Injuries of the pancreas

Branislav D. Stefanović1,2, Branislava D. Stefanović1,2, Aleksandar R. Karamarković1,3, Kristina S. Doklešiće, Vesna D. Bumbasirević2,3, Zlatibor M. Lončar1,3
1 Clinic for emergency surgery, Emergency center, Clinical center of Serbia, Belgrade
2 Department of anesthesiology and reanimatology, Emergency center, Clinical center of Serbia, Belgrade
3 Medical faculty University of Belgrade, Belgrade

Background: In spite of significant progress in diagnostics and surgery for pancreatic injuries in the last few decades, there have still been professional controversies about its management. Aim: Retrospective analysis of patients with pancreatic injuries, treated at the Clinic for Urgent Surgery of the Emergency Center, Clinical Center of Serbia (2003-2013), highlighting the relevant diagnostic and therapeutic aspects of the pancreatic injuries, present dilemmas, as well as review of post-operative complications and mortality. Methods: Statistical analysis. Results: In the abovementioned period, 60 patients with pancreatic injuries were treated. More than 50% of patients were managed by lesion suture and drainage. A total percentage of complications was 32.6% and an overall mortality was 18%. Conclusion: Management of pancreatic injuries might present a serious professional problem, even if managed by qualified and experienced teams in highly specialized (“high volume”) centers.

Key words: injuries, pancreas, complications, mortality

INTRODUCTION

Historical background. The injuries of pancreas were first described by Travers1 in 1827, using the autopsy material. In 1903, Mikulicz2 published 45 cases from the literature of that time. Newton3, in 1929, described the first successful reconstruction of the injured major pancreatic duct, and Whipple4 in 1946, suggested subtotal or total pancreatectomy for the extensive injuries of the pancreatic head and duodenum.

Incidence. Although the injuries of pancreas are relatively rare and tenth by frequency5, with the incidence of 1%-2%6, the increase of this number has been reported lately7. Pancreatic injuries are localized in the head and/or body region in 2/3 of cases8, and they occur in 50%-98% of time when associated with the injuries of other organs and/or organic system7,8.

Mechanism of injury. The injuries of pancreas may occur by high-energy direct force on the anterior-lateral abdominal wall (blunt trauma-27%), or may result from penetrating injuries of abdomen (73%)9. In blunt abdominal trauma, the pancreatic injuries occur due to compression and/or deceleration forces. In this situation, there is a contusion of pancreas against the lumbar spine and resulting disruption, what may be seen in traffic accidents (blow of the lower part of wheel onto the driver’s abdomen and/or tightening of safety belt), or even in children by blow of bike wheel into the epigastrium during the fall6,10,11. In distinction from this mechanism of injury, pancreatic lesions within penetrating abdominal injuries may be induced by cold weapon or firearms. Diagnosis. When the injury of this organ is suspected within the blunt abdominal trauma, the presence of general and non-specific signs such as abdominal pains, asthenia (weakness), fever, leukocytosis and higher C-reactive protein (CRP) values, the elevated serum amylase (and lipase) levels are relative and not a definite sign of pancreatic lesion. Similarly, determination of amylase level in the peritoneal lavage specimen, after diagnostic peritoneal lavage (DPL) has also indefinite value as diagnostic parameter. Native abdominal X-ray, except for finding of gas (air) in the peripancreatic area and retroperitoneum, indicating the possible pancreatic lesion associated with duodenal lesion, has no higher diagnostic significance in detection of pancreatic injuries9. Although the Focus Assessment Sonography of Trauma (FAST)12 is an initial “imaging” diagnostic method for detection of pancreatic injuries, multi-slice computed tomography (MSCT) is a “golden standard”10,11 for detection of these injuries. Magnetic resonance imaging (MRI, MRCP), endoscopic retrograde cholangiopancreatography (ERCP) and angiography are methods mostly reserved for highly
specialized tertiary level “A” centers, for patients who are hemodynamically stable, while during intraoperative exploration, an intraoperative ultrasonography, intraoperative endoscopy and intraoperative pancreatography may be available.

**Grading, scaling and scoring of pancreatic injuries.** Lucas classification of pancreatic injuries in 1977 \(^1\) is a baseline of the majority of subsequent classifications, which have been lately revised and amended by other authors \(^2\); this also applies to current most adopted classification which was recommended by the American Association for the Surgery of Trauma (AAST) in 1990\(^3\).

**Treatment.** The majority of pancreatic injuries is detected during exploratory laparotomy. During the exploration of abdomen, a specialist should explore the pancreas thoroughly from the cephalic to the caudal part, both from the anterior and posterior aspect, by opening widely the omental bursa through the gastrocolic ligament and omentum minus, strictly performing Kocher maneuver and spleen mobilization. Minor pancreatic lesions, involving the capsule rupture with superficial parenchymal lacerations (to 2 cm wide and 1 cm deep), and without opening the major pancreatic duct, are generally managed by suture and adequate drainage. The injuries of the body of pancreas, which are associated with the Wirsung duct lesion, are most often treated successfully by distal pancreatectomy, while the injuries of duodenocapsular region, associated with lesions of duodenum and/or great blood vessels require complex surgical intervention that will be discussed in details further in this paper.

Complications. A total percentage of complications in pancreatic injuries is 30%-60%\(^6\). General complications include hemorrhage (followed by coagulopathy) and sepsis, and they are at the same time most frequent causes of lethal outcome \(^6\); specific complications involve pancreatic fistula, abscess and pancreatic pseudocyst \(^7,10,11\).

Mortality. Until the beginning of 20\(^{th}\) century, the mortality from pancreatic injuries was 100%\(^3\); during the World War I-80%, World War II-56%, and during the Korea war this figure was reduced to 22%\(^6\). Today, an overall mortality from the pancreatic injuries varies from 9% - 34%\(^6\).

**MATERIAL, METHODS&RESULTS**

The study included retrograde statistical analysis of patients who were treated for pancreatic injuries at the Clinic for Urgent Surgery, Emergency Center, Clinical Center of Serbia, in the period 2003-2013. In this period, a total of 60 patients (50 males and 10 females, mean aged 42 years) were managed. There were 39 (65%) penetrating injuries, and 21 (35%) patients had abdominal blunt injuries. Twenty patients (33.2%) received the pancreatic injury in the traffic accident, 15 (24.9%) patients got the injury within the penetrating injury incurred by cold weapon, 6 (9.9%) patients were injured by firearms, and the rest of 19 patients (32%) was injured by other mechanisms.

![TABLE 1](table1.png)

**LUCAS GRADING OF INJURIES TO THE PANCREAS**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Injury</th>
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<tbody>
<tr>
<td>I</td>
<td>Simple superficial contusion or peripheral laceration with minimal parenchymal damage; any portion; intact pancreatic duct</td>
</tr>
<tr>
<td>II</td>
<td>Deep laceration, perforation or transection of the neck, body or tail of the pancreas, with or without duct injury</td>
</tr>
<tr>
<td>III</td>
<td>Severe crush, perforation or transection of the head of the pancreas, duct injury</td>
</tr>
<tr>
<td>IV</td>
<td>Combined pancreaticoduodenal injury; duct injury</td>
</tr>
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Elevated serum amylase levels (mean value 525 U/l) were recorded in 38 patients (63.8%). Upon the initial abdominal ultrasonography, for diagnosis verification, all patients were referred to contrast multi-slice computed tomography (MSCT) examination. This was the way to make diagnosis in 51 (84.6%) patients, i.e. the injury of pancreas.

Associated injuries were recorded in 41 (68%) patients, as follows: liver-8%, spleen-12%, stomach-5%, colon -7%, small intestine-9%, small intestine mesentery-6%, CNS-3% and chest-20%.

In 43 (71%) injuries, the injury was localized in the region of body or tail of pancreas, and the remaining 17 (29%) got the injury of cephalic region of pancreas. According to Lucas classification, 28 (47%) patients got injuries by type Lucas I, 18 (30%) by type Lucas II, 9 (15)-by Lucas III and 5 (8%) had the injury by type Lucas IV (Figure 1).

In 12 (20%) patients, the pancreatic injury was managed only by drainage (minor superficial hematomas and contusion foci), 26 (43%) patients underwent suture with drainage, 12 (20%) patients had distal pancreatectomy, 3 (5%) were subjected to duodenal diverticulization with triple diversion, and 7 (12%) had cephalic duodenopancreatectomy (Figure 2).

According to severity of injury and performed surgical intervention, all patients were treated in the intensive care unit (mean stay 12 days), during which period, other than permanent monitoring, adequate respiratory, cardiocirculatory, nutritional and immunological support was carried out; in addition, antibiotic therapy was administered according to drug susceptibility test and correction of coagulopathy was completed until full stabilization of hemogram and coagulation status.

A total percentage of postoperative complications after surgical management of pancreatic injuries was 32.6%. In postoperative course, the following postoperative complications were recorded (Figure 3) coagulo-
Injuries of the pancreas

Pathology-8%, septic syndrome-26%, pancreatic fistula-23%, pancreatic abscess-15% and pancreatic pseudocyst-6%.

Upon the analysis of material, a total mortality rate was 18%.

DISCUSSION

Pancreatic injuries in blunt trauma with indefinite symptomatology are serious diagnostic problem. In these situations, in any reasonable suspicion of pancreatic injury, additional necessary diagnostic procedures should be undergone as soon as possible, because the experience shows that as soon as the pancreatic injury is detected and managed, the postoperative morbidity and mortality are lower.

In 1943, Naffziger and McCorkle first detected the increase of serum amylase level in pancreatic injuries. Although some studies (Bradley, 1998) had pointed to degree of sensitivity of this laboratory parameter of 82%, subsequent studies have disproved such findings. This laboratory diagnostic indicator has very variable and relative degree of sensitivity (48%-85%) and specificity (0-81%). Hyperamylasemia, as diagnostic parameter of pancreatic injuries, depends on the time of blood sampling, where there is no statistical correlation between the degree of hyperamylasemia and severity of the injury. Moreover, the increase of serum amylases may be detected in gastric, duodenal and small intestine injuries and even in patients without any abdominal trauma but with CNS lesions (unknown central mechanism).

Although contrast multi-slice computed tomography (MSCT) has sensitivity and specificity of 70%-80% for detection of pancreatic injuries, the interpretation of CT findings depends largely on the quality of equipment, training and expertise, and experience of radiologist. In minority of cases, MSCT could present directly visible pancreatic lesion. More often, an indirect CT indicator of pancreatic injury is the presence of “3B” sign (blood, bile, bubbles) - that is, the finding of collection of blood, bile and/or air (gas) in peripancreatic bed and retroperitoneal space.

Jurkovich (15) reported that 50% of pancreatic injuries were Lucas I category, and 25% belonged to Lucas II type. Intraabdominal bleeding is the most frequent indication for urgent laparotomy and this is the situation when the largest number of pancreatic injuries is actually detected. Nevertheless, not a small number of the injuries of this organ is being overlooked. In such circumstances, a surgeon is often faced with the issue of surgical hemostasis due to massive bleeding, what distracts his attention and takes time. This is when the pancreatic injury is not paid enough attention, and, accordingly, it is put aside for a time being, neglected and finally completely overlooked.

Yet in 1929, Newton did successfully the first reparation of the injured Wirsung duct, and in the first half of 20th century, several more authors favored this technique (Pellegrini, 1959; Martin, 1967). In the following years, the majority of authors abandoned such surgical management of the lesioned pancreatic duct as uncertain and burdened by numerous early and late complications; they recommended far much safer method-distal splenohemipancreatectomy with obligatory identification and ligation of the major pancreatic duct (Balasegaram, 1979) (Jones, 1978). Andersen (1980) proposed a modification of distal pancreatectomy in trauma, meaning that the stapler (TA-55 Auto suture) would be used to make surgical resection and extraction of the body and tail of pancreas. Few years later, Robey suggested a preservation of the spleen within the pancreatic trauma when the body and tail were injured (“distal pancreatectomy with splenic preservation”). However, the results of this surgical technique pointed soon to higher risk of lienal vein thrombosis, significantly longer time of surgical intervention and higher postoperative morbidity.

FIGURE 1
GRADING OF INJURIES TO THE PANCREAS ACCORDING TO THE LUCAS SCALE

FIGURE 2
OPERATIVE TREATMENT OF THE INJURIES TO THE PANCREAS
According to attitude of many authors, solving the problem of adequate drainage of peripancreatic space and peritoneal recess after surgical management of pancreatic injuries lies in combined application of sump and soft Penrose drains 29,30.

Coagulopathy, as systemic complication, was recorded in 8% of our patients, and it always preceded, along with hypothermia and acidosis, the development of septic syndrome and multiorgan dysfunction, what was confirmed by other authors as well 6.

Our patients (23%), who got postoperative pancreatic fistula, mostly had “low output” pancreatic fistulas, with median range of secretion between 200-500 cc/m of pancreatic juice/24 h. After combined somatostatin therapy, enteral feeding (EF) and total parenteral nutrition (TPN), a great majority of these fistulas were spontaneously closed within 2-4 weeks, what was compatible with results of other authors 31. The results of some non-randomized studies 32 on successful use of Octreotide (synthetic somatostatin analogue), in combination with TPN, glucagon and calcitonin, for the treatment of posttraumatic pancreatic fistulas, have remained controversial 35,31.

Minor peripancreatic abscesses were treated by antibiotics (according to drug susceptibility test), and larger collections with X-ray-, US-, or CT-assisted percutaneous drainage, what was in the line with recommendations and experience of most authors 35. Also, our patients with posttraumatic pseudocysts of pancreas (15%) were treated on the similar way.

The analysis of specific mortality of large series indicates that the mortality, in isolated injuries of pancreas (both blunt and penetrating) accounts for 6%, while this proportion is 28% in case of the associated injuries. However, in firearms injuries, this rate figures out at 50.6% 6. Moreover, specific mortality depends on the presence/absence of shock, hemodynamic stability of a patient, localization of injury and association of pancreatic injury with other organs. Therefore, it is 6.9% in hemodynamically stable patients, and even 53.4% in patients who are in the state of hemorrhagic shock on admission 6. Finally, mortality depends upon the localization of injury as well. Therefore, mortality from the pancreatic tail injuries is 3.8%, from the pancreatic body injuries-21.6% while the lesions of the cephalic region associated with duodenal injuries result in mortality as high as 51.9% 6.

**CONCLUSION**

As the injuries of pancreas are relatively rare, the majority of surgeons, even those practicing urgent surgery within their narrow specialty, do not see many of them during their professional career. Therefore, the analyzed series of pancreatic injuries are relatively scarce in available literature. Today, there is still a large number of professional controversies related to diagnostic procedures and their surgical management. There is no unique or ideal operation that can manage the pancreatic injuries. Final treatment outcome of these injuries is, to a large extent, multifactorial and depends upon patient’s general
condition and age, mechanism of injury, presence/absence of hemorrhagic shock, lesion extent, association of lesion with other organ injuries, time from the injury to the onset of management, as well as the fact whether a patient is treated in “low volume” or “high volume” center. For all these reasons, this problem deserves further investigation for establishment of more specified standards, protocols and consensus regarding the complete treatment of pancreatic injuries.

SUMMARY

POVREDE PANKREASA

Uvod: Uprkos značajnom napretku koji je tokom poslednjih decenija načinjen u dijagnostici i operativnoj zbrinjavanju povreda pankreas, još uvek postoje stručne dileme i kontroverse u vezi sa njihovim rešavanjem. Cilj: Retrospektivna analiza pacijenata sa povredama pankreas, lečenim na Klinici za uredženje povreda pankreas. Suturovanje je vreme lečenja. Rezultati: U pomenutom period lečenje je bilo 60 bolesnika sa povredom pankreas. Suturovanje je bilo u većem broju pacijenata (50%). Ukupan procenat komplikacija je iznosio 32.6%, a ukupni mortalitet 21%. Zaključak: Zbrinjavanje povreda pankreas može predstavljati ozbiljan stručni problem, čak i kada se rešava od strane iskusnih timova u visoko-spezijalizovanim (“high volume”) centrima.

Kljucne reči: pankreas, trauma, dijagnoza, lečenje, komplikacije.

REFERENCES