Pancreatic Trauma

Alana Beres
Pediatric Surgery Fellow
Montreal Children’s Hospital
June 10th, 2013
• 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)
- 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

Radiographics.rsna.org
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

- 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
- May not be elevated early after injury
- Trend more important than number
- Levels do not correlate with injury
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.
Non-operative management of high-grade pancreatic trauma: Is it worth the wait?

Alana L. Beres\textsuperscript{a}, Paul W. Wales\textsuperscript{a}, Emily R. Christison-Lagay\textsuperscript{a}, Mary Elizabeth McClure\textsuperscript{b}, Mary E. Fallat\textsuperscript{b}, Mary E. Brindle\textsuperscript{c,*}

\textsuperscript{a}The Hospital for Sick Children, Division of General and Thoracic Surgery, University of Toronto, Toronto ON, Canada
\textsuperscript{b}Kosair Children's Hospital, Division of Pediatric Surgery, Department of Surgery, University of Louisville, Louisville KY, USA
\textsuperscript{c}Alberta Children's Hospital, Division of General and Thoracic Surgery, University of Calgary, Calgary, Canada AB T3B6A8
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

<table>
<thead>
<tr>
<th>Grade</th>
<th>Type of Injury</th>
<th>Description of Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hematoma</td>
<td>Minor contusion without duct injury</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Superficial laceration without duct injury</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma</td>
<td>Major contusion without duct injury or tissue loss</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Major laceration without duct injury or tissue loss</td>
</tr>
<tr>
<td>III</td>
<td>Laceration</td>
<td>Distal transection or parenchymal injury with duct injury</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration</td>
<td>Proximal transection or parenchymal injury involving ampulla</td>
</tr>
<tr>
<td>V</td>
<td>Laceration</td>
<td>Massive disruption of pancreatic head</td>
</tr>
</tbody>
</table>
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 parentral 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±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±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±11.3 vs. 15.3±9.1, p=0.03)
<table>
<thead>
<tr>
<th></th>
<th>Non-Operative Management (n=24)</th>
<th>Operative Management (n=15)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>16 (67)</td>
<td>11 (73)</td>
<td>0.73</td>
</tr>
<tr>
<td>Mean Age (years)</td>
<td>8.9±3.9</td>
<td>9.6±4.1</td>
<td>0.60</td>
</tr>
<tr>
<td>Mean Injury Severity Score</td>
<td>22.5±11.3</td>
<td>15.3±9.1</td>
<td><strong>0.03</strong></td>
</tr>
<tr>
<td>Associated Injuries (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any</td>
<td>12 (50)</td>
<td>7 (50)</td>
<td>1.00</td>
</tr>
<tr>
<td>Other Abdominal</td>
<td>10 (42)</td>
<td>6 (43)</td>
<td>1.00</td>
</tr>
<tr>
<td>Thoracic</td>
<td>1 (4.2)</td>
<td>2 (14)</td>
<td>0.54</td>
</tr>
<tr>
<td>Cranial</td>
<td>2 (8.3)</td>
<td>1 (7.1)</td>
<td>1.00</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>3 (13)</td>
<td>1 (7.1)</td>
<td>1.00</td>
</tr>
<tr>
<td>Operative Procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal pancreatectomy</td>
<td>0</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Drainage at laparotomy</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
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

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

- Univariate analyses demonstrated that patients with an initial non-operative management strategy had:
  - longer hospitalization (27.5±19.8 vs. 15.1±8.4 days; p=0.01)
  - more days of TPN (21.8±18.9 vs. 7.9±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
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

Alana Beres MDCM & Sherif Emil MDCM

Division of Pediatric General Surgery

The Montreal Children’s Hospital
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 x 1.9 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