Nonoperative Management of Pancreato-Duodenal Injuries

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Abstract

Following injuries to the pancreas and duodenum (PDI) patients often present in extremis and undergo immediate laparotomy for hemodynamic instability and peritoneal signs. Nonoperative management (NOM) may be offered in selected patients with low-grade injuries. Precise mapping of the injury, most commonly by computed tomography, is a prerequisite for NOM because clinical symptomatology can be variable and misleading. Additionally, delaying the treatment of PDI that should be corrected surgically may lead to significant complications. Therefore, NOM of PDI presents unique challenges, and the decision-making is not as straightforward as it is with NOM of other solid abdominal organs. Essentially, only duodenal hematomas without full-thickness wall perforation (Grade I and selected II) and pancreatic trauma without major duct involvement (Grade I and selected II) could be offered NOM. In these cases, the reported success rates vary from 74 to 95%. There are also a few severe pancreatic injuries that can be managed by stents with adequate reconstitution of the major pancreatic duct integrity and resolution of symptoms and without the need for operative management. Intensive monitoring and follow-up by clinical examination and repeat CT imaging is essential in these patients, as the risk of complications, and particularly a pseudocyst is high.

Key Words

Pancreatic injuries · Duodenal injuries · Nonoperative management · Endoscopic retrograde cholangiopacreatography

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Introduction

The technologic improvements of computed tomography (CT), the use of angiographic embolization, and advancements in critical care have greatly enhanced the ability to offer nonoperative management (NOM) in trauma patients. Solid abdominal organs have been increasingly treated by NOM in recent years, and the outcomes have been superior to those produced after surgical intervention. The majority of blunt splenic and liver injuries undergo NOM with over 90% success rate [1] and a great safety record [2, 3]. NOM principles have transferred in penetrating trauma with similar outcomes. In the largest reported series of abdominal gunshot wounds of the anterior or posterior abdomen, 42% of the patients were managed nonoperatively with 90% success rate [2]. For verified penetrating solid organ injuries, NOM has been applied successfully to 28, 15, and 4% of patients with liver, kidney, and spleen injuries, respectively [3].

Pancreatic and/or duodenal injuries (PDI) are associated with significant morbidity and mortality, and present clinical and technical challenges for the treating physician. Although the death rate is reported to be up to 32% for pancreatic and 25% for duodenal injuries [4, 5], most of the deaths are due to hemorrhage and associated injuries (liver, stomach, large vessels) and not directly related to the PDI. NOM of PDI has been offered for low-grade injuries and with justifiable reluctance. Hemodynamically stable patients without clinical symptoms have been candidates for NOM.

Diagnosis

Due to the retroperitoneal location of the duodenum and pancreas, the clinical manifestations of injury are often subtle. Abdominal tenderness in the right upper quadrant or epigastrium may be minimal or absent on initial presentation, but serial assessments increase the diagnostic value of the clinical examination. In the presence of undiagnosed injury, abdominal tenderness almost always develops within 12–48 h from admission although the late onset of symptoms has also reported [6]. The potential lack of alarming signs and symptoms require the suspicion of the treating physician, based on the mechanism, site, and direction of injury [7, 8]. Evidence of direct impact on the upper abdomen, such as lower rib fractures, soft tissue ecchymosis, supraumbilical seat belt sign, and upper lumbar spine fractures in patients after motor vehicle collision should raise questions regarding the involvement of the pancreas and duodenum.

PDI have been classified by the American Association for the Surgery of Trauma (Tables 1, 2) and include lacerations and hematomas [9]. This classification corresponds with outcomes (the higher the grade, the worse the outcome) and allows management decisions, comparison of results among centers, and standardization of care.

Serum amylase has been used as a laboratory marker for PDI. The low specificity of the test has been demonstrated with studies showing hyperamylasemia in 80% of the 61 patients with nonpancreatic traumatic shock [10]. Similarly, in 85 patients with blunt trauma the amylase level was increased in 53%, while only one patient was diagnosed with a pancreatic injury [11]. Two series of 56 and 35 children with pancreatic trauma reported 70 and 77% sensitivity of hyperamylasemia, respectively [12, 13]. In one study, 65% of the patients with pancreatic and 83% of the patients with hollow-visceral injuries had normal amylase levels on admission [14]. In a multicenter study on 101 patients with blunt pancreatic injury, 73% had abnormal serum amylase on admission and 89% had hyperamylasemia in serial measurements [15]. A report on 73 patients with blunt pancreatic trauma supports that even if the initial amylase can be unreliable, abnormal levels will be found within 3 h from injury and recommends that patients with suspected injury to have repeat blood draws at 3 h [16]. A study on 22 children with pancreatic injuries suggested that serial amylase levels could be used to identify patients with major pancreatic injuries [17].

The role of amylase for duodenal injuries has not been as well evaluated. In a small study on 24 children with blunt duodenal trauma, amylase levels did not differentiate patients with hematoma and patients with perforation [18]. Furthermore, a large multicenter review on 2,249 patients with small bowel injury demonstrated that the initial amylase value, although significantly different compared to matched patients without an injury, did not differentiate between patients with perforated and nonperforated injuries (93.7 vs. 102.7 U/l, p = NS) [19]. The authors noted that despite the statistical significance, there was significant overlap between normal and abnormal levels and patients with and without injury and no clear cutoff point could be used to help identify patients with injury. Of note, only 12% of the study population had isolated duodenal injury.

Computed tomography is currently the standard of care for the diagnosis of pancreatic injuries. CT findings suggestive of pancreatic injury include: intraperitoneal fluid, fluid in the lesser sac, retroperitoneal fluid, pancreatic edema or hematoma, thickening of the anterior renal fascia, fluid between the pancreas and the splenic vein, and a line of transection at the site of injury [20]. In a multicenter study on 101 patients with blunt pancreatic injury, CT was performed on 37 patients [15]. When compared with operative findings, CT had a 71% overall sensitivity in identifying the pancreatic injury, 64% accuracy in detecting the exact grade of injury, and 41% sensitivity in identifying ductal involvement. Similar results have been reported by others, with a sensitivity of CT for pancreatic injury identification ranging

Table 1. Duodenal organ injury scale by the American Association for the Surgery of Trauma. (D1 = first portion of the duodenum, D2 = second portion, D3 = third portion, D4 = forth portion).

Grade	Type	Description
I	Hematoma	Involving a single portion of the duodenum
	Laceration	Partial thickness without perforation
II	Hematoma	Involving more than one portion
	Laceration	Disruption of > 50% of the circumference
III	Laceration	Disruption of 50–75% of the circumference of D2
		Disruption of 50–100% of the circumference of D1, D3 or D4
IV	Laceration	Disruption of > 75% of the circumference of D2
		Disruption involving ampulla or common pancreatic duct
V	Laceration	Massive disruption of pancreas-duodenum
	Vascular	Devascularization of the duodenum

Table 2. Pancreatic organ injury scale by the American Association for the Surgery of Trauma.

Grade	Type	Description
I	Hematoma	Minor contusion without duct injury
	Laceration	Superficial laceration without duct injury
II	Hematoma	Major contusion without duct injury or tissue loss
	Laceration	Major laceration without duct injury or tissue loss
III	Laceration	Distal transection or parenchymal injury with duct injury
IV	Laceration	Proximal transection or parenchymal injury involving the ampulla
V	Laceration	Massive disruption of pancreatic head

between 47 and 85% [12, 21–24]. In a recent review of 50 patients with blunt pancreatic injury, a subgroup analysis of 11 patients with ductal injury underlined the role of CT for this patient population (91% sensitivity and 91% specificity) [25]. It is important to realize that most of the above suboptimal results have been produced with older-technology CT scanners. As helical CT is being now delivered by 16-slice and 64-slice scanners, the quality and accuracy of the images are expected to be much higher and remain to be evaluated in a prospective study.

CT findings indicative of duodenal injury include periduodenal tissue edema, duodenal wall thickening, extravasation of vascular or enteric contrast agent, and the presence of free air. The combination of free fluid, free air, and bowel wall thickening on CT had 75% sensitivity and 79% specificity in identifying small bowel injury in a multicenter study. Although duodenal injuries represented a small portion of the sample size, CT findings were unable to differentiate between perforated and nonperforated injuries overall, and 13% of the patients with perforated injuries had no CT findings [19]. Similarly, a multicenter study on 30 patients with blunt duodenal rupture showed that 27% of the patients who underwent CT prior to laparotomy had no radiographic findings [26]. In contrast to these data, another study on 27 pediatric trauma patients reported that all patients with full-thickness perforation had CT evidence of retroperitoneal air or contrast extravasation [27]. As stated above, most of these studies report the efficacy of single-slice or 4-slice scanners and do not reflect the current technology. It is expected that with the improved protocols and resolution of new scanners, the diagnostic accuracy will be significantly better [28].

Endoscopic retrograde cholangio-pangreatography (ERCP) has been used in selected pancreatic injuries with 100% positive predictive value in identifying major duct involvement [29–33]. Uncommonly used as a first-line test, ERCP becomes useful in patients with delayed presentation (with the late onset of pain or post-traumatic pseudocysts) [30, 34–36]. Houben et al. [37] reported on 15 pediatric trauma patients with pancreatic injuries all of whom but two presented with a delay. In 11 patients who underwent CT and ERCP imaging, ERCP identified four injuries completely missed or poorly defined by CT. Furthermore, magnetic resonance cholangio-pancreatography (MRCP) was utilized in seven patients, of whom four had also ERCP; both modalities identified the pancreatic injury, but in one case the MRCP missed the pancreatic duct injury despite identifying correctly a parenchymal tear.

Nonoperative Management

Selected patients can be safely managed by NOM. In a retrospective multicenter study on 173 pediatric trauma patients with blunt pancreatic injuries, NOM was successful in 74% [38]. The remaining patients were taken to the operating room for intraperitoneal air on CT or hemodynamic instability. NOM has been successful in 89–94% of the pediatric patients with duodenal hematomas and not full thickness lacerations [18, 39]. In a study on 24 pediatric trauma patients with duodenal injuries, 17 patients with hematomas were successfully managed by NOM, whereas two with radiologic evidence of complete obstruction underwent surgical exploration [18].

Although routine repeat imaging in the NOM of solid organ injuries has not shown benefit [40], data for PDI suggest a role for repeat evaluation. In a small report on six pediatric trauma patients with blunt pancreatic ductal injury, the initial CT was normal in five patients; in subsequent CT imaging fluid in the lesser sac was present in five [30]. Similar results, proving the increased sensitivity of CT as time from admission to imaging is greater, have been reported on both pediatric and adult patients with pancreatic injury [31, 41]. A study on the timing of CT diagnosis in 21 patients with blunt duodenal injury, demonstrated that CT was more sensitive after 6 h from admission [42]. Since most patients present to the ED after short transfer times from the scene and undergo early CT evaluation, the study supports the value of repeat CT imaging in stable patients with duodenal injuries.

The efficacy of ERCP-placed stents in nonoperatively managed ductal injuries has been reported to successfully restore the lumen integrity and patency or facilitate proximal drainage after ampullary stening [32]. Houben et al. [37] reported on 15 pediatric trauma patients with pancreatic injuries; 12 underwent ERCP and 9 had a stent placed into the fluid collection or in the distal duct. In two cases, stent placement was unsuccessful due to tortuous duct anatomy in one patient and pancreas divisum in another. The authors reported transient rise in serum amylase in five and increased abdominal pain in two patients. All stents were removed at a median of 127 days after placement. In adults, a prospective study on 23 patients with pancreatic injury reported three stents placed (24 h, 36 h, and 4 days after admission) in patients with major duct injury and contrast extravasation in the parenchyma [43]. The follow-up at 3 months demonstrated complete resolution of the leak. The NOM of post-traumatic pseudocysts is also described in a series of five patients with successful drainage in all five [44]. However, a report on long-term follow-up of six patients with major duct injury who underwent ERCP and stent placement (8 h to 22 days after admission) describes one death related to sepsis and four cases of duct stricture [45]. Stent removal was successful in four patients, early on in one (at 59 days) and later on the other three (12, 19, and 39 months, respectively). Initial data, while limited, illustrate a potential role for stent placement in stable patients with ductal injury, but further research of the optimal indications and outcomes is necessary to determine the exact subpopulation that will benefit from this method.

Serial clinical examination by an experienced surgeon is advocated as the most important principle of NOM for trauma patients; repeated assessment for abdominal tenderness and signs of peritoneal inflammation is crucial to detect the need for acute surgical intervention [46]. Organized trauma teams provide the full-time coverage and consistency that is required to monitor such patients diligently [47, 48]. In our institution, we have developed a specialized dedicated 23-h observation unit (Trauma Rapid Assessment Care Unit, TRACU), where trauma patients undergoing NOM are admitted and followed. The monitoring equipment, increased nurse-to-patient ratio, priority in urgent imaging evaluation, and the awareness of the trauma team ensure proper assessment and follow-up of these patients.

Outcomes

In a prospective study on 23 patients with blunt pancreatic injury, three patients with major duct injury underwent ERCP and stent placement, and three with minor duct injuries diagnosed with ERCP, were managed expectantly with no stent. One patient died due to colonic rupture and two developed pseudocyst [43]. A multicenter study reported on 128 pediatric trauma patients who underwent successful NOM, while 45 failed it [38]. Pancreatitis developed in 26 patients, pseudocyst in 12, and fistula in 2. In the subgroup of 30 patients with ductal injury (morbidity data were available for 18), pancreatitis developed in 6 patients, pseudocysts in 9 and fistula in 1. When comparing Grade III pancreatic injuries in 11 patients with available morbidity data, there was no significant difference in complication rates between patients with successful and failed NOM, despite the increased severity of the patients with ductal injury who failed NOM (16 ± 11 vs. 29 ± 16, $p = 0.025$). Pseudocyst formation following NOM of pancreatic injuries is approximately 45–50% [13, 49, 50].

Patients selected for NOM are hemodynamically stable and without major associated abdominal injuries. Since the high mortality of PDI is mostly related to intra-abdominal bleeding and concurrent injuries [51, 52], the low mortality in patients who undergo NOM could be attributed to the decreased severity of injury [38]. Nevertheless, NOM is associated with decreased mortality compared to historic controls and should be considered in stable patients with PDI. Post-traumatic pseudocyst development emphasizes the need for follow-up of these patients in order to diagnose the complication and plan its management.

Summary

There are two types of PDI patients who can be managed by NOM:

1. Patients with low-grade duodenal or pancreatic (Grade I or selected II) injuries: Grade I or II duodenal hematomas (involving one or more portions of the duodenum) can be managed without an operation for as long as there is no long-term obstruction and no full thickness laceration of the bowel wall. Grade I or II pancreatic hematomas can similarly be managed by NOM. Grade II lacerations (no major duct involvement) can be offered a trial of NOM with the understanding that pancreatitis or a pseudocyst may form.
2. Patients with a higher grade of pancreatic injury (grade III or IV): These are uncommon cases in which the patient is either asymptomatic or not a candidate

for safe surgical intervention due to major derangement of the physiologic condition from trauma and/or co-morbidities. In these patients, ERCP with stenting is a valid alternative and the risk of complications significant.

All patients with full-thickness duodenal lacerations and the majority of patients with pancreatic lacerations of grade III and higher should be operated on, if diagnosed early. It is important to realize that NOM is not the ''conservative'' approach but rather the radical one. It requires intensive monitoring, increased awareness, detailed knowledge of the physiology, and – above all – an experienced physician by the bedside.

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