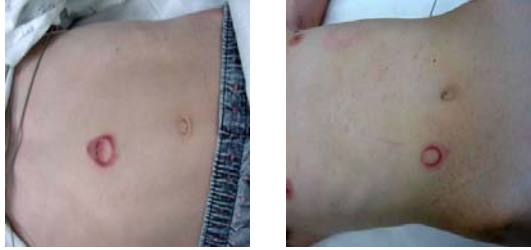


Blunt Abdominal Trauma



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Blunt Abdominal Trauma



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Penetrating Abdominal Trauma



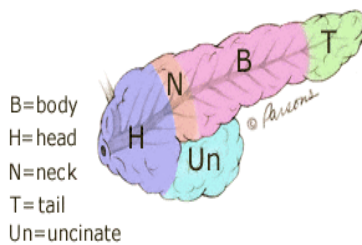
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Sites of Injury

- **Penetrating:** evenly divided between head, body, tail
 - 80% distal - left of superior mesenteric vessels
 - 20% proximal
 - 10-15% of all pancreatic trauma
 - 90% of all grade IV and V pancreatic injuries
- **Blunt:** typically involves junction between head and body
 - 85-90% of all pancreatic trauma

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Pancreatic Anatomy



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Associated injuries

- **Isolated pancreatic injury:**
 - rare
 - more common with blunt mechanism
- greater than 98% of patients with penetrating pancreatic injury will have associated injuries

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Associated Injuries

- Blunt trauma:
 - liver
 - spleen
 - duodenum / small bowel
- Penetrating trauma:
 - stomach
 - liver
 - small bowel / colon
 - inferior vena cava

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Diagnosis of Pancreatic Injury

- **CT scan:**
 - Accuracy greater than 90%
 - sensitivity increases 4 - 12 hours after initial insult
 - unable to directly visualize ductal system
- **Amylase / Lipase:**
 - High sensitivity / low specificity
 - Higher levels with ductal injuries
- **Laparotomy:**
 - 15-40% missed injuries
 - Up to 60% in unstable patients
 - Difficult to visualize all surfaces of gland

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CT scan

- Relatively high sensitivity for pancreatic injuries: approaching 90% with new generation scanners
- Subtle findings on initial scans
- sensitivity markedly improves 4-12 hours after injury
- provides indirect, but no direct evidence of ductal injury
- Best test for all *stable* patients with abdominal trauma

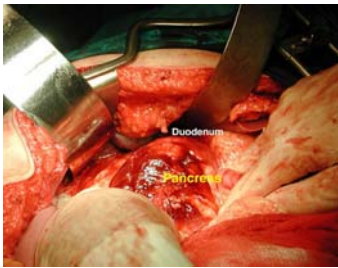
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Pancreatic Injury Scale

- Grade I: Minor contusion / laceration, no ductal injury
- Grade II: major contusion / laceration, no ductal injury
- Grade III: injury with distal ductal involvement
- Grade IV: injury with proximal ductal involvement
- Grade V: massive disruption of pancreatic head

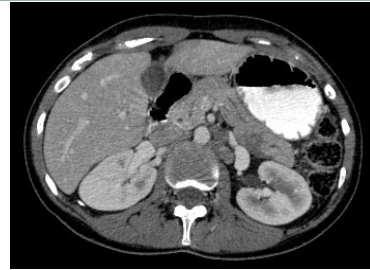
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Pancreatic Trauma: grade I



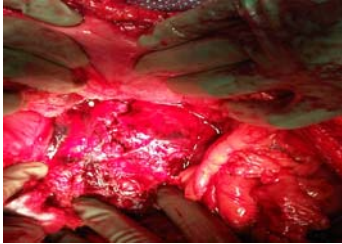
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Pancreatic Trauma: grade II



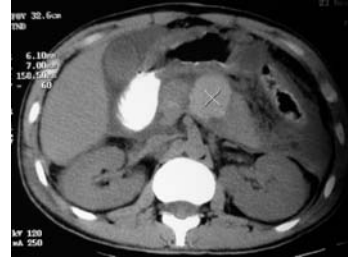
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Pancreatic Trauma: grade II



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Pancreatic Trauma: grade III



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Pancreatic Trauma: grade IV



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Pancreatic Injuries

- Grade I and II injuries comprise about 80% of all pancreatic injuries
- Grade III: 15 %
- Grade IV and V: less than 5%

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Pancreatic Injuries

Grade III, IV, V

- Mortality approaches 30%:
 - Early: secondary to associated injuries
 - Late: sepsis
- Morbidity approaches 80 %: primary factor-major ductal injury
 - fistulas
 - pseudocysts
 - pancreatis sepsis / abscess

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Diagnosis of Major Ductal Injury

- Determination of ductal integrity is vital
- Dictates management plan
- Best diagnostic method??
 - ERCP
 - MRCP
 - Laparotomy / Intraoperative studies
 - CT scan

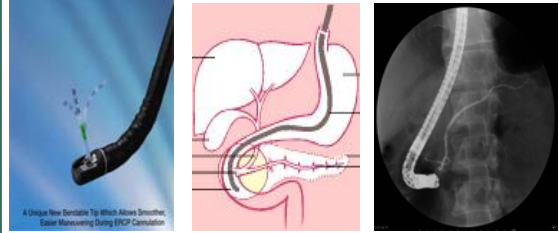
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ERCP: endoscopic retrograde cholangiopancreatography

- Considered the “gold standard” in the diagnosis of major ductal injury
- Drawbacks:
 - only stable patients
 - expert endoscopist
 - invasive procedure: 5-15% complication
 - 10-25% patients cannot be cannulated
 - 3AM ERCP ??

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ERCP



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MRCP: magnetic resonance cholangiopancreatography

- Limited studies in the trauma population: few studies performed show sensitivities approaching 95% in detecting and excluding ductal injury
- Advantages:
 - Non-invasive
 - Relatively fast study
- Drawbacks:

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MRCP



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Intraoperative Assessment Ductal Integrity

- Indicated only in those few patients where extensive resection is contemplated
 - ERCP
 - Direct / Indirect Pancreatography:
 - lateral duodenotomy - direct cannulation ampulla
 - cannulation of gall bladder, cystic duct, CBD
 - cannulation distal pancreatic duct

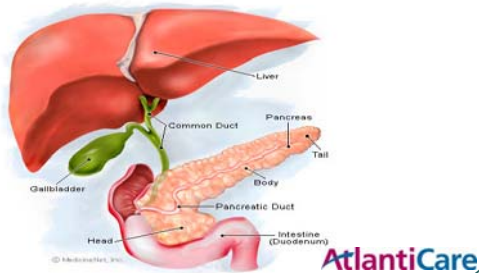
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Intraoperative Pancreatography

- *Direct pancreatography:*
 - *lateral duodenotomy:* direct cannulation of ampulla
 - *distal pancreatectomy:* direct cannulation distal duct
 - performed using a small pediatric feeding tube -5fr
 - high morbidity / fistula formation
- *Indirect pancreatography = Cholangiography:*
 - less than 50% visualization of pancreatic ducts
 - attempted prior to direct pancreatography

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Pancreatography



Treatment Pancreatic Injuries

- **Basic surgical tenets:** unstable patients diagnosed and treated in the OR; control hemorrhage / contamination.
- **Diagnose major ductal injury**
- **Conservative operative management:**
 - external drainage - imperative
 - internal drainage / defunctioning procedures rarely indicated and increase morbidity

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External Drainage

- **Vital in most all pancreatic injuries**
 - Minimum of 4 drains for major injuries
- **Closed-suction drains:** in several randomized studies have proven more effective
 - less incidence of septic complication
 - provides a controlled and effective egress of fluid

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External drainage system



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Pancreatic Exposure

- **Via lesser sac through gastrocolic ligament:**
 - full exposure of anterior surface body and tail
- **Extended Kocher maneuver:**
 - full exposure of head and uncinate process
- **Mobilization of spleen medially:**
 - full exposure posterior body and tail

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Spleen-preserving distal pancreatectomy

- **Controversial**
- **Should be attempted in the stable patient without splenic injury**
- **According to several studies operative time is minimally prolonged**
- **less incidence of infectious complications / subphrenic abscesses**

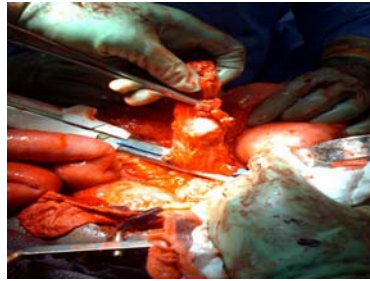
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Transection of Pancreas

- **Technical considerations:**
 - electrocautery preferable
 - if possible ligate pancreatic duct with nonabsorbable
 - parenchymal closure with nonabsorbable suture
 - stapling devices: fast and effective
 - omental patch
 - external drainage

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Pancreatic transection



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Pancreatic Transection



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Treatment Strategies

- **Grade I:** minor contusions/injuries/lacerations, no ductal involvement
 - closed - system external drainage
- **Grade II:** major contusions/injuries/lacerations, no ductal involvement
 - closed - system external drainage

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Treatment Strategies

- **Grade III:** distal injury with ductal injury / or high suspicion of ductal injury
 - no need to confirm ductal integrity
 - **Stable patient:** distal pancreatectomy/ external drainage
 - +/- splenectomy
 - **Unstable patient:**
 - Control hemorrhage / spillage
 - External drainage

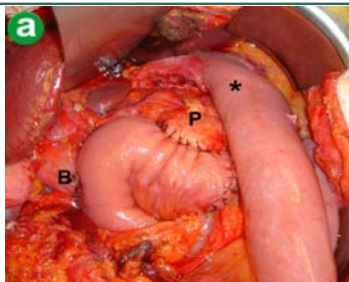
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Treatment Strategies

- **Grade IV:** proximal injury with ductal injury / high suspicion ductal injury. < 1% pancreatic injuries
 - **stable patient:** "pancreatography"
 - **No ductal injury:** drainage
 - **Ductal injury:** subtotal pancreatectomy
 - injury distal to confluence of CBD and pancreatic duct
 - +/- roux-en Y pancreaticojejunostomy / controversial
 - diabetics
 - less than 10% residual pancreas
 - **unstable patient:** external drainage used *almost exclusively*

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Roux en Y pancreaticojejunostomy



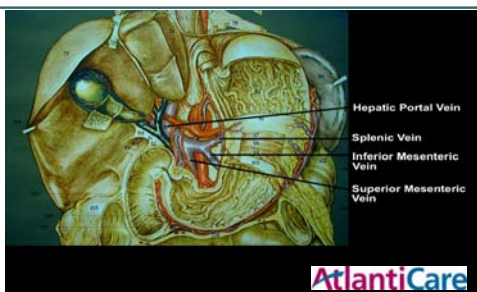
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Treatment Strategies

- **Grade V:** massive disruption of pancreatic head / combined pancreaticoduodenal injury. < 1% pancreatic injuries
 - **Hemodynamically unstable patient:** high morbidity / mortality secondary to major vasculature injury
 - **Damage control:**
 - control hemorrhage and spillage, pack, drain, TICU

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Vascular anatomy



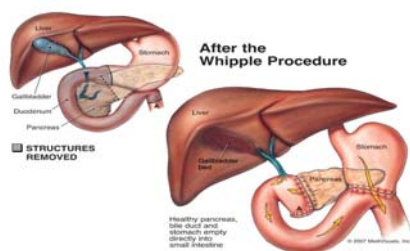
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Treatment Strategies

- **Grade V:** hemodynamically stable patients
 - **Complete devascularization of head of pancreas +/- duodenal injury:** pancreaticoduodenectomy
 - **Vascular supply intact:**
 - external drainage +/- pyloric exclusion
 - external drainage +/- "triple tubes"

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Whipple Procedure



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Wide External Drainage

- **Treatment of choice for Grade IV / V injuries ?**
 - supported by several recent papers
 - expect a high rate of post-operative complications
 - requires extensive TICU management
 - high incidence sepsis / ARDS / ARF
 - **risks appear to be less than extensive resective procedures**

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Pyloric exclusion

- *In theory* completely diverts flow of enteric contents and prevents activation of extravasated enzymes and "autodigestion phenomenon"
- usually applied to high grade combined duodenal and proximal pancreatic duct injuries
- includes temporary pyloric occlusion, gastrojejunostomy, tube duodenostomy, external drainage, repair of duodenal injury; +/- feeding tube
- questionable efficacy; possibly increased risks vs wide external drainage
- must confirm ductal injury prior to procedure

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"Triple Tubes"

- In theory diverts flow of enteric contents
- usually applied to isolated duodenal injuries, with or without low grade proximal pancreatic injuries
- includes gastrostomy tube, feeding jejunostomy tube, and retrograde jejunostomy tube
- of questionable efficacy
- maintains bowel continuity, no anastomosis involved, fast

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Pancreatic trauma



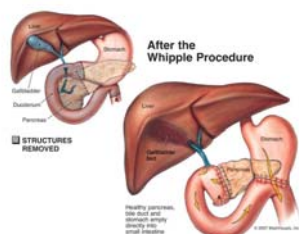
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Pancreaticoduodenectomy

- Indications:
 - rare
 - stable patients with non-viability of pancreatic head and or duodenum
 - frequently initial insult has performed the dissection
 - uniformly poor results +/- surgery
 - vast majority of these patients exsanguinate or are too unstable for definitive repair

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Pancreaticoduodenectomy



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Complications of Pancreatic Trauma

- Abdominal complications:
 - pancreatic fistulas: 12-55%
 - intra-abdominal abscess: 8-34%
 - pancreatitis: 5%
 - bile leak: 5%
 - pseudocysts: 1-2%
- Systemic complications:
 - Sepsis: 12%
 - ARDS: 10%
 - renal failure: 5%

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Pancreatic Fistulas

- Most common complication arising from pancreatic trauma
- invariably seen with proximal injuries
- > 100 cc/day for greater than 10 days with elevated amylase
- vast majority close in 2-12 weeks with conservative treatment
- octreotide has not been proven beneficial
- 5-7% will require reoperation, usually with a Roux limb to injured pancreatic segment

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Traumatic pancreatic pseudocyst



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EAST Practice Guidelines

• Reference Quality

- **Class I:** prospective randomized controlled trials
- **Class II:** clinical studies with prospective data; analysis retrospective
- **Class III:** analysis based on retrospectively collected data

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East Guidelines

- **No level I or Level II recommendations**
- **Level III recommendations:**
 - Delay in diagnosis of main pancreatic duct injury increases morbidity
 - CT scan suggestive but not diagnostic of pancreatic injury
 - Amylase / lipase suggestive but not diagnostic of pancreatic injury
 - Grade I and II injuries can be managed by drainage alone
 - Grade III injuries should be managed with distal resection and drainage
 - Closed suction system is the preferred method of drainage

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EAST Guidelines

- Vast majority of morbidity can be prevented with timely diagnosis (< 12 hrs)
- Morbidity related to grade III injuries and higher
- Resection preferred treatment over ductal repair or anastomosis
- Pancreatico-jejunostomy should not be performed
- Grade IV / V injuries: most favor debridement and wide drainage

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EAST Guidelines

- **Splenic preservation:** additional 60 minutes of operative time; not recommended
- **Pediatric pancreatic injury:** generally follow same principles as for adults; some experts recommend conservative management for all pediatric pancreatic injuries
- **Drains:** closed suction systems
- **Octreotide:** no benefit with respect to fistulas, abscess, drainage output, LOS, infection

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Damage Control Surgery {DCS}

- Optimal treatment for complex / severe pancreatic injuries; grades IV and V
- Prevention of metabolic failure
- Principles of DCS:
 - Phase I: control hemorrhage; intestinal spillage; debridement; wide external drainage
 - Phase II: correction of hypothermia, metabolic acidosis, coagulopathy
 - Planned reoperation in 24-48 hours

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DCS

- Recent literature supports DCS for extensive pancreatic trauma
- Compared to resection and anastomosis:
 - Increased survival
 - Increased preservation of pancreatic parenchyma
 - Decreased rates of complications
- Whipple's procedure rarely, if ever indicated

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Conclusion

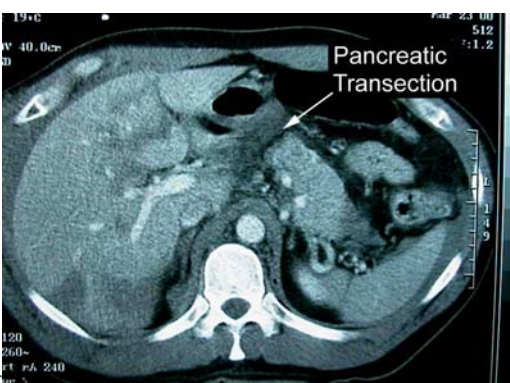
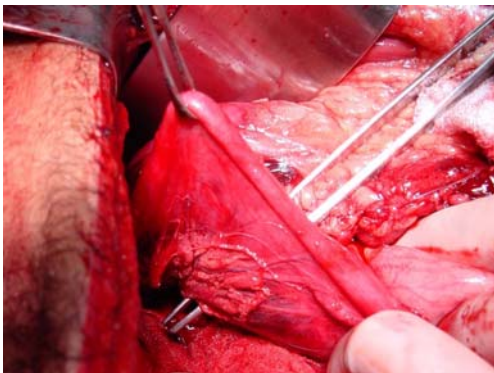
- Most pancreatic injuries can be managed by external drainage alone
- Ductal injuries markedly increase morbidity and must be diagnosed early
- Conservative management plan for most high grade pancreatic injuries
- "damage control" probably best treatment for high grade pancreatic injuries
- Early diagnosis key to prevent morbidity and mortality

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References

- Patton JH, Fabian TC; Complex Pancreatic Injuries. Surgical Clinics North America. Vol. 76, pp783-795, August 1999
- Patton JH, Kyden SP, et al; Pancreatic Trauma: A Simplified Management Guideline. J Trauma Vol.43, August 1997
- Farrell RJ, Krige JE, et al; Operative Strategies in Pancreatic Trauma. British J Surgery, pp 934-937, 1996.
- Fulcher AS, Turner MA, et al; MRI in Assessment Pancreatic Duct Trauma. J Trauma. Vol.48, 2000.
- Trunkey DD, Lewis FR, et al. Current Therapy of Trauma. 4th Edition. pp 237-243. 1999.

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Grade III pancreatic injury

