

Blunt Transection of the Pancreas Treated by Distal Pancreatectomy, Splenic Salvage and Hyperalimentation

Four Cases and Review of the Literature

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The increasing awareness among surgeons of overwhelming postsplenectomy sepsis has led to new and innovative procedures to save the spleen. In pancreatic transection injuries (Type II)²⁶ the classical treatment has been distal pancreatectomy and splenectomy. The opportunity to treat several patients with pancreatic transections sustained during blunt abdominal trauma lead to the review of the literature on the subject. Particular attention was paid to treatment of these injuries using distal pancreatectomy with splenic salvage, appropriate drainage, and hyperalimentation. Associated complications were likewise investigated and reviewed.

FOUR CASES of blunt transection of the body of the pancreas were treated at the Naval Regional Medical Center in Portsmouth, Virginia from 1976 to 1980 (Table 1). The patients ranged in age from 17 to 24 years. Three of the four patients presented with very minimal signs and symptoms of abdominal injury and subsequently developed evidence of peritoneal irritation. There was a delay of six to 48 hours from the time of injury until surgery. Preoperative serum amylase was elevated in each instance.

Materials and Methods

Each case was treated surgically by distal pancreatectomy, with special attention given to splenic salvage. Splenectomy was necessary in only one instance. The pancreatic duct was ligated with nonabsorbable suture when identified. Interrupted sutures were used to close the edge of the pancreas in cases 3 and 4. In cases 1 and 2, the duct was not identified, and the edge of the pancreas was left open. Soft sump and Penrose drains were placed in the region of the pancreatic bed and in the

lesser sac in all cases. The skin wounds were managed by delayed primary closure.

In case 1 an initial attempt at splenic salvage was attempted, but during the dissection of the distal pancreatic fragment from the splenic vessels, the distal splenic vein entered the pancreatic parenchyma and was ligated. Because of this and the prolonged time from injury to operation, splenectomy was performed to facilitate the operation.

After operation, nasogastric suction was maintained until gastrointestinal function returned. Oral feedings were delayed for ten to 12 days, and each patient received intravenous hyperalimentation for approximately two weeks. The drains remained from five to seven days.

Results

The hospital course of patient 3 was complicated by bleeding from gastric stress ulcers and by atelectasis, however, he and the others were discharged in good condition following a hospital stay of approximately two and one-half weeks.

Discussion

Injury to the pancreas occurs in nearly 2% of blunt abdominal trauma.⁸ A significant number of these are transections. The original description of blunt transection of the pancreas was by Travers⁴⁰ in 1827 (Table 2). The first intra-abdominal exploration for pancreatic transection was in 1895 by Villiere.⁴¹ Walton⁴² in 1923 first suggested distal pancreatectomy for injury to the pancreas based on Mayo's²⁸ distal pancreatectomy for iatrogenic transection of the pancreas during splenec-

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TABLE 1. Cases

Date	Sex	Age	Mode of Injury	Type of Injury	Delay	Signs Symptoms	Serum Amylase	Procedure	Complication	Hospital Stay
1. 1976	M	24	assault	trans. body	48h.	tenderness rigidity	500	distal panc'y., splen'y.	—	18d.
2. 1977	M	20	dropped 175 lbs. on abd.	trans. body	12h.	distention rebound	1024	distal panc'y.	—	19d.
3. 1978	M	17	wire in path of motor-cycle	trans. body	12h.	tenderness rigidity	312	distal panc'y.	UGI bleed atelectasis	18d.
4. 1979	F	21	auto accident	trans. body	6h.	hypotension tenderness	3000	distal panc'y.	—	18d.

tomy. Distal pancreatectomy was first used successfully for blunt transection of the pancreas in 1955 by Hannon and Sprafka¹⁸ and reinforced as a procedure of choice by Weitzman and Rothschild⁴³ in 1968. Other methods of repair have included attempts at direct repair of the duct of Wirsung,^{11,38,32,34} implantation of the distal pancreatic fragment into a Roux-en-Y jejunal loop,²⁵ and drainage of both proximal and distal segments of the pancreas into a Roux-en-Y loop²³ (Table 3). No modern series has yet emphasized the need for splenic salvage and the technical feasibility of saving the spleen during distal pancreatectomy.

Acute forcible compression of the pancreas against the vertebral column is the mechanism of injury in blunt abdominal trauma. Disruption of pancreatic tissue and fracture of the intrapancreatic ductal system with release of exocrine enzymes causes necrosis of tissue and retroperitoneal irritation with extravasation of plasma. Injury of the pancreatic vessels results in hemorrhage into the peripancreatic retroperitoneum.

Associated injury commonly involves the liver, duodenum, or spleen as well as other intra-abdominal organs and vessels.^{1,15,22,33,45} Mortality from blunt pancreatic injuries ranges from 16 to 20%.^{4,14,22} A review of several series (Table 4) shows a mortality of approximately 17%. The presence of associated injuries,^{15,23} hypotension,³³ pancreatic ductal injury,¹⁹ and injury to

the pancreatic head³ correlate best with subsequent death.¹⁰

Diagnosis of blunt pancreatic injury depends on a high index of suspicion in any person sustaining blunt abdominal trauma. The patient usually presents with mild or even absent physical signs of injury. Mild abdominal tenderness is a common initial finding. However, the gradual development over the ensuing six to eight hours of involuntary guarding, rebound tenderness, and diminished bowel sounds should arouse suspicion of pancreatic injury. Indeed, the patient may well appear to have acute pancreatitis with signs of hypovolemia and toxicity.

Laboratory examination usually suggests hemoconcentration showing an increased hematocrit secondary to extravasation of plasma into the peripancreatic tissues. Serum and urinary amylase is increased in 91% of patients with blunt pancreatic trauma.^{22,33} Serial amylase determinations may add to the diagnostic predictability.^{19,33}

Plain abdominal radiographs usually provide no distinctive findings in pancreatic trauma.³⁰ Upper gastrointestinal radiographic examination with water soluble contrast material has been used to identify accompanying duodenal rupture,^{9,26} but gives no help in the diagnosis of isolated pancreatic injury.

Peritoneal lavage has been used to detect elevated

TABLE 2. History Pancreatic Transection and Repair

Description of pancreatic transection-----	Travers	1827
Description of isolated pancreatic transection -----	Jaun	1856
Exploration for pancreatic transection -----	Villiere	1895
Attempted repair of pancreatic transection -----	Garre	1905
Distal pancreatectomy for iatrogenic transection-----	Mayo	1913
Suggested distal pancreatectomy for traumatic injury-----	Walton	1923
Distal pancreatectomy for blunt pancreatic transection -----	Kinniard	1954
Successful distal pancreatectomy for blunt transection -----	Hannon and Sprafka	1955

TABLE 3. Other Methods of Repair

Attempted repair of duct-----	Newton	1929
Roux-en-Y anastomosis, distal pancreatojejunostomy-----	Letton and Wilson	1929
Intubation of pancreatic duct, sphincterotomy, distal pancreatectomy-----	Doubilet and Mulholland	1958
Intubation of pancreatic duct, sphincterotomy, and suture of pancreas-----	Pelligrini and Stein	1959
Roux-en-Y anastomosis, proximal and distal pancreatojejunostomy-----	Jones and Shires	1964
Intubation of pancreatic duct with suture of the duct and pancreatic capsule-----	Martin, Henderson, and Walsh	1967

amylase levels in the abdominal cavity. The primary indication for peritoneal lavage, however, is the detection of associated intra-abdominal injury.³³

The decision to treat blunt abdominal injury by operative intervention is based on the results of physical examination and pertinent laboratory findings. The presence of symptoms and signs of peritoneal irritation on initial evaluation or the development of such during an observation period warrants exploration of the abdomen. Elevated serum amylase has also been used as a sole indication for exploratory laparotomy to ensure proper treatment of pancreatic injuries.¹

Once the decision to perform leparotomy for blunt abdominal trauma has been made, it is essential to adhere to certain basic guidelines in examining the pancreas. The most important step in assessing the nature of pancreatic injury is examination of the entire pancreas. It is imperative that all hematomas of the upper retroperitoneum be explored. All adjacent structures must be carefully examined. Division of the ligament of Treitz and the Kocher maneuver will allow visualization of the third and fourth portions of the duodenum and the head of the pancreas. Generous division of the gastrocolic omentum will allow adequate exposure of the lesser sac.

After evaluation of the pancreas and search for associated injury has been accomplished, classification of the severity of injury is necessary to formulate a plan for adequate surgical repair. The classification in Table 5 uses location of pancreatic injury, (body and tail vs. head), presence of ductal injury, and presence of duodenal injury as criteria for separation into the classes I through IV of progressively more severe injury.²⁶

Fundamentals of surgical repair of types III and IV pancreatic injuries consist of distal pancreatectomy with debridement of all necrotic and traumatized tissue, meticulous hemostasis, and adequate drainage of the pancreatic bed. Classically, distal pancreatectomy for transection injuries of the pancreas has included splenec-

TABLE 4. Mortality

	Blunt Injuries	Deaths
Anane-Sefah	10	0
Anderson	25	14
Babb	21	0
Bach	34	7
Graham	100	15
Heitsch	21	2
Jones	74	13
Meier	16	3
Steele	30	8
White	27	1
	358	63
		17.6%

TABLE 5. Classification

Class I: Contusion, peripheral laceration, intact ductal system.
Class II: Distal laceration, transection, disruption; suspected ductal disruption; no duodenal injury.
Class III: Proximal laceration, transection disruption; suspected ductal injury; no duodenal injury.
Class IV: Severe combine pancreaticoduodenal disruption.

TABLE 6. Complications

	Cases	Drain	Fistula	Pseudocyst	Abscess
Anane-Sefah	19		2	0	0
Graham	58	P	16	—	—
Heitsch	16	SP	1	0	1
Jones	30	—	2	0	1
Smith	9	—	1	0	1
Steele	26	—	6	0	0
Weitzman	8	—	0	0	0
Yellin	60	SP	5	1	8
	226		33	1	11
			14.6%	0.6%	6.6%

S = sump.
 P = penrose.

tomy.^{18,24} Indeed, current literature includes rare cases of splenic salvage during distal pancreatectomy for blunt trauma.^{5,9,21,26,45} Preservation of splenic tissue by Roux-en-Y pancreaticojejunostomy in children has been described¹⁶ in order to avoid long-term complications following splenectomy, especially sepsis. Splenic salvage during distal pancreatectomy is possible by careful dissection of the pancreatic tail from the splenic hilum. Meticulous dissection of several small arteries and veins arising from the splenic vessels in the retroperitoneum is carried out, but in two of the cases the force of the injury itself had accomplished separation of the pancreas

TABLE 7. Pancreatic Endocrine Insufficiency (after distal pancreatectomy)

	Cases	Persistent Hyperglycemia
Anane-Sefah	19	0
Anderson	17	0
Babb	17	0
Bach	20	2
Balasegaram	49	0
Graham	58	0
Heitsch	16	0
Jones	30	3
Karl	5	0
Smith	9	0
Steele	26	0
Weitzman	8	0
White	15	0
Yellin	60	1
	348	6
		1.7%

from its retroperitoneal structures. Simple pressure using a large abdominal pad allowed adequate hemostasis after the distal pancreatectomy was completed by blunt dissection. Autotransplantation of splenic tissue may prove to be a viable alternative in the remaining instances,⁷ but was not performed in the earliest case (Case 1). The pancreatic duct is ligated with nonabsorbable sutures when possible.⁴⁵ Drainage is accomplished by placement of soft sump and Penrose drains.²

The more common postoperative complications following distal pancreatectomy are fistula formation, intra-abdominal abscess, pseudocyst formation, prolonged pancreatitis, and sepsis. In this series, splenic salvage did not seem to have any deleterious effects, and no patient required re-exploration for hemorrhage or abscess formation. A review of several series of distal pancreatectomy performed for either blunt or penetrating pancreatic injury from 1968 to 1978 gives an idea of the frequency of postoperative complications (Table 6). Approximately 15% of the cases developed fistulae. Less than 7% were complicated by intra-abdominal abscess, and less than 1% developed pseudocyst.

The type of drains used are indicated when available. The use of soft sump drains in addition to Penrose drains has been shown to be associated with fewer postoperative complications in pancreatic injury.² However, it is impossible to correlate the drainage methods with the incidence of fistula formation in the series reviewed because of the lack of uniformity in describing postoperative fistula. The presence of drainage immediately after operation,¹⁵ four weeks after surgery,³³ and at the time of discharge⁴⁵ were all used to identify major postoperative fistula formation by various series. None of the fistulae required surgical treatment.

Concern for pancreatic insufficiency following distal pancreatectomy has stimulated development of technically more difficult and time-consuming procedures. However, of 72 cases of distal pancreatectomy through 1969,³³ only one instance of pancreatic endocrine insufficiency occurred.¹³ A review of more recent series shows only six of 348 cases resulting in insulin deficiency (Table 7). These results are not surprising in view of Dragstedt's¹¹ resection of 90% of a dog's pancreas without impairment of insulin production in 1943. Concern for pancreatic endocrine insufficiency seems unwarranted. Hyperalimentation and GI tract rest are an integral part of postoperative management. The use of hyperalimentation combined with complete gastrointestinal tract rest has been shown to decrease the output of pancreatic juices.³⁹

Hyperalimentation and complete bowel rest have been used to facilitate closure of pancreatoduodenal fistulae because of this finding.¹² The combination is also felt to prevent prolonged postoperative pancreatitis.⁴⁴ It

is possible that hyperalimentation and bowel rest will decrease the incidence of fistula or pseudocyst formation following pancreatic trauma when instituted immediately after operation.

Discussion

In conclusion, a high index of suspicion is necessary to avoid overlooking blunt pancreatic injury. Early operative intervention with distal pancreatectomy is the treatment of choice for transection injuries. Preservation of splenic tissue is performed whenever feasible. The use of soft sump drains decreases the complication rate. Postoperative bowel rest and hyperalimentation are felt to do the same. Fistula formation is the most common postoperative complication. Endocrine insufficiency is rare.

Distal pancreatectomy has been used successfully for transection injuries of the pancreas many times over the last 25 years. It is less time-consuming and is less difficult to perform than several other proposed surgical repairs. The addition of techniques to preserve the spleen seems logical and appropriate in these cases to avoid subsequent septic complications now well known to occur in the adult. This approach does not lengthen the operative time or increase the known complications of distal pancreatectomy. This approach combined with adequate drainage of the retroperitoneal space, bowel rest, and hyperalimentation is the favored procedure in a traumatized patient with a transection injury of the pancreas.

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