Management of Penetrating Trauma to the Distal Pancreas and the Kidney

SUNY Downstate Department of Surgery
Kings County Medical Center

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5/19/2011
Case

19 y/o M presented S/P GSWs to left axilla and epigastrium

- Speaking Clearly
- Breath Sounds Present & Equal B/L
- VS: 158/75; 90; 18; 100%,
- No Obvious Hemorrhage
- GCS: 15
- Entry Sites: anterior left axilla and epigastrium, no exits
  - Upper Extremity exam normal
  - Abdomen initially nontender, but worsened
- FAST: No significant fluid in pericardial sac
Case

Imaging
Case

**OR:**

- Foley placed prior to start of case showed gross hematuria
- GU called
- Ex-Lap:
  - Through & Through liver: no significant bleeding
  - Through & Through stomach (Mid Body): Repairs X2 with TA stapler
  - Through & Through pancreas ~3cm from distal tip, through duct (Grade 3): Distal Pancreatectomy + Splenectomy
  - Left Kidney Injury through cortex, collecting system, and renal vein (Grade 4): Nephrectomy
  - JP drain placed near pancreatic resection
Case

Hospital course:
- Admitted to SICU
- Extubated POD #1
- Transferred to floor POD #3
- Discharged home POD #7
Management of Distal pancreatic Injuries

- Pancreatic injury in 6% of patients with gunshot wounds to the abdomen
- Pancreatic injury in 2% of patients with stab wounds to the abdomen
- Mortality rate for penetrating pancreatic injury – 20%
- Mortality does not correlate with the mechanism or the severity of pancreatic injury, but rather with the presence of associated injuries

Subramanian A; Dente CJ; Feliciano DV. The management of pancreatic trauma in the modern era. Surgical Clinics of North America. 2007-12-0187:6,. 1515(19) (Baylor + Emory)

## Management of Distal pancreatic Injuries

<table>
<thead>
<tr>
<th>GRADE</th>
<th>INJURY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hematoma Minor contusion without duct injury</td>
</tr>
<tr>
<td></td>
<td>Laceration Superficial laceration without duct injury</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma Major contusion without duct injury or tissue loss</td>
</tr>
<tr>
<td></td>
<td>Laceration Major laceration without duct injury or tissue loss</td>
</tr>
<tr>
<td>III</td>
<td>Laceration Distal transection or parenchymal injury with duct injury</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration Proximal (to right of superior mesenteric vein) transection or parenchymal injury</td>
</tr>
<tr>
<td>V</td>
<td>Laceration Massive disruption of pancreatic head</td>
</tr>
</tbody>
</table>

The major variable for management is the integrity of the major pancreatic duct.

- situated approximately one third the distance of the gland's width (from the superior border down).
- roughly 4 mm in width (adult)
- Findings associated with ductal disruption
  - central hematomata
  - Laceration through more than 50% of the width of the gland
  - leakage of pancreatic juice
  - injury to the midportion of the gland

Walker ML. The operative approach to pancreatic injury J Natl Med Assoc. 1992 Feb;84(2):183-4. (Morehouse, Atlanta, Georgia)
Management of Distal pancreatic Injuries

62 survivors of penetrating abdominal trauma.

- 7 grade I
- 30 grade II
- 19 grade III
- 4 grade IV
- 2 grade V

Management of Distal pancreatic Injuries

29 of 37 Grade I and II patients were treated with drainage alone
- 4: no surgery
- 2: distal resections.
- No difference in complication rates

**Conclusion:** Drainage should continue to be used in non-ductal injuries and resection is not essential in these cases.

Young, PR; Meredith, JW; Baker, CC, et al Pancreatic injuries resulting from penetrating trauma: a multi-institution review Am Surg. 1998 Sep;64(9):838-43
Management of Distal Pancreatic Injuries

For grade III patients, fistulae formed in 2/15 (13%) of the patients with resection.

A fistula also occurred in the only patient who had drainage alone for a missed grade III injury.

Conclusion: Grade III-V injuries should be managed with resection and drainage.

Management of Distal pancreatic Injuries

123 adult patients with pancreatic injuries (81% penetrating)

Patton JH Jr.; Lyden SP; Croce MA; Pritchard FE; Minard G; Kudsk KA; Fabian TC
Management of Distal pancreatic Injuries

Splenic Preservation

– In ten cadaver dissections of distal pancreas, an average of 22.1 tributaries of the splenic vein and 7.6 branches of the splenic artery were demonstrated.

Management of Distal pancreatic Injuries

Splenic Preservation
- Hemodynamically stable
- Isolated pancreatic injury
- especially a child 10 years of age or younger

Management of Distal pancreatic Injuries

Description of procedure

- splenic artery and vein are exposed and isolated
- Followed by cephalad retraction of the splenic vessels and caudal retraction of the pancreatic specimen
- multiple small branches between these structures are exposed
- ligation with sutures or metal clips and division of all the branches is performed
- the body and tail of the pancreas can be removed with salvage of the spleen
Distal pancreatectomy with splenic salvage should be considered in the hemodynamically stable patient with an isolated pancreatic injury. The arrow illustrates the detachment of distal pancreas.

Subramanian A; Dente CJ; Feliciano DV. The management of pancreatic trauma in the modern era. Surgical Clinics of North America. 2007-12-0187:6, 1515(19)
Management of Distal pancreatic Injuries

Splenic preservation with distal pancreatectomy in 9 patients

– showed that it could be done in 51 minutes with minimal complications

Management of Distal pancreatic Injuries

Eastern Association for the Surgery of Trauma Guidelines for Pancreatic Trauma:

- “Drainage alone suffices for grade I/II injuries”
- “While grade III and higher injuries should undergo a resectional procedure and drainage in order to reduce morbidity.”
- “Another discussion that is common in the management of pancreatic injury is the issue of splenic preservation. While this approach might make intuitive sense, the data supporting this approach in traumatic pancreatic injury is not adequate.”

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Management of Kidney Injuries


<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of renal injury, %</td>
<td>2.8</td>
<td>3.25</td>
<td>N/A</td>
<td>1.4</td>
<td>1.2</td>
</tr>
<tr>
<td>N</td>
<td>154</td>
<td>132</td>
<td>2254</td>
<td>227</td>
<td>6231</td>
</tr>
<tr>
<td>Blunt</td>
<td>93.5</td>
<td>95.4</td>
<td>89.8</td>
<td>93.4</td>
<td>81.6</td>
</tr>
<tr>
<td>Penetrating</td>
<td>6.5</td>
<td>4.6</td>
<td>10.2</td>
<td>6.6</td>
<td>18.4</td>
</tr>
<tr>
<td>Minor injuries</td>
<td>92</td>
<td>72</td>
<td>91.1</td>
<td>81.7</td>
<td>82.5</td>
</tr>
<tr>
<td>Major injuries</td>
<td>8</td>
<td>28</td>
<td>8.9</td>
<td>18.3</td>
<td>17.5</td>
</tr>
<tr>
<td>Renal exploration</td>
<td>N/A</td>
<td>7.4</td>
<td>7.4</td>
<td>7.1</td>
<td>13</td>
</tr>
<tr>
<td>Nephrectomy</td>
<td>3.8</td>
<td>3.2</td>
<td>0.8</td>
<td>N/A</td>
<td>7</td>
</tr>
</tbody>
</table>

**TABLE 1**

The epidemiology of renal trauma (from [1])

N/A, not available; Major injury defined as AAST grades 2–5 or ICD-9 code for laceration, parenchymal disruption, or vascular injury.
Management of Kidney Injuries

RENAL INJURY SCALE

<table>
<thead>
<tr>
<th>GRADE</th>
<th>INJURY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Contusion Microscopic or gross hematuria; urologic studies normal</td>
</tr>
<tr>
<td></td>
<td>Hematoma Subcapsular, nonexpanding without parenchymal laceration</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma Nonexpanding perirenal hematoma confined to the renal retroperitoneum</td>
</tr>
<tr>
<td></td>
<td>Laceration &lt;1 cm parenchymal depth of renal cortex without urinary extravasation</td>
</tr>
<tr>
<td>III</td>
<td>Laceration &gt;1 cm parenchymal depth of renal cortex without collecting-system rupture or urinary extravasation</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration Parenchymal laceration extending through the renal cortex, medulla, and collecting system</td>
</tr>
<tr>
<td></td>
<td>Vascular Main renal artery or vein injury with contained hemorrhage</td>
</tr>
<tr>
<td>V</td>
<td>Laceration Completely shattered kidney</td>
</tr>
<tr>
<td></td>
<td>Vascular Avulsion of renal hilum that devascularizes kidney</td>
</tr>
</tbody>
</table>

Management of Kidney Injuries


<table>
<thead>
<tr>
<th>Indication</th>
<th>Description</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute</td>
<td>Persistent, life-threatening haemorrhage believed to stem from renal injury</td>
<td>(4)</td>
</tr>
<tr>
<td>2</td>
<td>Renal pedicle avulsion (grade 5 injury)</td>
<td>(4)</td>
</tr>
<tr>
<td>3</td>
<td>Expanding, pulsatile or uncontrolled retroperitoneal haematoma (thought to indicate renal pedicle avulsion)</td>
<td>(4)</td>
</tr>
<tr>
<td>Relative</td>
<td>A large laceration of the renal pelvis, or avulsion of the PUJ</td>
<td>(3)</td>
</tr>
<tr>
<td>2</td>
<td>Coexisting bowel or pancreatic injuries</td>
<td>(3)</td>
</tr>
<tr>
<td>3</td>
<td>Persistent urinary leakage, postinjury urinoma or perinephric abscess with failed percutaneous or endoscopic management</td>
<td>(3)</td>
</tr>
<tr>
<td>4</td>
<td>Abnormal intraoperative one-shot IVU</td>
<td>(3)</td>
</tr>
<tr>
<td>5</td>
<td>Devitalized parenchymal segment with associated urine leak</td>
<td>(3)</td>
</tr>
<tr>
<td>6</td>
<td>Complete renal artery thrombosis of both kidneys, or of a solitary kidney, or when renal perfusion appears to be preserved</td>
<td>(4)</td>
</tr>
<tr>
<td>7</td>
<td>Renal vascular injuries after failed angiographic management</td>
<td>(3)</td>
</tr>
<tr>
<td>8</td>
<td>Renovascular hypertension</td>
<td>(4)</td>
</tr>
</tbody>
</table>
Management of Kidney Injuries

Need for Surgery:
- Grade I = 0%; Grade II = 15%; Grade III = 76%
- Grade IV = 78%; Grade V = 93%

Need for Nephrectomy
- Grade I = 0%; Grade II = 0%; Grade III = 3%,
  Grade IV = 9%; Grade V = 86%

Management of Kidney Injuries

Higher nephrectomy rate
- Penetrating mechanism
- High-velocity weapons and
- Overall injury severity of the patient

Management of Kidney Injuries

- Renal salvage is often less likely in multiorgan injury because urine leak is detrimental to other repairs.
- Vascular injuries, even primary segmental branches are often irreparable and result in nephrectomy.


Brandes, Steven B.; McAninch, Jack W. Reconstructive surgery for trauma of the upper urinary tract. Urologic Clinics of North America | 1999-0226:1, | 183-199 (Wash U, St. Lois)
Management of Kidney Injuries

- Proximal Vascular control is key
- Mobilize the ipsilateral colon along the white line of Toldt and reflecting it medially
- Incise Gerota's fascia longitudinally
- Evacuate Perinephric hematoma and fat
- Sharp and blunt dissection is begun away from the site of injury so as not to dissect subcapsularly

Management of Kidney Injuries

Management of Kidney Injuries

- Complete exposure of the entire kidney, renal pelvis, and upper ureter is obtained

- Debridement
  - Intrarenal hematoma is first evacuated and then all nonviable tissue excised sharply with a scalpel
  - Injuries that devitalize parenchyma to the renal poles are usually best managed by partial nephrectomy, whereas most interpolar injuries are best managed by renorrhaphy

Management of Kidney Injuries

- sharp wedge resection.
- All bleeding sites are oversewn with figure-of-eight 4-0 chromic suture,
- collecting system is closed with running 4-0 chromic suture.
- Thrombin-soaked Gelfoam bolsters are used to fill the parenchymal defect.
- renal capsule edges are reapproximated with interrupted 3-0 Vicryl sutures.

Management of Kidney Injuries

- a large area of nonviable tissue is visualized
- Resection of all nonviable parenchyma.
- Closure of the collecting system and filling of the parenchymal defect with Gelfoam
- Complete coverage of the defect with an omental pedicle flap sutured in place with 3-0 Vicryl sutures.

Management of Kidney Injuries

- If capsule is not available for primary closure, the defect can be covered by a flap or free graft.
- Pedicle flap of omentum is ideal for coverage because it offers an excellent vascular supply, lymphatic drainage, and sealing properties for the cut parenchyma and collecting system.

Management of Kidney Injuries

For large parenchymal defects or a shattered kidney with multiple lacerations, another alternative is to use an envelope of Vicryl mesh.
Mean rate of hypertension after renal injury in published series is 5.2 (0.6–33)%

RESULTS AND RENAL FUNCTION SIX MONTHS AFTER CONSERVATIVE TREATMENT OF SEVERE GRADE IV AND V BLUNT RENAL TRAUMA: A PROSPECTIVE EVALUATION

Plaid G.1, Long J.A.2, Tenier N.1, Thuillier C.1, Chodez M.1, Arvin-Berod A.1, Arnoux V.1, Skowron O.1, Descotes J.L.1, Rambeaud J.U.1
1CHU Grenoble, Dept. of Urology, Grenoble, France, 2CH Annesy, Dept. of Urology, Annesy, France

Introduction & Objectives: A prospective multi-center study was set up to evaluate the results and relative renal function 6 months after conservative treatment for severe blunt renal trauma (grades IV or V).

Materials & Methods: From January 2004 to April 2010, 88 patients were admitted to a center of the French Alps with a grade IV or V blunt renal trauma (confirmed on CT scan). Conservative treatment was allowed in 75 cases (50%). Mean age was 27 (10-70). The lesions were classified according to the AAST classification, grade IV in 69 cases (including 51 with urinary extravasation), and grade V in 10 cases. Their management required endoscopic drainage in 21 cases, selective arterial embolization in 10 cases, 3 attempted endovascular revascularisation (angioplasty+stenting), and a mean transfusion rate of 1 red blood cell unit (0-10).

Results: An evaluation of the relative renal function with renal scintigraphy was available in 22 patients (26%). 4 grades V and 16 grades IV. The mean relative function of the traumatized kidney was 34%, and 39% in grade IV only (15-50%). Considering grade V traumas, 2 kidneys showed no remaining function, the other 2 had a relative function of 20% and 25%. No arterial hypertension was noted during follow-up. Mean hospital stay was 16 days.

Conclusions: Our attitude of first-line conservative treatment for grade IV blunt renal trauma provides excellent results at 6 months. On the other hand, conservative treatment of grade V trauma provides mixed results regarding renal function, but a major benefit in terms of hospital stay (15 vs. 25 days), without clinical consequences at 6 months.
Management of Kidney Injuries

Prospective multi-center study to evaluate the results and relative renal function 6 months after conservative treatment for severe blunt renal trauma (grades IV or V)

January 2004 to April 2010

88 patients were admitted to centers in the French Alps

Management of Kidney Injuries

Conservative treatment was allowed in 79 cases (90%)

Grade IV in 69 cases

Grade V in 10 cases.

Evaluation of the relative renal function with renal scintigraphy

Available in 22 patients (28%)

Grades IV: 18 patients

Grade V: 4 patients

Mean relative function: (All patients): 34%
  - grade IV: 39%
  - Grade V: 2 kidneys showed no remaining function, the other 2 had a relative function of 20% and 25%.

Management of Kidney Injuries

Take home points

- Grade I&II pancreatic injury can usually be managed with drainage alone
- Grade III and higher pancreatic injury should usually be managed with resection and drainage
- Splenic Preservation should be considered in Stable patients with isolated pancreatic injury, especially children under the age of 10
- Renal salvage should be attempted in isolated grade I – IV kidney injury, especially when there are no other indications for exploration
Penetrating Trauma to the Distal Pancreas and the Kidney

Penetrating Trauma to the Distal Pancreas and the Kidney

- Patton JH Jr.; Lyden SP; Croce MA; Pritchard FE; Minard G; Kudsk KA; Fabian TC Pancreatic trauma: a simplified management guideline J Trauma. 1997 Aug;43(2):234-9
- Subramanian A; Dente CJ; Feliciano DV The management of pancreatic trauma in the modern era | Surgical Clinics of North America | 2007-12-01 187:6, | 1515(19)