



## The Incidence and Surgical Approaches of Pancreatic Injuries Following Blunt and Penetrating Abdominal Trauma in Al-Diwaniyah Teaching Hospital

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### Article History:

Received on: 12 Feb 2020

Revised on: 27 Mar 2020

Accepted on: 27 Apr 2020

### Keywords:

Pancreatic injury, abdominal trauma, surgical approaches

### ABSTRACT

The pancreas is a long J-shaped, soft, lobulated retroperitoneal organ. Pancreatic injury is relatively uncommon, occurring in 0.2–2 % of all trauma patients and 3–12 % of patients with abdominal injury. All traumatic pancreatic injuries are associated with significant morbidity with an overall rate of morbidity nearing 40%, higher grade pancreatic injuries are associated with higher rates of morbidity and mortality. To evaluate of surgical management of blunt and penetrating pancreatic trauma. During the period from January 2015 to September 2018, thirty patients with blunt and penetrating abdominal trauma were managed in emergency surgical department in Al-Diwaniyah Teaching Hospital and assigned in prospective a case control study. Patients with proved associated pancreatic injury (regardless of the degree) at the time of laparotomy were included in the study. The mean age of patients was 34.4 year (17- 57 years) among them there was 25 male (83.3 %) and 5 females (16.7%) The overall mortality rate is 20% (6 patients). The predominant mechanism of injury was penetrating 24 patients (80%) from gunshots and 6 patients with blunt abdominal trauma resulted from road traffic accidents). Pancreatic injury is infrequent in abdominal trauma. Its frequency is little different between blunt and penetrating abdominal trauma.



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ISSN: 0975-7538

DOI: <https://doi.org/10.26452/ijrps.v11i3.2532>

Production and Hosted by

IJRPS | [www.ijrps.com](http://www.ijrps.com)

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### INTRODUCTION

Pancreatic injury is relatively uncommon, occurring in 0.2–2 % of all trauma patients and 3–12 % of patients with abdominal injury (Vasquez *et al.*, 2001; Wisner, 1990). Pancreatic injury occurs predominantly in males (68–90 % male) and in the young (mean age 27–35 years) (Ilahi *et al.*, 2002;

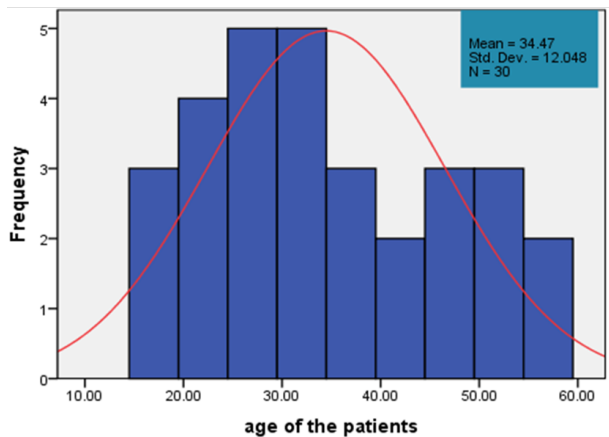
Cogbill *et al.*, 1991).

In the United States, penetrating trauma is responsible for the majority of pancreatic injuries in adults, 48–81 % (Ilahi *et al.*, 2002; Patton *et al.*, 1997; Smego *et al.*, 1985; Leppäniemi *et al.*, 1988; Heuer *et al.*, 2011). Outside of the United States, blunt trauma is the cause of the majority of pancreatic injuries (Linsenmaier *et al.*, 2008; Wong *et al.*, 1997).

In blunt injury, the pancreas is most commonly injured by crushing force applied to the upper abdomen resulting in compression of the pancreas against the lumbar vertebral column with crush injury or transection the region of the pancreatic neck. Blunt force to the right side of the abdomen may cause combined duodenal and pancreatic injuries as these structures are compressed against the vertebral column.

Pancreatic injury can range in severity from traumatic pancreatitis, contusions, and minor lacerations to complete gland transection and main pan-

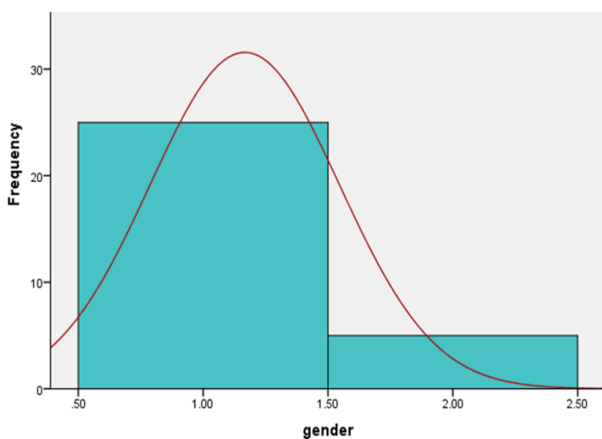
creatic ductal injury. Pancreatic injuries are classified and graded according to the damage to the pancreatic parenchyma and the ductal system.



**Figure 1: Age Distribution**

Grading of pancreatic injuries enables an exact description of injuries, can influence management, and allows a comparison of outcomes and effective quality control of treatment (Takishima *et al.*, 2000). There are several classification systems of traumatic pancreatic injuries (Scollay *et al.*, 2006; Kao *et al.*, 2003) but the pancreatic organ injury scale (OIS) proposed by the American Association for the Surgery of Trauma (AAST) fulfills most of these criteria and at present is the universally accepted classification scheme (Chinnery *et al.*, 2012). This OIS scale involves five grades, which concedes the significance of more complex injuries to the pancreas, and particularly those injuries affecting the pancreatic duct and the pancreatic head.

Double contrast (oral and intravenous) spiral computed tomography is routinely obtained unless the patient has peritoneal signs or other indications for abdominal exploration, and is the most frequent initial study for suspected pancreatic trauma (Lahiri and Bhattacharya, 2013).



**Figure 2: Gender Distribution**

With good radiographic contrast enhancement, the pancreas can be adequately visualized, and peripancreatic hematoma or fluid, or parenchymal disruptions identified. The findings on CT, which may indicate pancreatic injury include:

1. Peripancreatic fluid in the lesser sac;
2. Pancreatic hematoma or partial laceration;
3. Diffuse gland enlargement with pancreatitis or focal edema at the site of injury; and
4. Thickening of the left anterior renal fascia. These findings are often subtle.

An additional finding which is easy to recognize is the presence of fluid interdigitating between the pancreas and the splenic vein. It is important to remember that CT images showing laceration of the pancreatic body greater than 50 per cent significantly increase the likelihood of main pancreatic duct injury (Kao *et al.*, 2003).

While all traumatic pancreatic injuries are associated with significant morbidity with an overall rate of morbidity nearing 40%, higher grade pancreatic injuries are associated with higher rates of morbidity and mortality – Mortality rate for low grade injuries (AAST I and II) is estimated to be less than 10% – Mortality rate for higher grade injuries (AAST III and higher) increases to nearly 30%. Higher grade injuries typically require surgical management given ductal involvement (Menahem *et al.*, 2016; Boffard and Brooks, 2000).

**Table 1: Gender Distribution**

|        | Frequency | Percent |
|--------|-----------|---------|
| male   | 25        | 83.3    |
| female | 5         | 16.7    |
| Total  | 30        | 100.0   |

**Patients and methods**

During the period from January 2015 to September 2018, thirty patients with blunt and penetrating abdominal trauma were managed in emergency surgical department in al Diwaniya teaching hospital and assigned in prospective a case control study. Patients with proved associated pancreatic injury (regardless of the degree) at the time of laparotomy were included in the study.

All rescued patients were immediately admitted and receive the resuscitation according to ATLAS schedule, patients characteristic variable including patients demographic characteristics including

**Table 2: Mortality Rate**

|        | Frequency | Percent | Mortality     |                    |
|--------|-----------|---------|---------------|--------------------|
|        |           |         | Valid Percent | Cumulative Percent |
| none   | 24        | 80.0    | 80.0          | 80.0               |
| mortal | 6         | 20.0    | 20.0          | 100.0              |
| Total  | 30        | 100.0   | 100.0         |                    |

**Table 3: Mechanism of Pancreatic Injury**

|       |             | Frequency | Percent | Mechanism of Injury |                    |
|-------|-------------|-----------|---------|---------------------|--------------------|
|       |             |           |         | Valid Percent       | Cumulative Percent |
| Valid | blunt       | 6         | 20.0    | 20.0                | 20.0               |
|       | penetrating | 24        | 80.0    | 80.0                | 100.0              |
|       | Total       | 30        | 100.0   | 100.0               |                    |

**Table 4: Haemodynamic Stability**

|          | Haemodynamic Status |       |
|----------|---------------------|-------|
|          | Frequency           | %     |
| stable   | 10                  | 33.3  |
| unstable | 20                  | 66.7  |
| Total    | 30                  | 100.0 |

sex and age were tabulated., haemodynamic stability, mortality, morbidity, mechanism of injury, associated intra abdominal injury, grade of pancreatic injury and type of surgical technique of the pancreatic trauma were tabulated and assessed. All patients with blunt abdominal trauma who is haemodynamically stable or become so after resuscitation were subjected to abdominal CT scan. All patients were operated upon and surgery performed and /or supervised by specialist surgeon on duty. The pancreatic injury was graded according to American Association of the Surgery of Trauma classification of pancreatic trauma-Organ Injury Scale (AAST-OIS).

## RESULTS AND DISCUSSIONS

The mean age of patients was 34.4 year (17- 57 years) Figure 1 among them there was 25 male (83.3 %) and 5 females (16.7%). Table 1, Figure 2.

The overall mortality rate is 20% ( 6 patients) Table 2. The predominant mechanism of injury was penetrating 24 patients ( 80%) from gunshots and 6 patients with blunt abdominal trauma resulted from road traffic accidents Table 3.

About two third of patients (66.7%) was haemodynamically unstable at the time of arrival Table 4.

Isolated pancreatic glandular injury was a minority 10%, more commonly, the pancreatic injury was associated with multiple organs injury, vascular injury and complex pancreaticoduodenal injury (53.3%, 23.3%, 13.3% respectively) Table 5. Milder form Grade 1 and 2 pancreatic injury was the most frequent account for 83% of cases, while grade 3 and 4 account for about 13%, and the worst grade 5 injury represent a minority about 3% Table 6.

Regarding type of surgical action undertaken according to the degree (grade) of pancreatic damage, simple repair being the most commonly used(33.3%) followed by complex repair (26.7%), simple drainage( 13.3%), distal pancreatectomy (10%), diversion approach (10%) and damage control (6.7) Table 7.

The post-operative morbidity was predominantly( 76.7%) due to wound and cardio respiratory complication, however major morbidity like duodenal and pancreatic fistulae has occurred in 16.7% Table 8. An attempt to correlates the grade of pancreatic injury and associated other intra-abdominal organ injury, results declare a significant association p value 0.003.

Results also showed that there was no significant impact of the mechanism of injury (blunt vs penetrating) upon the mortality, but the presence of an associated organ injury and the higher grade of pancreatic damage was found to significantly increase the mortality p value 0.001. The association of the grade of pancreatic injury with the mechanism of injury and the hemodynamic status declared no significant association. Results also showed no significant association between the mechanism of injury and the presence of an associated organ injury.

Although abdominal trauma has worldwide commonness, the associated pancreatic accompaniment is rare account for less than 5% of abdominal trauma (Jurkovich and Bulger, 2004; Wind *et al.*, 1999) the incidence raise to 12% in penetrating injuries (Lin *et al.*, 2004; Wolf *et al.*, 2005).

Menahem *et al.* stated that the majority of pancreatic injury were caused by blunt abdominal trauma in European nations mostly due to road traffic accidents (Taggar and Coleman, 2016). This is not the case in countries with non strict legalization of firearms like the united states (Davis *et al.*, 1976; Young *et al.*, 1998; Petrone *et al.*, 2017).

In our country, the unabated use of firearms greatly amplified the incidence. Our data revealed that 80% of the injuries was penetrating entirely from shots from pistol, machine guns and shells. These weapons caused damage to the tissue along the passage track and the distant shock wave damage (Fabian *et al.*, 1990). No single case was reported in our series to cause pancreatic injury from stabbing accidents.

However, the remaining 20% was induced by blunt trauma mainly resulted from road traffic accidents, causing high energy shearing forces impacts upon the abdomen that damage the retroperitoneal organs among which the pancreas, kidneys and major vessels are the most vulnerable, the mechanics by which the pancreas injured in blunt trauma is by crushing against the vertebral column where the superior mesenteric vessels cross the neck of the pancreas (Akhrass *et al.*, 1997; Bradley *et al.*, 1998; Asensio *et al.*, 1999; Ewaid and Abed, 2017).

It has very high associated mortality probably not due to the pancreatic parenchymal damage per se, but the associated vascular and sold organ injuries. There has been wide range of estimated mortality from 20- 40% (Fabian *et al.*, 1990; Ewaid and Abed, 2017). Our data revealed an overall mortality rate of 20%. It has been found that the early mortality was attributed to the uncontrolled hemorrhage, late mortality cases were caused by uncontrolled septic complications, furthermore undue delay in the initiation of surgical management will enhance this rate (Ewaid and Abed, 2017; Ewaid *et al.*, 2019a,b; Al-Zaidy *et al.*, 2019). In our series mean patients' age was 34.4 year with male predominant sex (83.3 %), findings that is consistant with data published by Baradaran *et al.* and Ravinder *et al.* (Abed and Ali, 2017; Abed and Salim, 2019). Two third of our patients was haemodynamically unstable, factor that greatly predict associated other organ injury, and determine the necessity for immediate surgery. Pancreatic injury in isolation was a rarity in our

study account for only 10%, figure which greatly coincide with most published literatures (Petrone *et al.*, 2017; Abed and Salim, 2019; Abed *et al.*, 2019). More commonly pancreatic injury is part of multiple injuries involving more than one organ, in the present study other abdominal organ injury was very frequent including solid organs, viscera particularly the duodenum and vascular injury these results were comparable with the results Vasquez *et al.* and Memon *et al.* (Salim and Abed, 1926; Ewaid *et al.*, 2020). Grading of pancreatic damage as approved by the American Association for the Surgery of Trauma (AAST) (Bedirli *et al.*, 2003), is an important step in the management of pancreatic injury following abdominal trauma, in our series the most frequent grade was found to be grade 1 and 2 accounting for 83% of pancreatic injuries, followed by grade 3 and 4, while grade 5 was the least common, these figures are comparable with results published by Vasquez *et al.* and Young *et al.* who stated, grade 1 and 2 are the commonest type of injury specially after penetrating trauma (Salim and Abed, 1926; Tan *et al.*, 2009).

While slightly differ from other literatures which confirm that Grade 3, followed by grade 2, this difference probably attributed to the fact that the magnitude of trauma that cause higher grade pancreatic damage is likely to be associated with multiple organ damage and hemodynamic instability, those particular patient has less chance of hospital arrival in the stage of reversibility or my die before they rescued, other explanation probably arise from predominance of blunt abdominal trauma in these series.

Surgical treatment of the pancreatic damage is greatly influenced by many factors, the most important of which is the grade of pancreatic damage however other factors may interplay, including the hemodynamic stability, associated injury and the pancreatic duct integrity. Our data revealed, that simple suture repair and external drainage was the most frequent attempted action in grade 1 laceration and 2 injury. Complex repair was attempted in grade 2 and 3 injury. External drainage alone was done for grade 1 contusion. Diversion procedure was performed for selected cases of grade 3 and 4, finally distal pancreatectomy was adopted in sever grade 2 laceration and grade 3 injury. No single case was treated by pancreaticoduodenectomy, instead damage control procedure was adopted in critical situations. Comparisons with the results published by Benjamin *et al.*, Biffi *et al.* and Sharpe *et al.*, the great majority of patients operated for pancreatic trauma were managed by external drainage and only 4 patients underwent pancreatic resection.

**Table 5: Associated Injury**

| Associated injury                  | Frequency | Percent |
|------------------------------------|-----------|---------|
| multiple organ                     | 16        | 53.3    |
| isolated injury                    | 3         | 10.0    |
| complex pancreaticoduodenal injury | 4         | 13.3    |
| associated vascular injury         | 7         | 23.3    |
| Total                              | 30        | 100.0   |

**Table 6: Grades of pancreatic injury according to American Association of the Surgery of Trauma Classifications of Pancreatic Trauma – Organ Injury Scale(AAST-OIS)**

| Grade of pancreatic injury  | Frequency | Percent |
|---|-----------|---------|
| Grade 1<br>minor contusion without ductal injury                        | 13        | 43.3    |
| Grade 2<br>major contusion/laceration without ductal injury             | 12        | 40.0    |
| Grade 3<br>distal transection or parenchymal injury with ductal injury  | 2         | 6.7     |
| Grade 4<br>proximal transection or parenchymal injury involving ampulla | 2         | 6.7     |
| Grade 5<br>mass destruction of the pancreatic head.                     | 1         | 3.3     |
| Total   | 30        | 100.0   |

**Table 7: Type of Surgical Action**

| Type of pancreatic surgery | Frequency | Percent |
|----------------------------|-----------|---------|
| drainage                   | 4         | 13.3    |
| simple repair              | 10        | 33.3    |
| complex repair             | 8         | 26.7    |
| diversion approaches       | 3         | 10.0    |
| distal pancreatectomy      | 3         | 10.0    |
| damage control laprotomy   | 2         | 6.7     |
| Total                      | 30        | 100.0   |

**Table 8: Post Operative Morbidity**

| Morbidity            | Frequency | Percent |
|----------------------|-----------|---------|
| none                 | 2         | 6.7     |
| cardiorespiratory    | 8         | 26.7    |
| duodenal fistula     | 2         | 6.7     |
| pancreatic fistula   | 3         | 10.0    |
| wounds complications | 15        | 50.0    |

However they adopted a non operative management for hemodynamically stable patients with radiologically diagnosed pancreatic trauma (Taggar and Coleman, 2016). Conversely Fabian et al. prefer the closed drainage for all Grade 1 and 2 injury and he stated that an attempt to repair a capsular damage will lead to necrosis. In general the question, to resect or not in pancreatic trauma is still pending. Pancreatic trauma is associated with significant morbidity approaching 60% (Lin et al., 2004). In the present study, half of patients suffered from wound related complications (infection, seroma, disruption) and one quarter they suffered from cardiorespiratory complications (lung collapse, DVT and pulmonary embolism, myocardial infarction). However, the pancreatic related damage (and / or associated duodenal) were associated with 17 % morbidity (pancreatic and duodenal fistula). This morbidity rate was analogous to results published by Chinnery et al. and Akhrass et al. (Jurkovich and Bulger, 2004). Bradley et al. demonstrated a significant association between the pancreatic related complications and injury to the Wirsung duct. Our data declared that increasing grade of pancreatic injury would likely to be associated with other organ injury, a fact that has been published by Asensio et al. this finding can be explained by the fact that the pancreas is well surrounded by many vital organs and major vessels in an intimate or close proximity. Since the mechanism of injury is widely different between literatures influenced by public availability of firearms, wherefore the registered mortality will be different also. One series from Canada showed a higher mortality from penetrating injury than blunt trauma (22.2 VS 6.2). However our results showed no significant difference in the mortality rate between the two types of trauma, a finding also supported by data published by Jones RC who reported very convergent mortality rate between blunt and penetrating trauma on his large sample series. A finding which not stand beyond doubt, is the mortality rate is significantly associated with the presence of associated organ injury, which has been confirmed by many literatures (Fabian et al., 1990; Ewaid and Abed, 2017). For the mentioned reason of the protected and deep location of the gland and the intimate association with many vital organs, the more sever pancreatic damage (higher grade) the more associated mortality, this finding was prominent in our study and supported by others Ravinder et al. (Abed and Salim, 2019).

Our results failed to find a significant statistical association between the grade of pancreatic damage and the mechanism of injury, probably because of the small sample size, however Vasquez et al. demon-

strated a higher grade of pancreatic injury in penetrating abdominal trauma (Salim and Abed, 1926). On the other extreme Velmahos et al. and Krige et al. demonstrated higher grades of pancreatic injury with blunt trauma, they attributes this finding to the greater magnitude of trauma and associated organ injury. Furthermore, no significant association has been found between the grade of pancreatic injury and hemodynamic status, this finding appeared to be confusing, and contradict with data published by Tan et al , who stated that, Grade 3, 4 and 5 are more commonly presented with hemodynamic instability, this particularly true for blunt trauma due to the substantial force needed to fracture the pancreas is more likely to cause major abdominal injury and intra peritoneal hemorrhage, other possible explanation is that the rescue operation do not possess the enough speed and efficacy to hold the situation until full hospital management, so more victims of the high grade pancreatic injury and its associated hemodynamic instability will escape the registration. Moreover this non significant value my become so if the sample size is larger. In all patients with blunt abdominal trauma (100%), the pancreatic injury was associated with injury to other organs as compared to 87% of patients with penetrating injury, these values are consistent with the data of Vasquez et al who found that the isolated pancreatic injury is extremely rare and Associated intra-abdominal injuries occur in over 90% of cases. (Salim and Abed, 1926). Contrariwise to our results Iacono et al found a higher incidence of associated injury in penetrating trauma than blunt trauma.

## CONCLUSIONS

Pancreatic injury is infrequent in abdominal trauma. Its frequency is little different between blunt and penetrating abdominal trauma, with predominance of the latter in our country due to illegalized wide spread use of firearms. Young adult and middle age male are the most frequent victims. Pancreatic injury carries very high mortality and morbidity rate, the majority of whom are multiply injured and haemodynamically unstable at the time of presentation. Isolated pancreatic injury is rare after abdominal trauma. The vast majority of pancreatic injury are of grade 1 and 2. The presence of other associated injury greatly increase the mortality. We also conclude that the grade of pancreatic injury significantly associated with increased mortality and the presence of associated other organ injury, and it is not influenced by the mechanism of injury and presence has no impact on the haemodynamic stability. Neither the mortality nore the presence of asso-

ciated injury has a significant association with the mechanism of injury.

### Conflict of Interest

None.

### Funding Support

None.

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