

# **Pancreatic Trauma**

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- Nothing to disclose

# Learning Objectives

- Understand the mechanism of injury resulting in traumatic injuries to the pancreas in children
- Discuss some of the controversies in the management of these injuries
- Learn about associated injuries and their contributions to outcomes

# Outline

- Discuss basics of pancreatic trauma
  - Injury diagnosis
  - Mechanisms
  - Associated injuries
- Controversial management of the injuries
  - Recent study
- Case presentation and video

# Background

- Trauma is the leading cause of mortality in children
- Hepatic and splenic injuries= majority
  - Non-operative management has become the standard of care
- Injuries to the pancreas are rare
  - < 10% of blunt abdominal injuries
- Diagnosis can be challenging in cases of blunt trauma

# Background

- EAST recommendations 2009 ([www.east.org](http://www.east.org))
- Level III recommendations only:
  - Delay in the recognition of main pancreatic duct injury causes increased morbidity.
  - CT scan is suggestive but not diagnostic of pancreatic injury
  - Amylase/Lipase levels are 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 resection, and drainage.
  - Closed suction is preferred to sump suction.

# Injury diagnosis: does timing matter?

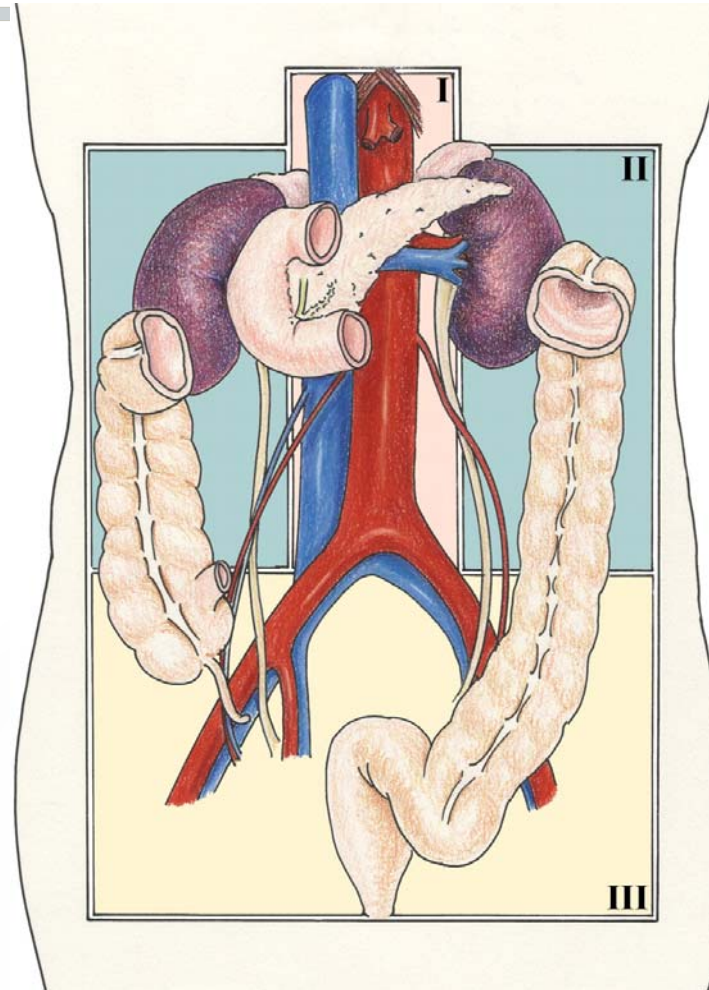
- Main pancreatic ductal injury increases morbidity and mortality
  - Increased if delay in diagnosis
  - Most common pancreatic related complication is peri-pancreatic abscess
  - Complication rates as high as 80% reported after a 24 hour delay in diagnosis

# Injury diagnosis

- Suspicion based on history, physical exam
  - PE may not be reliable given retroperitoneal location
- Blunt abdominal trauma in children- solid organ injuries are common with direct blows or high energy mechanism (Gaines BA, J Trauma 2009).
- Liver and spleen in children can extend below the ribcage, which is also more compliant than in adults
- Pancreas is retroperitoneal. It can be injured due to the direct force or by being crushed against the spine



# Injury diagnosis



# Injury diagnosis

- CT scan is the mainstay of diagnosis
  - Fluid in lesser sac, peripancreatic hematoma-suspicious
  - Not perfect, can miss injuries, or can undergrade them
    - Canty TG Sr, Weinman D. J Pediatr Surg. 2001
- ERCP most accurate to define ductal injury
  - Can be challenging in small children, lack of expertise
  - MRCP an alternative- often requires sedation or GA, delay in obtaining the imaging
    - Non-therapeutic if needed

# Injury diagnosis

- Elevated serum amylase and lipase
  - Adamson WT, Hebra A, Thomas PB, Wagstaff P, Tagge EP, Othersen HB. J Pediatr Surg. 2003
- May not be elevated early after injury
- Trend more important than number
- Levels do not correlate with injury
  - Takishima T, et al. Ann of Surgery July 1997

# Mechanism

- Bicycle handle bar injury by far the most common in children (30%)
  - Isolated pancreatic injury
- Falls
- Sports related
- MVC
- Penetrating very rare

# Associated injuries

Arkovitz MS et al. J Trauma, Injury, Infection and Crit Care, Jan 1997

- . Anatomic association:
  - Duodenum (12%)
  - Liver (19%)
  - Spleen (12%)
  - Biliary
  - Small bowel
  - Vascular
- Mechanism:
  - Head injury (23%)
  - Orthopedic (23%)
  - GU (15%)

# Associated injuries

- Major cause of morbidity
  - Vascular injuries-hemorrhage
  - Duodenal injuries
  - Biliary injuries
- May cause the pancreatic injury to be missed if taken directly to the OR pre-imaging.

# Hot off the press

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## Non-operative management of high-grade pancreatic trauma: Is it worth the wait?

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# Controversy

- The management of blunt pancreatic injury in children is controversial
  - Lower grade injuries (grades I and II)
  - High grade injuries involving transection of the pancreatic duct (grades III-V)



## AAST Injury Scoring Scale for the Pancreas

### Pancreas Injury Scale

Grade	Type of Injury	Description of Injury
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 ampulla
V	Laceration	Massive disruption of pancreatic head

# Controversy

- Management of high grade pancreatic trauma
  - Operative in adult trauma literature
- Previously shown that non-operative management is safe
  - Advocates for prompt surgical intervention when there is known ductal disruption
- Study goal:
  - **compare outcomes associated with operative versus non-operative management strategies in high grade traumatic injuries to the pancreas**

# Methods

- All traumatic injuries to the pancreas presenting to two Level 1 pediatric trauma centres
  - January 1993 to July 2010
  - The Hospital for Sick Children (Toronto) and Kosair Children's Hospital (Louisville)
- Baseline characteristics collected:
  - demographics, injury mechanisms, pancreatic injury grade, injury severity score (ISS) and associated injuries
- Patients with high-grade injuries (Grade III,IV or V) were included in the analysis
  - Stratified based on planned management

# Methods

- Planned strategy for operative management: surgery within the first 48 hours from admission
- Primary outcome of interest: **overall complication rate**
- Secondary outcomes
  - Length of stay (LOS)
  - Days of total parenteral nutrition (TPN).

# Methods

- Continuous data:
  - means with standard deviation (SD) or
  - median with interquartile range (IQR),
  - categorical variables were summarized with proportions.
  - Univariate hypothesis testing
- Confounding: controlled for ISS and the presence of any associated injury using regression analyses.
- SPSS® (version 19)
- $p < 0.05$  considered significant
- 95% confidence intervals included

# Results

- 79 subjects with pancreatic injuries were identified
  - Two patients were excluded: devastating CNS injuries
- The majority of the 77 remaining patients were
  - male (64%)
  - Mean injury severity score of  $16.6 \pm 11.7$ .
  - Associated injuries were common:
    - 44/77 patients (58%)

# Results

- 39 patients with high-grade pancreatic injuries
  - Similar baseline characteristics to all patients sustaining pancreatic injury
- All blunt mechanism
  - Bicycle handlebars (15 patients)
- Mean ISS was  $19.2 \pm 10.8$
- Median injury grade was III (IQR III,IV)
  - No patients with grade V injury.
- 19 patients (50%) had an associated injury

# Results

- All laparotomies for known pancreatic injury.
- 39 patients with grade III and IV injuries stratified into 2 groups based on initial management plan,
  - non-operative (N=24) or operative (N=15)
- Baseline characteristics were similar except for **ISS**
  - Higher in the non-operative group ( $22.5 \pm 11.3$  vs.  $15.3 \pm 9.1$ ,  $p=0.03$ )



	Non-Operative Management (n=24)	Operative Management (n=15)	P value
<b>Male (%)</b>	16 (67)	11 (73)	0.73
<b>Mean Age (years)</b>	8.9±3.9	9.6±4.1	0.60
<b>Mean Injury Severity Score</b>	22.5±11.3	15.3±9.1	<b>0.03</b>
<b>Associated Injuries (%)</b>			
<b>Any</b>	12 (50)	7 (50)	1.00
<b>Other Abdominal</b>	10 (42)	6 (43)	1.00
<b>Thoracic</b>	1 (4.2)	2 (14)	0.54
<b>Cranial</b>	2 (8.3)	1 (7.1)	1.00
<b>Musculoskeletal</b>	3 (13)	1 (7.1)	1.00
<b>Operative Procedure</b>			
<b>Distal pancreatectomy</b>	0	12	
<b>Drainage at laparotomy</b>	0	3	

# Results: outcomes

- LOS
- Duration of TPN
- Complications:
  - overall rate
  - need for delayed operation
  - pancreatic fistula
  - intraabdominal abscess
  - pancreatic pseudocyst
  - pancreatic leak
  - central venous catheter complication

## Outcomes of patients with high-grade injuries based on initial management strategy

	Non-Operative Management (n=24)	Operative Management (n=15)	P value
<b>Mean duration of TPN (days)</b>	21.8±18.9	7.9±7.6	<b>0.003</b>
<b>Mean LOS</b>	27.5 ±19.8	15.1±8.4	<b>0.01</b>
<b>Any Complications (%)</b>	17 (74)	4 (27)	<b>0.007</b>
Delayed OR	2 (8.3)	0	0.51
Fistula	1 (4.3)	1 (6.7)	1.00
Abscess	2 (8.7)	0	0.51
Leak	0	1 (6.7)	0.40
Pseudocyst	13 (57)	0	<b>&lt;0.001</b>
CVC complication	7 (30)	3 (20)	0.71

# Results: outcomes

- Univariate analyses demonstrated that patients with an *initial non-operative management strategy* had:
- **longer hospitalization** ( $27.5 \pm 19.8$  vs.  $15.1 \pm 8.4$  days;  $p=0.01$ )
- **more days of TPN** ( $21.8 \pm 18.9$  vs.  $7.9 \pm 7.6$  days;  $p=0.003$ )
- **higher proportion of complications** (17/24 vs. 4/15;  $p=0.007$ ).
  - Of the specific types of complications, only development of a pancreatic pseudocyst was significant (13 vs. 0;  $p=<0.001$ )

# Results: outcomes

- Logistic regression:
  - Was planned non-operative strategy was independently predictive of overall likelihood of any complication?
  - Controlled for confounding effects of ISS and associated injuries.
- The odds ratio for complications in patients receiving a **non-operative management** strategy was **8-fold greater** than for those undergoing planned operative management
  - OR 8.11; 95% CI 1.60-41.23
  - ISS and the presence of any associated injury were **not** independently predictive of overall complications

# Results: outcomes

- Linear regression model:
  - ISS
  - Any associated injury
  - Management strategy
  - Clinical outcomes: LOS and days of TPN
- **Non-operative strategy was a significant predictor of prolonged TPN (13 days longer  $p=0.024$ )**
  - did not predict LOS ( $p= 0.058$ )
- ISS and associated injuries were not significant independent predictors of prolonged LOS or prolonged use of TPN

# Discussion

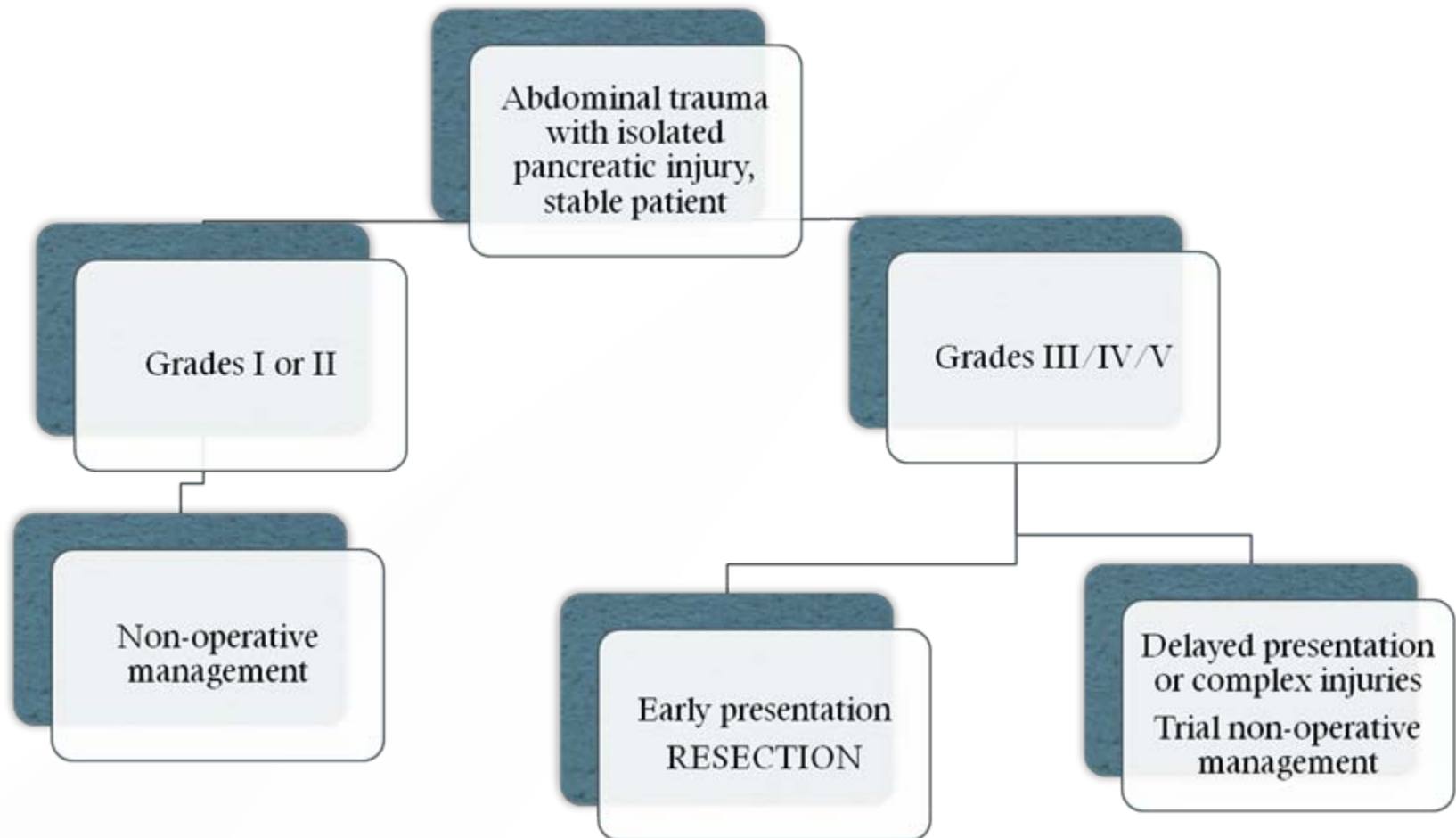
- Extension of non-operative management remains controversial
- Non-operative management of these injuries has been shown to be both feasible and safe, but at what cost?
- Non-operative management of high grade injuries leads to:
  - **8-fold increase** in the rate of complications
  - Increased days of TPN
  - Trend towards increased LOS

# Conclusions

- Non-operative management may be the preferred strategy in cases not amenable to resection and those presenting after a significant delay
- Our results suggest early operative intervention for patients with ductal transection is associated with less morbidity
- Our algorithm for management of pediatric pancreatic injuries would include:
  - Non-operative therapy for stable patients with grade I and II injuries
  - Early surgical resection for patients with ductal transection



# Management algorithm



# Outcome details

- Of the 13 patients with pseudocysts:
  - 1 required operative intervention in the form of a cyst-jejunostomy
  - 1 patient required percutaneous drainage
  - 2 patients required ERCP and stent placement
- The 3 patients who underwent laparotomy and drain placement with no pancreatic resection had an average LOS of 27.6 days with 15.3 days of TPN.
  - They also had 50% of the complications in the entire operative group.

# Laparoscopic partial pancreatectomy for traumatic transection

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# Case presentation

- 4 year old male
- Previously healthy
- No medications, no allergies
- Climbed bookshelf/TV stand to get remote
- Shelving and TV fell on his abdomen
- Brought to outside hospital
  - Elevated lipase
- Transferred to MCH

# Case presentation

- Normal Vital signs, afebrile
- Abdomen soft, tender epigastric
  - No external signs of trauma
- WBC 23.5, HGB 117
- AST 265 (↑), ALT 231 (↑), lipase 306

# Case presentation

- CXR normal
- CT abdomen/pelvis:
  - Segment VII liver laceration (2.7 x1.9 cm)
  - Irregular hypodensity traversing the entire width of the pancreas at junction of head and tail. Normal enhancement



# Case presentation

- Placed NPO, NGT, IVF
- Taken to the OR the following AM
  - Planned laparoscopic partial pancreatectomy
  - Spleen preserving if possible



# Post-operative course

- NG removed on POD#2. No TPN
- CF diet started, advanced as tolerated
- JP drain amylase measured
- Drain removed on POD#5 and patient discharged home
- Well at time of follow up with normal amylase and lipase

# Evidence

- Mainly isolated case reports
- Largest single series: 3 cases from CHOP (J. Pediatric Surgery, March 2011)
  - Ages 8, 10, 13
  - 2 stapled, 1 hand sewn
  - No fistulae, no pancreatic insufficiency
- Multi-institution: 7 cases, 6 level 1 pediatric trauma centres over 10 years (J. Laparoscopic and Advanced Surgical Techniques)
  - No splenectomy
  - 2 pancreatic leaks

# Conclusion

- Laparoscopic distal pancreatectomy is feasible in setting of trauma in a stable child
- Rare injury, evidence only anecdotal/case reports/case series

# Summary

- Pancreatic injuries are rare in children and can be challenging to diagnose
- Mechanism of injury
- High rate of associated injuries that carry significant morbidity
- Amylase and lipase levels not always helpful
- Management can be either operative or non-operative depending on the grade of injury and timing of presentation