The Pattern and Optimal Surgical Treatment of High – Velocity Penetrating Duodenal Injuries

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Haqqi I .Razzouki*, Jasim A. Al-Badri*, Hussein Hadi*

*CABS, Specialist Surgeons, Al-Yarmouk Teaching Hospital

Abstract:

Background: The increased incidence of high velocity missile (H.V.M.)abdominal injuries in Iraq had been associated with an increase in the incidence of duodenal injuries.

Setting: Second and fourth surgical units at Al-Yarmouk Teaching Hospital.

Objective: To study the pattern of duodenal injuries, evaluate the proper surgical methods of duodenal injury management, to minimize the morbidity & mortality rates.

Patients &methods: Prospective study of forty two duodenal injury patients in 6 years period between Jan .2003 – Dec .2008 managed surgically .For Grade 2 duodenal injury we did primary repair with tube drainage, for grade 3; primary repair with tube duodenostomy or primary repair with triple ostomies, or primary repair with Pyloric exclusion and gastro-jejunostomy.

Results: Four hundred six laparatomy for (H.V.M.)abdominal injury, of these 42 cases (10.3%)associated with duodenal injury .80 %35 male & 20 %7 female aged between (10-50)years with mean age of 32 .There were no isolated duodenal injury, 43.8 %had haemorragic shock on admission to the emergency room, 14 cases 33.3 %died perioperatively, 4 cases 9.5 %died postoperatively due to complications, no death in patients after leaving hospital

Conclusions: Second part of the duodenum is the most common site of injury .Grade 3 duodenal injury has high morbidity & mortality rate .Time interval between the injury & operation is more important to decrease morbidity & mortality rate.

Introduction:

The management of the duodenal injuries is still controversial among trauma surgeons .This is because of the anatomical retroperitonial location of the duodenum; it's proximity to the important intraperitonial structures, its marginal blood supply and the biliary, pancreatic & gastro-intestinal secretions .The massive multiple organs trauma in the (H.V.M.)injuries contributes to the difficulties in management .Duodenal injuries are relatively uncommon .They are reported in 3.7 % of all laparotomy for trauma .However due to greater devastation of the modern weapons being used in violent assaults, duodenal injuries are seen with much greater frequency than 10 years ago .This applies more to the current situation in Iraq, where there is a high incidence of injuries due to (H.V.M)and shrapnel .Previous studies of duodenal injuries reported an incidence of about 80 %occurring as the result of penetrating trauma .Many series reported that the second portion of the duodenum is most common injured 35 .%In our prospective study we had analyzed our experience with duodenal injuries & investigated the value of different surgical approaches according to the duodenal injury severity D.I.S .Also we described the sources of duodenal -related morbidity & mortality.

Material and Methods:

A prospective study of forty two (H.V.M.)duodenal injuries who had been operated upon in 6 years period between Jan .2003 – Dec .2008 at Al -Yarmouk Teaching Hospital second & fourth surgical unites .All cases were diagnosed at laparatomy .We document the sex, age, sites, grade& number of duodenal injuries .All cases were associated with visceral injuries .The surgical procedures done as related to the grade of injury has been studied .Also types of postoperative complications, morbidity & mortality related to the duodenal injury .We classified the duodenal injuries according to the American association .Surgical treatment into 5 grades .Table 1**Methods of**

operations -:Primary repair - :Usually in grade 2 duodenal injury we performed debridement & simple transverse two layers primary repair with tube drain.**Primary repair & tube duodenostomy** : -The tube introduced inside the duodenum for decompression with tube drain in the sub hepatic region .**Complex repair** - :This procedure was used for grade 3 injury as pyloric exclusion with gastro-jejunostomy or Roux-en-Y gastro-jejunostomy .

Repair with triple ostomies with or without duodenostomy .Morbidity was analyzed according to the duodenal injury & to the general morbidity – mortality that happened in the hospital .No deaths were noticed in patients after discharge from the hospital .(D.I.S.)clinical data .The clinical data of the (D.I.S.)shown in table 2Examination technique: Utilizing the spiral CT scan, somatom plus 4 model 1999 , k.v 140, MAS 120 , minute 39 sec.

Table 1 :Duodenum organ injury scale according to AAST (American Association for the Surgery of Trauma)

Grade		***Injury Description***
1.	Haematoma Laceration	Involving single portion of the duodenum partial thickness, no perforation.
2.	Haematoma Laceration	Involving more than one portion Disruption <50%mof circumference.
3.	Laceration	Disruption 50-75 %of circumference of D2 Disruption 50-100 %of circumference of D1,D3,D4
4.	Laceration	Disruption >75 %of circumference of D2 Involving ampulla or distal common bile duct.
5.	Laceration Vascular	Massive disruption of the duodenopancreatic complex. Devascularization of the duodenum

Table 2: Duodenal injury severity (D.I.S.)clinical data

Location	***G1***	***G2***	***G3***	***G4***	***G5***	***Total &%***
D1	0	4	0	0	1	5(11.9(%
D2	0	14	6	1	1	22(52%)
D3	0	3	3	0	0	6(14.3%)
D4	0	3	2	0	0	5(11.9%)
More than D	0	2	2	0	2(4.7%)	4(9.5%)
Total &%	0	26(61.9%)	13(31%)	1(2.4%)	1	42(100%)

Result:

During the 6 years period of study the incidence of (H.V.M.)duodenal injuries was)10.3 .(%42 patients of the 406 (H.V.M.)laparatomy had duodenal injuries, most of them were of the young age groups)10 – 50 (years, mean age 32 years .Males were predominant with 35 male 80%and 7 females 20 %all were (H.V.M)injuries .Table3.

Table 3 :Patient injury characters

	No .of patients	***%***
Gender		
Female	7	20
Male	35	80
Age	mean (50-10) age32 years	
H.V.M .injury	42	100
Shock	18	42.8
Duodenal severity		
G1	0	
G2	26	61.9
G3	13	31
G4	1	2.4
G5	2	4.7
Isolated duodenal injury.	0	
Duodenal other organ inj	42	100

Table 4 :Associated intra-abdominal injuries in 42 patients

Associated inj .Organ	***No.***
Liver	22
Pancreas	17
Stomach	17
Colon	16
S.bowel	14
V .cava	8
Kidney	9
Major vessels	6
Retroperitonialhaematoma	1
Diaphragm	2
Aorta	1
Spleen	0

Eighteen patients (42.8%)had haemorrhagic shock on admission in emergency room (E.R.)14 patients died peri-operatively (33.3%) .There were no isolated duodenal injury and all 42 patients had associated injured organs as Liver 22, Pancreas 17, Stomach 17, Colon 16, S .bowel 14, I .V . cava 8, Kidney 9, major vessels 6, retroperitoneal haematoma 1, diaphragm 2 & Aorta 1 patients.Table4

For the majority of the patients we did primary closure with tube drain in the sub hepatic space . Most of the patients were grade 2 (26 patients, 61.9%)& grade 3 (13 patients, 31%)duodenal injury . The duodenal -related & over all morbidity rate was high in grade 3 duodenal injuries .When the first choice was P.R .for grade 3 duodenal fistulae was higher than with C.R .All G3 cases repaired by P.R .were reoperated upon again with C.R .or P.R + .tube duodenostomy, these were 4 cases(9.5%)with G3 duodenal injuries where the first operation was P.R .reoperated again by C.R.., Other morbidity causes were sub hepatic abscess, pleural effusion , intra-abdominal abscess, wounds infection, stricture of V .cava .Table5.

9.5(4%)cases died post-operatively in the hospital because of the different complicationsof duodenal fistula, pancreatic fistula, biliary fistula & abscess formation

Table 5 :shows post-operative complications

complication	***No .of patients***
Infection	
-Wound infection	10
-Intraperitonial abscess	5
-Septicemia	1
Pulmonary	
-Atelectesis	4
-Pl .effusions	2
-Pnumonia	7
-Bleeding	30
Gastro-intest.	
-D .fistula	3
-Pancreatic fistula	2
-Biliary fistula	1

Discussion:

Although the frequency of duodenal injuries is low compared to other intra-abdominal visceral injuries; the high number of (H.V.M.)casualties during the violence in Iraq resulted in severe duodenal injuriesThese injuries have high probability of causing morbidity such as fistula formation & sepsis; also they have high mortality rates .Duodenal injuries should be considered complex when the injury is of high grades in severity or when associated with extensive injury to the pancreas or common bile duct or ampulla of vater .Duodenal trauma with an early diagnosis and prompt treatment can be managed effectively by simple surgical techniques .Severe duodenal injuries and those associated with major destruction of adjacent structures the pancreato-biliary or abdominal vessels require more thoughtful strategy .That incorporates a careful consideration of the physiologic stability of the patient and the extent of local destruction .During the period 2003-2008, 42 cases of duodenal injuries were managed and followed by the authors .The injuries were classified according to the (D.I.S.)classification and the anatomic location of the injury[1] .The morbidity & mortality were evaluated .In the literature, the most common penetrating factor is gunshot wounds (74.6%)followed by stab wounds (19.5%)and shotgun blasts (5.9%) .In our series, 90 %of cases were due to gunshot injury and 10 %due to blast injury .In the literature, the second portion of the duodenum is the most affected(35%), 3rd &4th portions injured in 15 %each. 1st portion is involved in 10 %and there are multiple injuries in 10 .%The pattern is similar in our series with the second portion involved in 52.4 %of cases . All the cases in our series were associated with other visceral injuries .All the cases presented as acute abdomen .The decision to explore was done on clinical grounds and in most cases there was no need for further investigations .Exploratory laparatomy remains the ultimate diagnostic test .Intra-operative assessment is essential .After controlling the hemorrhage, a thorough search is done for bile staining, bubbles of entrapped air in the peri–duodenal tissues and peri-duodenal hematoma . Kocherization of the entire duodenum is essential to facilitate inspection of first and second parts . Mobilization of the hepatic flexure and cephalic displacement of the small bowel is done to visualize the third part .Optimal management of duodenal injuries requires a complete assessment of the associated injury to the pancreas as well as the bile duct and the ampulla .Some authors advice intra-operative pancreatography if available to exclude injury to the adjacent pancreatic duct .Severe duodenal injury is associated with the following factors :(H.V.M.)injury, 1st or 2nd-part injury, injury-operation interval >24 hrs, adjacent C.B.D, peri-ampullary and or pancreas injuries .In the haemodynamicaly unstable patient the optimal treatment is an abbreviated laparatomy with

control of bleeding, rapid closure of G.I.T lacerations by suture or stapling .Provisional closure of skin and intensive care unit (I.C.U.)resuscitation (Damage control surgery). Restoration of the GIT continuity is accomplished at a secondary operation when the patient hypothermia, acidosis and coagulopathy have been corrected .

In our study the majority of operations were Primary repair 50% When we used P.R .in G3(D.I),there was high incidence of duodenal fistula 4/5 (80%); but when we did C.R .or PRTD in grade 3 injury there was no duodenal -related mortality .The main purpose of using more complex procedures is to exclude the duodenal repair from gastric secretions and allow time for adequate healing of the duodenal repair .In the literature about 45 %of cases require complex procedures for duodenal repair .One of these procedures is tube decompression or triple ostomies consisting of gastrostomy, duodenal tube and jejunostomy .Tube decompression can be achieved either antegrade proximal to injury site or retrograde via a jejunostomy .Cogbill et al; study showed that the tube duodenostomy was neither routinely necessary nor effective in preventing duodenal relate complications[2] .Another study reported no significant difference in duodenal fistula rate between patients treated with duodenorrhaphy and decompression and patient treated with duodenorrhaphy alone .The current preference is to avoid duodenostomy tubes and rely on pyloric exclusion procedures in complex injuries to protect the duodenal suture line .Another surgical option is resection and end-to-end anastomosis .This may help if there is a large defect in the wall and primary closure may narrow the lumen or cause tension on the suture lines a serosal patch of jejunum may help .Side-to-end,end-to-end Roux-en Y duodeno-jejunostomyor side-to-side duodeno-jejunostomy are other options .Pancreaticoduodenoctomy is a difficult choice reserved for patients with massive pancreatic haemorrhage, proximal pancreatic duct or peri-ampullary injuries which preclude reconstruction and combined devascularized injuries to the duodenum and head of pancreas .Overall mortality rate with this Whipple procedure is 33%, primarily related to associated vascular injuries.

In our study we found that PRTD prevented duodenal related morbidity in grade 3 injuries compared with P.R.; in our cases sever associated injuries were present which contributed to the morbidity of the duodenal injury .Extra -duodenal injury cases were associated with a high risk of postoperative morbidity. In our study, all cases had other visceral injuries so the overall morbidity was 46 %in comparing to the reported morbidity rates in other series 18 - %49%[2, 3] .Our fistula rate was 6 cases 14%; in the literature duodenal fistula rate was (0 -16.2%)[4]; our mortality rate was 33 % in 14 cases, the duodenal mortality rate is (10 – 29 %)[5] .We believe that C.R .has an important role in the management of duodenal injury but the majority of cases can be safely managed by P.R.; so we believe that C.R .is useful in G3 duodenal inj .Degiannis et al in a study from South Africa also agreed that the majority of duodenal injuries can be managed by simple repair .They confirmed that more complicated injuries require more sophisticated[6] .Bozkutr et al in a study from Turkey suggested that the use of primary repair in grade 3 injuries may be associated with higher duodenum-related morbidity; they recommended the use of complex repair for grade 3 duodenal injuries[7] .Velmahos et al; in a recent study from the U.S.A .concluded that pyloric exclusion is not necessary for all patients with severe duodenal injuries, they suggested that selected severe cases can be safely managed by simple primary repair[8].Ivatury et al found that decompressiveenterostomy&serosal patch might be associated with higher morbidity; P.R .in patient with extensive duodenal injury who could tolerate more extensive procedures may not be ideal for reducing post -operative duodenal related morbidity & mortality[9] .So C.R .should not be avoided in favor of simple repair in more extensive duodenal injury .As mentioned earlier, the most serious complication following treatment of duodenal injury is the development of a duodenal fistula .The management consists of extensive drainage, nutritional support by intra-venous hyper-alimentation or enteral feeding through a jejunostomy, drainage of all associated intra-abdominal abscesses and antibiotic therapy .If the patient has undergone duodenal exclusion

at the original operation, such fistula is an end fistula and will close on conservative management . If however a duodenal exclusion has not been performed and a high –output fistula persists beyond 3 weeks despite adequate drainage and nutritional support, duodenal exclusion at a re-exploration should be considered .It is important to mention a study done also at Al-Yarmouk Hospital in Baghdad by Rajab 9.He concluded that penetrating trauma abdominal index P.T.A.I should be included along with other injury severity indices because of its predictive value[10].

Conclusions:

- The most common site injured is the 2nd part of the duodenum .
- All of the cases have associated visceral injuries .
- The majority of the duodenal injuries can be managed by Primary Repair .
- G3 duodenal injury has high morbidity rate so we recommend using Complex Repair in G3 duodenal injury .
- Mortality rate increased if the time interval between injury & operation is more than 24hr.

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