repair with decompressive enterostomy/serosal patch. *J Trauma* 25:337–341
39. Feliciano DV, Martin TD, Cruse PA et al (1987) Management of combined pancreatoduodenal injuries. *Ann Surg* 6:674–679
40. Timaran CH, Martinez O, Ospina JA (1999) Prognostic factors and management of civilian penetrating duodenal trauma. *J Trauma* 47: 330–335
41. Rathore MA, Andrabi SI, Najfi SM, Chaudhry Z, Chaudhry AM (2007) Injuries to the duodenum—prognosis correlates with body Injury Severity Score: a prospective study. *Int J Surg* 5:388–393
42. Antonacci N, Di Saverio S, Ciaroni V et al (2011) Prognosis and treatment of pancreaticoduodenal traumatic injuries: which factors are predictors of outcome? *J Hepatobiliary Pancreat Sci* 18: 195–201
43. Fabian TC, Mangiante EC, Millis M (1984) Duodenal rupture due to blunt trauma: a problem in diagnosis. *South Med J* 77: 1078–1082
44. Velmahos GC, Tabbara M, Gross R et al (2009) Blunt pancreatoduodenal injury: a multicentre study of the Research Consortium of New England Centers for Trauma. *Arch Surg* 144: 413–419
45. Krige JE, Beningfield SJ, Nicol AJ, Navsaria P (2005) The management of complex pancreatic injuries. *S Afr J Surg* 43(3):92–102