Demographics of Colon Injury

- 2nd most common organ injured in penetrating abdominal trauma
- 2-5% of blunt abdominal trauma
- Penetrating injury: 75% firearms, 25% stabs
Historical Perspective

- Wallace (WW I) documented 59% mortality
- By end of WWI repair of injuries and proximal colostomies felt to be beneficial
- Ogilvie (WW II) strongly urged colostomy for all colon injuries
- Surgeon General (WW II) mandates colostomy for all colon injuries

Historical Perspective

- Mortalities decreased from 60% in North African campaign to 15% in the European Theatre (WW II)
- Korean/Vietnam conflicts: mandatory colostomies for transverse and left colon injuries
Historical Perspective

- Woodall & Ochsner showed lower mortality with primary repair (post WW II)
- Alternative of exteriorized repair emerged

Diagnosis of Colon Injury

- Most often diagnosed at laparotomy
- Gross blood on digital examination
- Complete mobilization of injured region
- Have higher suspicion with seatbelt sign
Diagnosis of Colon Injury

- Explore paracolic hematomas
- If injury questionable: grasp colon on both sides of area in question and milk toward presumed injury
- Penetrating flank injuries: triple contrast CAT scan or soluble contrast enema may be helpful

Treatment of Colon Injuries

- Colostomy
- Exteriorized repair
- Primary Repair
Colostomy

- Exteriorization of injury
- Loop colostomy with repair of injury
- Resection with end colostomy and mucus fistula or Hartmann’s procedure

Exteriorized Repair

- Snyder & Mason (WW II)
- Injury must lay on abdominal wall
- Suture line should not rest against device
- Must do second procedure: colostomy or colon replacement in peritoneal cavity
Exteriorized Repair

- Injured portion must lay on abdominal wall without tension
- Suture line should not rest against device

Primary Repair of Colon Injuries

- Optimal and most common procedure
- Indications continue to evoke controversy
- Stone & Fabian: first study to address safety (Ann Surg 79)
Primary Repair

- Flint: primary repair of Grade I injuries (Ann Surg 81)
- Shannon & Moore: Use PATI, CIS hemodynamic status (Surg 85)
- George: Risk factors fail to predict primary repair outcome (Ann Surg 89)

Primary Repair

- OIS Committee developed grading system (J Trauma 90)
- Several studies published with greater than 50% primary repair rate
- Became apparent that current criteria were too restrictive
AAST Colon Injury Scale

I. Contusion /hematoma without devascularization; Partial thickness laceration
II. Laceration < 50% circumference
III. Laceration > 50% circumference
IV. Transection of colon
V. Transection of colon with segmental tissue loss

Risk Factors for Complications

- Left versus Right Colon: NO
- Associated abdominal injuries: YES
- Shock: YES
- Blood Transfusions: YES
- Fecal Contamination: YES
- Time from Injury to Operation: NO
- Retained missile: NO
- Skin Closure: YES
Primary Repair
Randomized Prospective Series

<table>
<thead>
<tr>
<th>Patients</th>
<th>Complications Diversion</th>
<th>Complications Primary Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chappius (Ann Surg 91)</td>
<td>56</td>
<td>21%</td>
</tr>
<tr>
<td>Sasaki (J Trauma 95)</td>
<td>71</td>
<td>36%</td>
</tr>
<tr>
<td>Gonzalez (J Trauma 96)</td>
<td>109</td>
<td>25%</td>
</tr>
<tr>
<td>Gonzalez (Am Surg 2000)</td>
<td>176</td>
<td>21%</td>
</tr>
</tbody>
</table>

Despite these series, controversy continues over the indications for primary repair in colon injury!
Primary Repair in All Colon Injuries?

- AAST Multi-institutional observational trial.
  - 297 patients
  - 88 patients diverted
  - 4 deaths (4.5%), all in diversion group
  - Concluded all patients should undergo primary repair


EAST Practice Management Guideline: Recommendations

- 1st: Colon repair or R & A on all low risk patients

- 2nd: Conditionally recommend colon repair or R & A on all high risk patients. Colostomy may have limited role in select patients
Damage Control Laparotomy (DCL)

• Colostomy can be a technical challenge with an open abdomen
• Anastomosis may be a safe alternative
• Class III data suggests primary repair at subsequent operation may be a safe option.
• EAST Guidelines: Conditionally recommend NO mandatory colostomy even in delayed anastomosis colon repair may be performed. Clinical judgement is paramount.
When to Perform Primary Repair in DCL

- Primary repair should always be first consideration
- Should primarily repair injuries that do not require resection in all instances

When to Perform Primary Repair in DCL

- In high risk patients (> 12 hrs, shock, assoc. injuries, > 6 u prbcs, contamination) should do primary repair or R&A
- Damage Control: definitive repair in most; clinical judgement is paramount
War-Related Colon Injuries

- Vertrees: No difference in outcomes between colostomy and primary repair
- 65 war related colon injuries
- Emergency War Surgery
  - Consider colostomy in high risk


Colonic Leak

- Primary Repair: 3.5%
- Resection/Anastomosis: 5.5%
  - Colocolostomy: 9.0%
  - Ileocolostomy 4.2%

Majority of repair/anastomotic leaks managed by IR drainage and low residue diet
**Hand Sewn versus Stapled Anastomosis**

- No difference in complication rates
- No difference single vs. two layer

**Mortality**

**Colon Injury**

Mortality Causes:

1) Exsanguination
2) Sepsis & MOF (2-3%)

(Higher in Diversion than Primary Repair)
Complications
Colon Injury

Infectious Complications:

Abscess: 5-15%
Fistulas: 1-2%
Wound Infections: can close up to 50% of skin incisions

Colostomy Closure
Following Colon Injury

- Timing: usually 6-8 weeks
  - Published series average 100 days
  - Must have resolution of complications
  - Can be done on same admission

- Barium Enema: not necessary unless complications
Colostomy Closure
Collective Series

Complications:  
- 7.6% wound infection
- 2.7% anastomotic leak
- 2.3% bowel obstruction

Conclusions
- Primary Repair in all not requiring resection
- Primary anastomosis in most requiring resection
- A stoma can compromise wound management and closure in DCL
- Delayed primary anastomosis can be performed in most damage control procedures
Rectal Injuries
Significant Differences to Colon Injury

- 2/3’s are extraperitoneal
- Surrounded by bony pelvis
- Accessible via anus

* Cannot reliably treat by primary repair
Rectal Injury
Demographics

- 80% attributed to firearms
- 3% attributed to stabs and impalements
- 10% attributed to blunt trauma
- 6% transanal injuries
- 30% associated with bladder injuries

AAST Rectal Organ Injury Scale

I. Contusion or hematoma; partial thickness injury
II. Laceration ≤ 50% Circumference
III. Laceration > 50% Circumference
IV. Full thickness laceration with extension into perineum
✓ Devascularized Segment
Diagnosis of Rectal Injury

- High suspicion based on mechanism
- Digital examination
- CT Scan / X-rays
- Proctoscopy
- Evidence of injury, assume injury
- Consider water soluble contrast for equivocal cases

Treatment of Rectal Injury

- Current management adopted from Vietnam war experience
- 4 tenets of care:
  1) Debridement and Repair
  2) Fecal Diversion
  3) Presacral drainage
  4) Rectal irrigation
Debridement and Repair

- Intraperitoneal rectal injury
- Extraperitoneal rectal injury
  - Associated bladder injury
  - Significant wall loss

Treatment of Rectal Injury

Ivatury: Tailor surgery according to extent of injury

- Intraperitoneal injuries can be primarily repaired without colostomy
- Treat extraperitoneal injuries with colostomy and drainage
- If significant extraperitoneal rectal wall loss, repair, drain and consider Hartmann’s
Fecal Diversion

- Loop, loop with closed distal stoma, loop with mucus fistula, Hartmann’s
- Rombeau (Dis Col Rec 78): Barium study
- Colostomy location
- Loop colostomy best option

Loop Colostomy

- Maintain spur above distal lumen
- Most easily constructed
- Most easily re-anastomosed
Presacral Drainage

- Considered by many a necessary tenet
- Open versus closed
- Removal: 4th - 7th post-op day
- Recent controversy over necessity

Presacral Drainage
Pro-Drainage

- Lavenson & Cohen (Am J Surg 71)
- Armstrong (Surg 83)
- Tuggle & Huber (Am J Surg 84)
- Burch et. al. (Ann Surg 89)
Presacral Drainage

Anti-Drainage

- Thomas et al. (Am Surg 90)
- Levy et. al. (J Trauma 95)
- Mangiante et. al. (Surg 86)
- Gonzalez (J Trauma 98)

Presacral Drainage

EAST Guidelines 2016

- Conditionally recommend avoidance of routine presacral drainage
Rectal Irrigation

- Compelling data of support - Vietnam War
  - Lavenson & Cohen (Am J Surg 71)
- No conclusive supportive data in civilian population
  - Shannon et al. (J Trauma 88)

Rectal Irrigation

Several authors have shown no benefit:
- Tuggle & Huber (Am J Surg 84)
- Burch et al (Am J Surg 89)
- Thomas et al (Am Surg 90)
- University of Illinois (J Trauma 98)

Rectal irrigation probably of no benefit in the civilian population
Antibiotics in Rectal Injury

- Class I data that 24 hr prophylaxis is as effective as 3-5 days
- Monotherapy as effective as combination therapy

Rectal Injury Complications

- Mortality: 0-5%
- Abscess: 3-10%
- Rectal Fistula: 0-5%
Penetrating Rectal Injury
Associated Bleeding

- Often have associated bleeding in presacral and perirectal space
- Several treatment methods described:
  - Packing
  - Angiographic embolization
  - Thumbtacks
  - Foley balloon tamponade

Penetrating Rectal Injury

- Trajectory of missile through extraperitoneal rectum
- Often confront significant bleeding from the presacral venous plexus
Foley Tamponade Technique

- Place foley in bullet tract and inflate at point of bleed
- Suture peritoneum at balloon site
- Occlude foley if necessary

Foley Tamponade Technique

- Foley exiting opposite colostomy
- Deflate foley at 5 days assuming stable hemodynamics and hematocrit
Rectal Injuries
Associated with Pelvic Fractures

Causes: Bone spicules, Anorectal lacerations

Treatment

Control hemorrhage first
Determine if open vs. closed
Assess and repair rectal laceration
Diversion of fecal stream if necessary
Drain

Conclusions

- All penetrating injuries of the colon can be primarily repaired.
- Consider colonic diversion when destructive injury requires resection.
- Rectal injuries require diversion when extraperitoneal and repair when intraperitoneal
- Distal irrigation, repair of extraperitoneal injuries and presacral drainage are questionable adjuncts