Management of Combined Pancreatoduodenal Injuries

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From 1969 to 1985, 129 patients with combined pancreatoduodenal injuries were treated at one urban trauma center. A total of 104 patients (80.6%) had penetrating wounds, and multiple visceral and vascular injuries were usually associated with the pancreatoduodenal injury. Primary repair or resection of one or both organs coupled with pyloric exclusion and gastrojejunostomy (68 patients) and drainage was used in 79 patients (61.2%) in the entire study and in 59% (36 of 61) of all patients treated since 1976. Simple primary repair of one or both organs and drainage was performed in 31 patients (24%), whereas the remaining 19 patients (14.8%) had pancreatoduodenectomies (13 patients) or no repair before exsanguination (six patients). Major pancreatoduodenal complications occurring in the 108 patients surviving more than 48 hours included pancreatic fistulas (25.9%), intra-abdominal abscess formation (16.6%), and duodenal fistulas (6.5%). The overall mortality rate for the study was 29.5% (38 of 129). The acute mortality rate with these injuries will remain high secondary to injuries to associated organs and vascular structures. The morbidity and late mortality rates related to the moderate to severe pancreatoduodenal injury itself can be decreased by the addition of pyloric exclusion and gastrojejunostomy to the primary repairs.

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COMBINED INJURIES to the pancreas and duodenum are among the most complicated traumatic gastrointestinal lesions being treated today. As in patients with other abdominal injuries, the perioperative mortality rate is related to the severity of the pancreatoduodenal injury and the number and magnitude of associated injuries. Late morbidity and mortality rates after surgery, however, are often influenced by the type of repairs used for the pancreatoduodenal injury. With injuries of moderate severity to either organ, the formation of fistulas leading to breakdown of adjacent repairs and secondary hemorrhage has been frequently reported.[1-5]

In the past 15 years, a variety of operative procedures have been used for the treatment of injuries to either the pancreas or the duodenum; however, few reports have emphasized results when combined pancreatoduodenal injuries are being treated. This is a report of a recent 18-year experience with 129 consecutive patients with combined pancreatoduodenal injuries. All patients were treated at the Ben Taub General Hospital, a Level I trauma center affiliated with the Baylor College of Medicine in Houston, Texas, from 1968 to 1985.

Methods

Resuscitation and evaluation of patients in the emergency center changed on several occasions during the long time interval of the review. Diagnostic peritoneal lavage was first used on a regular basis in evaluating patients with no symptoms or minimal symptoms after blunt abdominal trauma in 1978. In 1980, the use of diagnostic peritoneal lavage was extended to asymptomatic patients with stab wounds to the anterior abdomen that were found to have penetrated the peritoneum on local wound exploration.[6] Throughout the period of the review, patients with symptoms after blunt trauma to the abdomen; stab wounds to the lower chest, anterior abdomen, or back; or gunshot or shotgun wounds with peritoneal traverse were taken to surgery after resuscitation with crystalloid solutions and type-specific packed red blood cells.

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TABLE 1. *Mechanism of Injury*

Mechanism	Number (%)
Penetrating	
GSW	82
SW	15 (80.6)
SGW	7
Blunt	25 (19.4)

GSW = gunshot wound; SW = stab wound; SGW = shotgun wound.

Intravenous pyelography was performed in stable patients with hematuria after blunt abdominal trauma and in all stable patients with penetrating wounds to the abdomen who were to have celiotomy. Perioperative antibiotics were given to patients with blunt trauma to the abdomen if the surgeon chose to use them and to all patients with perforating wounds to the intra-abdominal gastrointestinal tract other than the esophagus, under rigidly controlled protocols.[7,8]

In patients with profound shock and a massively distended abdomen secondary to a hemoperitoneum, thoracotomies were performed on occasion in either the emergency center or operating room to allow for cross-clamping of the descending thoracic aorta before or concurrent with celiotomy.[9]

A midline incision was used to enter the abdomen, and all blood and gastrointestinal content was evacuated manually and with a suction device. Complete visualization of the anterior pancreas was generally accomplished by division of the gastrocolic omentum and a Kocher maneuver. If visualization of the posterior pancreas was required, division of the retroperitoneum inferior to the pancreas and medial mobilization of the tail of the pancreas and spleen were performed. Complete visualization of the duodenum was attained by an extensive Kocher maneuver and complete mobilization at the ligament of Treitz; on rare occasions the ascending colon and small bowel were mobilized, as well, to allow for a better view of the third portion of the duodenum.[10]

Pancreatic contusions or capsular lacerations not involving the duct were treated by the insertion of soft Penrose drains, which were left in place for 10–14 days.

TABLE 2. *Location of Injury in Pancreas and Duodenum*

Location	Number
Duodenum	
First	9
Second	58
Third	22
Fourth	10
Multiple	30
Pancreas	
Head or uncinate	101
Body	21
Tail	7

On occasion, a nonabsorbable continuous suture was used to reapproximate the sides of a pancreatic laceration. Transections of the pancreatic duct at or to the left of the superior mesenteric vessels were most commonly treated by distal pancreatectomy with splenectomy. On rate occasions, the transection of the gland was completed, the proximal duct ligated at the site of transection, and a Roux-en-Y limb used to drain the distal segment.[11] Transections of the duct in the head of the pancreas or at the ampulla of Vater were treated by pyloric exclusion with gastrojejunostomy and drainage or an extensive resection such as a Whipple procedure.[12]

Simple duodenal perforations, blowouts, or through-and-through injuries were treated with a two-layer suture repair; on occasion, Penrose drains were inserted and left in place for 7–10 days. Complete transections, large lacerations, or injuries involving loss of a portion of the duodenal wall were treated with a two-layer suture repair, pyloric exclusion with gastrojejunostomy, and drainage. Extensive injuries involving destruction or devascularization of a portion of the duodenum were treated by resection, closure as possible, pyloric exclusion with gastrojejunostomy and drainage, or by an extensive resection such as a Whipple procedure.

As noted above, combined pancreatoduodenal injuries with moderate to severe injury to either organ, especially the duodenum, were treated by the addition of pyloric exclusion with gastrojejunostomy during the entire time period of the review. The technique has been well described in a number of recent publications[1,3,12] and will be reviewed only briefly here. Once the most dependent portion of the greater curvature has been isolated, a gastrotomy is performed. The pyloric ring is grasped with one or two Babcock clamps and elevated into view. The pyloric orifice is then closed with a double row of continuous sutures or with a single purse-string suture. Exclusions have been performed with either nonabsorbable monofilament polypropylene or absorbable polyglycolic acid sutures since 1977.[3] In general, for the exclusions performed in association with the more severe pancreatoduodenal injuries, polypropylene sutures have been used in order to prolong or even make "permanent" the closure of the pylorus. A two-layer antecolic gastrojejunostomy is then completed at the site of the gastrotomy.

For the purposes of this review, a pancreatic fistula was defined as Penrose drainage with an amylase content greater than that of serum. A duodenal fistula was defined as Penrose drainage with both an amylase and bilirubin content greater than that of serum. Intra-abdominal abcessess after surgery were diagnosed by ultrasonographic examination and confirmed by obtaining bacterial cultures with positive results at the time of percutaneous drainage or reoperation.

Data reviewed in this study were obtained from a previous publication on the same topic covering the years 1968–1976[1] and from the charts of the 61 patients treated between January 1977 through December 1985.

Results

From January 1968 through December 1985, 129 patients or seven patients per year with combined pancreatoduodenal injuries were treated. More than 88% were male patients, and the average age was 29 years. The most common mechanism of injury was a penetrating wound (104 of 129 = 80.6%), and gunshot wounds accounted for 78.8% (82 of 104) of these (Table 1). The head of the pancreas and the second portion of the duodenum were the most frequently injured areas, and multiple duodenal injuries were present in 30 patients (Table 2). A total of 437 associated injuries or 3.4 per patient occurred, with the most common being to the liver (47.3% of patients), colon (34.1%), stomach (33.3%), small bowel (29.5%), kidney (27.1%), and inferior vena cava (25.6%).

As in the previous study, patients with combined pancreatoduodenal injuries were assigned to one of four groups, based on the choice of operative repair (Table 3). Patients in group II, the largest in the study, were treated by various repairs. Included in this group were 79 patients (61.2% of entire study) who had a combination of a duodenal repair or resection and a pancreatic repair, distal resection, or Roux-en-Y. In every instance, however, either repair was more than a simple closure or the repair was felt to be tenuous and a pyloric exclusion with a gastrojejunostomy was added (68 of 79 = 86.1%) for diversion of the upper gastrointestinal tract. Since 1976, 59% (36 of 61) of all patients in the study have had a pyloric exclusion in addition to some type of repair. In group I, there were 31 patients (24%) who had smaller injuries and were treated with simple repair(s) with drainage. The Whipple procedure or a total pancreatoduodenectomy was required in the 13 patients in group III, while six patients in Group IV died in the operating room before any type of repair could be completed.

TABLE 3. *Operative Procedures*

Procedure	Number (%)
I. Simple repair; drainage	31 (24)
II. Duodenal repair or resection; pancreatic repair, distal resection, or Roux-en-Y; with or without pyloric exclusion; drainage	79 (61.2)
With exclusion	68
Without exclusion	11
III. Pancreatoduodenectomy	13 (10.1)
Whipple	10
Total	3
IV. None	6 (4.7)
Total	129 (100.0)

"Pancreatoduodenal" Complications (Table 4)

In the 108 patients surviving more than 48 hours, the most common "pancreatoduodenal" complication was the formation of a pancreatic fistula, which occurred in 28 (25.9%). It is of interest that the rate of fistula formation was 37.2% (22 or 59) from 1968 to 1976 and only 12.2% (6 of 49) from 1977 to 1985. The longest period of drainage for any pancreatic fistula was 3 months, with most (69.2%) closing within 2 weeks. Although no patients required reoperation for a pancreatic fistula before 1981, it has been necessary in two patients since that time. The first patient was a 22-year-old man who had a high output pancreatic fistula develop from the head of the pancreas after a stab wound that also injured the second portion of the duodenum, liver, common bile duct, gastroduodenal artery, lower ribs on the right, and multiple lumbar vessels. He had sepsis in the early period after surgery and had reoperation on the 11th day after surgery, at which time both pancreatic and biliary fistulas and peripancreatic and subhepatic abscesses were drained. His pancreatic fistula subsequently closed. The second patient was a 47-year-old man who had a Whipple procedure because of extensive injuries to the head of the pancreas and duodenum after a motor vehicle accident. He had an early pancreatic fistula develop that was redrained on the ninth day after surgery. He required further reoperations on days, 13, 24, 35, and 51 after surgery for several intra-abdominal complications before he died. He was the only patient in the entire study whose death could be related to the presence of a pancreatic fistula.

The second most common "pancreatoduodenal" complication in the 108 patients surviving more than 48 hours was the formation of an intra-abdominal fluid collection or abscess, which occurred in 18 (16.1%). Percutaneous drainage or a reoperation was required in all of these patients, and five subsequently died of multiple organ failure. It should be noted that the average number of intra-abdominal visceral or vascular injuries in this group of patients was 5.2.

The third most common "pancreatoduodenal" complication was the formation of a duodenal fistula, which

TABLE 4. *"Pancreatoduodenal" Complications in 108 Patients Surviving More than 48 Hours*

Complication	Number (%)
Pancreatic fistula	28 (25.9%)
Intra-abdominal abscess	18 (16.6%)
Duodenal fistula	7 (6.5%)

TABLE 5. *Cause of Late Deaths in 17 Patients*

Cause	Number
Sepsis; multiple organ failure	9*
Respiratory failure	5
Hemorrhagic pancreatitis	1
Pulmonary embolus	1
Cerebral injury	1

* Includes one pancreatic abscess.

occurred in seven patients (6.5%). Five of these closed spontaneously, while two required reoperation for improved drainage; however, no deaths occurred in this small group of patients. Five of the seven patients had severe duodenal injuries in which pyloric exclusion with gastrojejunostomy was used as an adjunct to protect the duodenal repair. One of the other two patients had a simple duodenorrhaphy that broke down after an intra-abdominal abscess formed adjacent to it. This patient had a pyloric exclusion (not included in Table 3) on the 134th day after surgery, and the duodenal fistula subsequently closed. The other patient with a fistula originally required a duodenal resection with reanastomosis as well as a Roux-en-Y pancreatojejunostomy for repair of a pancreatic transection.

Other Common Complications

Acute respiratory failure, pneumonia, or atelectasis occurred in 14 patients (13%) surviving more than 48 hours and was the most common systemic complication. Renal failure occurring in seven patients (6.5%) was the next most common complication. Intra-abdominal gastrointestinal and biliary fistulas were also common and occurred in 10 instances (five enteric, two gastric, two biliary, one colonic).

Mortality Rate

The overall mortality rate was 29.4% (38 of 129), with 55.3% (21 of 38) of patients dying within 48 hours of injury secondary to hypovolemic shock and transfusion-associated coagulopathies. Six or more intra-abdominal visceral or vascular injuries were present in 15 (71.4%) patients with perioperative deaths. In the four patients who died in the perioperative period since 1981, the average operative blood loss was 32 units.

Seventeen patients died (17 of 38 = 44.7%) in the late postoperative period, with sepsis and/or multiple organ failure (nine patients) and respiratory failure (five patients) accounting for most deaths (Table 5). One of the patients with sepsis died from a pancreatic abscess, while two died of multiple organ failure after emergent Whipple procedures. In the other three patients with late deaths, one had hemorrhagic pancreatitis develop and died from prolonged shock. Six or more intra-abdominal visceral or vascular injuries were present in nine (52.9%) patients with late deaths. Since 1981, the only two late deaths have occurred in the patients with emergent Whipple procedures.

If the operative procedure is compared with the mortality rate (Table 6), both simple repairs with drainage and more complex repairs with or without pyloric exclusion had mortality rates (22.8–25.8%) that were approximately half that of an emergent Whipple procedure or total pancreatoduodenectomy (46.2%).

TABLE 6. *Operative Procedures* versus *Mortality Rate*

Procedure		Mortality Rate Number (%)
I. Simple repair; drainage	31	8 (25.8)
II. Duodenal repair or resection; pancreatic repair, distal resection, or Roux-en-Y; with or without pyloric exclusion; drainage	79	18 (22.8)
III. Pancreatoduodenectomy	13	6 (46.2)
IV. None	6	6 (100.0)
Total	129	38 (29.4)

Outcome of Pyloric Exclusion

Partial follow-up of a much larger study of patients treated with the pyloric exclusion procedure for severe duodenal injuries between 1969 and 1980 has previously been published.[3] From 1981 to 1985, 13 patients had pyloric exclusion procedures for combined pancreatoduodenal injuries. Follow-up information in the form of an upper gastrointestinal x-ray after surgery (eight patients) or upper endoscopic examination after surgery (one patient) was available in nine patients (69.2%) and is summarized in Table 7.

Discussion

Because there is little consensus on the treatment of individual injuries to the pancreas or duodenum, it is not surprising that there is little agreement on the operative management of the combined injury. The lack of a unified approach is a reflection of both the wide variety of injuries that may occur in these organs, as well as the large number of operative procedures currently available. Also, comparisons between various forms of treatment are often difficult to interpret because of the rarity of solitary injuries to these organs, the lack of a uniformly acceptable classification system of injury, and the small number of patients in individual treatment groups.

A conservative approach to pancreatic injuries has emerged in recent years.[13,14] With contusions or lacera-

TABLE 7. *Follow-up of Nine Patients with Pyloric Exclusion Performed from 1981 to 1985*

Patient	Suture Used	Follow-up	Postoperative Interval	Status of Pylorus
1	0 polypropylene	UGI	9th day	Closed
2	0 polyglycolic acid	Endoscopy	58 weeks	Open; duodenal ulcers present
3	1 polypropylene	UGI	34 weeks	Open
4	1 polypropylene	UGI	8th day	Closed
5	2–0 polyglycolic acid	UGI	27th day	Small opening
6	2–0 polypropylene	UGI	37th day	Small opening
7	?	UGI	10th day	Closed
			22nd day	Open
8	3–0 polypropylene	UGI	20 weeks	Open
9	0 polypropylene	UGI	11th day	Small opening

UGI = upper gastrointestinal study.

tions not involving the main duct, either open Penrose drainage or closed sump drainage for a variable length of time is practiced in most centers[2,13–16]; however, not all surgeons agree with this approach.[17] Ductal transections away from the head are usually managed by distal pancreatectomy, most commonly with the loss of the spleen in adult patients.[2,13,14,16] When transection of the duct will lead to an 80% distal resection, a Roux-en-Y limb to the distal pancreatic segment is indicated in the patient whose condition is stable to lower the late incidence of diabetes mellitus.[2] If transection of the pancreatic duct is in question, some centers have advocated operative pancreatography through the duodenum[14] or through the distal duct after caudal pancreatectomy with splenectomy.[19] Although the ability to determine ductal transection with operative pancreatography appears to be excellent, most experienced trauma surgeons continue to use local inspection and exploration of the defect in the pancreas in order to decide if a major distal resection needs to be performed. This eliminates the need for a duodenotomy in the presence of a pancreatic injury and is quite accurate in assessing ductal injury.[1,2,13,14] Even if a pancreatic fistula results from a missed ductal injury, some of these will close without reoperation.[13] When a ductal disruption occurs in the head of the pancreas, a Roux-en-Y loop to the area of injury has been used in the past. Recent experience, however, from the original advocates of this approach, shows a marked decrease in use.[2] Pancreatoduodenectomy is reserved for patients with ductal disruption in the head of the pancreas with associated injuries to the duodenum and common bile duct, significant injury to the ampulla of Vater, or uncontrolled hemorrhage from the head of the pancreas. On rare occasions, it may be required to manage hemorrhage from the retropancreatic portal vein. The listed indications are present in only 2–3% of patients with pancreatic injuries in most studies.[2,13,14] Although the operation can be performed with remarkable success in traumatized patients who are stable,[20] the continuing 30–40% mortality rate in this study and others suggests that it should be used rarely.[21,22] In essence, solitary pancreatic injuries are rarely the source of significant morbidity or mortality rates, but the retroperitoneal location of the organ makes solitary injuries unusual. When other upper abdominal visceral and vascular injuries are present, the mortality rate with pancreatic injuries in large studies ranges from 15 to 20%.[2,13]

Although a simple two-layer closure is appropriate treatment for a small duodenal perforation or blowout,[23,24] a more aggressive approach to moderate to severe duodenal injuries has evolved in recent years.[3,5,12,25–30] This is a reflection of the significant morbidity rate that may result when a fistula is adjacent to other gastrointestinal or vascular repairs in the upper abdomen.

Duodenal "diverticulization" is an example of the aggressive approach and includes an antrectomy with a gastrojejunostomy and a tube duodenostomy. On occasion, truncal vagotomy and a choledochostomy may also be performed.[25,26] The diverticulization diverts the gastrointestinal stream away from the repaired duodenum, while the tube duodenostomy vents the area of repair. This technique is used in many centers but has the disadvantages of resecting normal tissue (antrum) and creating a second hole in an injured duodenum.

Pyloric exclusion has been used at the Ben Taub General Hospital on a consistent basis since the early 1970s and at the Denver General Hospital in recent years.[3,12,29] The basic principle of diversion of the gastrointestinal stream away from the healing duodenum is similar to that for the duodenal "diverticulization"; however, no normal tissue is removed, and the diversion is temporary because the pylorus reopens in 90–95% of patients at 2–3 weeks, as noted in this report. There continues to be much concern about the ulcerogenic potential of this operation when a truncal vagotomy is not performed. Although the studies from this hospital have reported isolated patients who have had marginal ulcers develop late after an exclusion has been performed,[1,3,12] it should be noted that the author of this paper (DVF) has never

had to reoperate on a patient with a marginal ulcer in 8 years as a full-time attending surgeon at Ben Taub.

Stone's use of duodenal decompression by gastrostomy and retrograde jejunostomy in association with a feeding jejunostomy is the third major technique of diversion or decompression currently being used for moderate to severe duodenal injuries.[5] The technique has had remarkable success in his hands but has not gained widespread use in trauma centers because of the need to create both gastrotomy and jejunotomy incisions in the patient who already has a significant duodenal wound.

Combined pancreatoduodenal injuries are most commonly caused by penetrating wounds in patients who routinely have other multiple intra-abdominal injuries. Because of the large number of combinations of injuries to the pancreas and duodenum that may occur, no one form of therapy is appropriate for all patients. Simple repairs with drainage were used in only 24% of patients in this study. The magnitude of the combined injuries prompted the performance of a pyloric exclusion with gastrojejunostomy as an adjunct for diversion in more than 50% of patients in the entire study and in 59% of patients treated since 1976. The low number of pancreatic fistulas (two) and duodenal fistulas (two) requiring reoperation in the study is felt to reflect the improved healing of the pancreatoduodenal complex when exclusion is used for moderate to severe injuries. In contrast, the significant number of intra-abdominal abscesses reflects the magnitude and multitude of intra-abdominal injuries.

The mortality rate with these injuries continues to be higher than for injuries to either organ alone,[1,22,31] and approximately 50% of all deaths occur in the perioperative period. Sepsis and multiple organ failure account for more than 80% of late deaths; however, neither commonly results from the management of the original pancreatoduodenal injury. Of the 17 late deaths occurring in this study, only the patient with hemorrhagic pancreatitis and the patient with a pancreatic fistula leading to multiple organ failure after an emergent Whipple procedure can be considered to have had true "pancreatoduodenal" deaths.

Conclusion

From a review of the operative treatment of 129 patients with combined pancreatoduodenal injuries treated over a recent 18-year period, the following conclusions can be drawn: (1) Simple perforations or ruptures of the duodenum combined with nonductal pancreatic injuries should be treated with primary repair and drainage. (2) More extensive duodenal injuries combined with pancreatic injuries not involving the duct in the head should be treated with repair or resection as indicated for both organs, pyloric exclusion with gastrojejunostomy, and drainage. (3) When the duodenum is devascularized, the pancreatic duct in the head transected, or the ampulla of Vater is destroyed, either a Roux-en-Y drainage procedure or Whipple procedure can be considered if the patient's condition is stable. If the patient's condition is unstable, a conservative resection, pyloric exclusion with gastrojejunostomy, and drainage should be performed.

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Discussion

DR. GEORGE. M. WATKINS (Tampa, Florida): Mother Nature performed a superb job of DRG planning by placing many of the organs of death under the protection of the lower rib cage or the pelvis. This protection resulted in the complexing of these organs in the right upper quadrant.

When penetrating injuries occur in the duodenopancreatic area, the colon, liver, associated major blood vessels, and the kidney are often involved. Two situations are set up: one, perioperative death from hemorrhage or immediate or short-term organ failure; second, major probabilities exist for late death and morbidity from sepsis and prolonged organ failure.

About 1977, as a reversal of roles we had today, I believe, Dr. Paul Jordan noted that there were only 47 survivors of the Whipple operation for trauma in the world at that time. Perhaps he convinced the group in the other hospital at Baylor to do less Whipple procedures. In the current manuscript there were only three Whipple procedures done from about 1980–1985.

The Whipple procedure, a formidable operation in the elective situation, rarely would succeed in circumstances that Dr. Feliciano has described. With blunt trauma, the rare patient requiring a radical operation is much more likely to have a unisystem disease and could undergo such a procedure.

As Dr. Feliciano notes in his manuscript, the properly drained pancreas is not a life-and-death problem even if a ductal injury is missed at original exploration. The problem is injury to the duodenum in the face of feces, blood, and a cold patient with coagulopathy.

Few trauma surgeons would argue with the Baylor's conclusions of treating simple injuries simply and using a variant of the pyloric exclusion in complex situations if at all possible.

My questions then are more detail than type of operation. With the lateral-to-medial injuries coming in from the side, going through the medial wall of the duodenum into the pancreas, I know no other way than to suture the inner wall of the duodenum from the inside and take my chances that pancreatic juice may dissolve that inner wall. I would like you to comment on that particular method of closure.

If the kidney is damaged along with the pancreas, we advocate peritoneal or omental compartmentalization and separate drainage for the kidney and pancreas. Urine mixing with pancreatic juice increases the activity of pancreatic secretions and, at least theoretically and probably, incidence of pancreatitis.

With Dr. Rhodes sitting in front of me and Dr. Dudrick in the back of the room knowing my interest in hyperalimentation, I hate to put the next forward. The works of Sheldon, MacArdle, Alexander, E. Moore, and ourselves suggest that the enteral route of feeding is preferable for lessening the prevention of immunologic and perhaps body cell mass deficiencies, thereby reducing death and morbidity in people who have long-term or very serious injuries.

Is not the 15 minutes for a duodenostomy drainage tube, a gastrostomy, and a catheter jejunostomy worth the time taken, at least the latter?

Finally, I am tempted in closing to put a few of my successes and other people's failures in front of you, but I would like to close by reminding the audience, many of whom do not do trauma surgery, that most of our major advances occur in warfare practice coming to civilian practice. In a patient who I am following now whom Dr. Robert McClelland saw and I am following after him, he showed how one can transfer the unusual civilian warfare to unusual civilian cases that are not trauma.

A faculty member's mother, frail 64-year-old woman, was operated on for right upper quadrant infection, presumably biliary. During exploration, she had pus coming out of a ruptured periampullary diverticulum. There was no way that this could be closed. Dr. McClelland, using his trauma training, immediately thought of diverticularization of the patient. The patient recovered without any particular problems. She is back to her normal activities, weight, eating, and taking care of grandchildren 18 months later without any problems.

DR. RONALD COY JONES (Dallas, Texas): Dr. Feliciano has presented data on one of the most difficult problems that faces the trauma surgeon. He has stressed the importance of early recognition of the injuries by kocherization of the duodenum to visualize the posterior wall of the duodenum and opening the lesser sac for direct visualization of the pancreas.

About 2 years ago we reported our experience with 500 patients treated at a single institution, Parkland Hospital in Dallas, and there was a subset of 91 patients who had combined pancreaticoduodenal injury. In three fourths of these patients, the duodenum was managed by suture repair, and about 40% had a duodenostomy. The duodenostomy is a no. 10 Foley catheter brought laterally through the wall of the duodenum and managed in the manner described by Dr. Welch for difficult closures of the duodenal stump. The fistula rate in this group of patients was 15%. Our overall mortality rate in patients sustaining pancreaticoduodenal trauma was 32% compared with Dr. Feliciano's 29% and the postoperative mortality was the same.

A literature review on pancreaticoduodenectomy for trauma reveals over 30 reports. The mortality rate continues to be in excess of 30%. Five of our patients were managed by the diverticularization procedure. Perhaps we are not properly selecting patients for this procedure, but our experience has not been very good using it. All of our patients had a significant complication. A duodenal fistula developed in two patients, one of whom died, one patient had a pancreatic fistula draining in excess of 30 days, and in two patients, biliary fistulas developed.

Dr. Weigelt from Parkland Hospital evaluated the benefit of the duodenostomy tube in about 200 patients sustaining duodenal trauma. The fistula rate in the more severely injured group was 9%; therefore, somewhere between 9 and 15% seems to be our rate of fistula. If Dr. Feliciano's results of 6% incidence of fistula using pyloric exclusion in more severely injured patients holds, then that is an alternative that should be considered in managing patients with difficult duodenal injuries.

Sometimes patients who have had gastrojejunostomy after subtotal gastric resection with an anticolic anastomosis have developed postoperative obstruction. In closing the pylorus in a permanent fashion as you describe, has obstruction of the gastroenterostomy developed in any patients? Secondly, if the duodenum is already open from injury, do you perform a pancreatogram to determine ductal injury? Lastly, how do you manage the patient who receives a 38-caliber gunshot wound to the head of the pancreas and the duodenum, both organs are viable, and the patient is stable?

Through the years, Dr. Jordan, Dr. Mattox, Dr. Feliciano, and the group at Baylor have been leaders in the field of trauma and have