Complications of Urinary Diversion

UGR 2007 Derek Ottem

OVERVIEW

- Classification of Urinary Diversion
- Factors Influencing Complications
- Complications According to Bowel Segment
- Metabolic / Physiological Complications
- Surgical Complications: Early and Late
CLASSIFICATION OF DIVERSION

- Orthotopic
- Heterotopic
  - Continent cutaneous
  - Non-continent cutaneous
  - Diversion to GIT

FACTORS INFLUENCING COMPLICATIONS

- Patient factors
- Bowel Factors
PATIENT FACTORS

- Performance status / Co-morbidities
- Pt / Caregiver compliance with CIC
- Mobility
- Previous XRT
- Renal function
- Liver function
- Body habitus
- BMI

BOWEL / TECHNICAL FACTORS

- Type of intestinal segment used
- Length of intestinal segment
- Continent vs continuously draining
- Method / extent of detubularization
- Capacity
- Compliance
- Refluxing or non-refluxing uretero-intestinal anastomosis
- Type of diversion chosen
**STOMACH COMPLICATIONS**

- Hypochloremic hypokalemic metabolic alkalosis
- Hyper-gastrinemia
- Hematuria Dysuria Syndrome

**JEJUNUM COMPLICATIONS**

- Most severe metabolic complications
- Hyponatremia
- Hyperkalemic hypochloremia metabolic acidosis
- Severe dehydration
Ileum

- Hyperchloremic hypokalemic metabolic acidosis
- Vit B12 deficiency

COLON

- Hyperchloremic hypokalemic metabolic acidosis
METABOLIC / PHYSIOLOGICAL COMPLICATIONS

- Renal deterioration
- Electrolyte disturbances
- Hypertension
- Altered sensorium
- Abnormal drug metabolism
- Osteomalacia
- Abnormal growth and development
- Vitamin deficiencies
- Anemia
- Chronic diarrhea
- Hyper-gastrinemia

ELECTROLYTE DISTURBANCES

- Colon and Ileum
  - Hypokalemic hyperchloremic metabolic acidosis
- Stomach
  - Hypokalemic hypochloremic metabolic alkalosis
- Jejunum
  - Hyperkalemic hyperchloremic hyponatremic metabolic acidosis
- Hyperammonemia
- Hypomagnesemia
- Hypocalcemia
HYPERCHLOREMIC METABOLIC ACIDOSIS: INCIDENCE

- 15% of ileal conduits
  - 10% severe enough to require treatment
- 20% of colon conduits
  - 15% require treatment
- 50% Ileal or colonic pouches
  - 40%
- 80% of Ureterosigmoidostomy
HYPERCHLOREMIC METABOLIC ACIDOSIS: Symptoms

- Easy fatigability
- Anorexia
- Weight loss
- Polydipsia
- Lethargy
- Exacerbation of diarrhea in GI diversions

HYPERCHLOREMIC METABOLIC ACIDOSIS: MOA

- NET ABSORPTION of AMMONIUM + Cl
- Increased secretion of HCO3
- Impaired distal tubule hydrogen secretion
PHYSIOLOGICAL RESPONSE

- Increased acid secretion by kidney
- Bone demineralization to buffer acidosis

*Figure 3*

*Mechanism of hyperchloremic metabolic acidosis.*
TREATMENT OF HYPERCHLOREMIC METABOLIC ACIDOSIS

- Alkalinizing Agents
  - NaHCO3
  - K-Citrate
  - Na-Citrate
- Blockers of Cl Transport
  - Chlorpromazine
  - Nicotinic acid

STOMACH
HYPOCHLOREMIC METABOLIC ALKALOSIS:

INCIDENCE

• Rare unless
  • Concomitant renal failure
  • Severe dehydration – Often triggered by vomiting or gastrointestinal illness
  • High serum gastrin levels
  • Overdistention of gastric segment – triggers gastrin release

Symptoms

• Lethargy
• Weakness
• Respiratory insufficiency
• Seizures
• Ventricular arrhythmia
HYPOCHLOREMIC METABOLIC ALKALOSIS: MOA

- H+ K+ and Cl loss in gastric segment
- Net addition of HCO3
- Serum gastrin levels correlate with systemic HCO3 concentration

HYPOCHLOREMIC METABOLIC ALKALOSIS: Treatment

- Acute severe metabolic alkalosis
  - Empty bladder
  - NaCl volume replacement
  - H2 blocker
  - PPI
  - Arginine hydrochloride
  - Surgical removal of gastric segment
HYPOCHLOREMIC METABOLIC ALKALOSIS:
Treatment
- Mild or Prophylaxis
  - Oral Na and K supplementation
  - H2 blockers

HYPOKALEMIA:
INCIDENCE
- Colonic diversions
  - 30% reduction in total body K
- Ileal diversions
  - 0-15% reduction in total body K
HYPOKALEMIA: MOA

- Colon or ileum diversions
  - Ileum may re-absorb some K passively blunting the loss
- Chronic metabolic acidosis
- Dehydration
- Renal K wasting

HYPOKALEMIA: SYMPTOMS

- Typically no symptoms
- At most severe
  - Muscle weakness
  - Paralysis
HYPOKALEMIA:
TREATMENT

- Correction of metabolic acidosis
  - Beware of acutely worsening K as it moves back to intracellular stores
- Oral K supplementation

ALTERED SENSORIUM:
MOA

- Hypomagnesemia
- Drug re-absorption
- Ammoniogenic encephalopathy
ALTERED SENSORIUM: HYPOMAGNESEMIA

- Renal loss
- Chronic diarrhea
- Decreased absorption

ALTERED SENSORIUM: HYPOMAGNESEMIA: SYMPTOMS

- Cardiac arrhythmias
- Tremor
- Tetany
- Seizures
ALTERED SENSORIUM

HYPOMAGNESESEMIA: TREATMENT

- Mg Replacement

AMMONIOGENIC: MOA

- Ammonium (NH4) secreted by kidney
- Ammonia (NH3) is produced by urease splitting bacteria (does not contribute to acidosis – no H+) but does contribute
- Reabsorbed and transferred to liver by portal circulation
- Normally liver copes and converts ammonia to urea
AMMONIA INTOXICATION:
RISK FACTORS

- Typically in pre-existing or acquired liver disease
- Ureterosigmoidostomies > Colon or ileal conduits
- Triggers in setting of liver disease
  - Constipation
  - Increased protein load
  - GI bleed
  - UTI with ammonia producer
  - Co-existing CNS depressant use
  - Renal failure
- Normal liver
  - Bacterial endotoxin – liver dysfunction with normal LFT’s

AMMONIA INTOXICATION:
SYMPTOMS

- Apathy
- Restlessness
- Sleep disturbances
- Impaired intellectual abilities
- Asterixis and lethargy
- Stupor
- Coma
AMMONIA INTOXIFICATION: TREATMENT

- Decrease nitrogen load / Remove precipitants
  - Drain urine diversion
  - Limit dietary protein / Vegetable better than animal
  - Treat any systemic or urinary infection
- Lactulose
  - Lowers gut pH so more NH4 than NH3
  - Promotes non urease producing bacteria
  - Decreases transit time of fecal matter
  - Complexes the ammonia
- Neomycin or tetracycline
  - Eliminate ammonia producing bacteria from GIT
- Arginine Glutamate
  - Complexes ammonia

ABNORMAL DRUG METABOLISM

- Drugs absorbed in GIT
- Drugs excreted unchanged in the urine
- Reabsorbed by intestinal segment
LIST OF DRUGS

- Dilantin
- Methotrexate / Chemotherapeutics
- Theophylline
- Antibiotics (Beta lactams, nitrofurantoin, aminoglycosides)

Chemotherapy

- Ensure patient well hydrated
- Drain diversion with catheter
- Consider leukovorin administration with methotrexate
Methotrexate Tolerance in Patients with Ileal Conduits and Continent Diversions

Sandy Srinivas, M.D.¹
Kamran Mahalati, M.D.²
Fuad S. Freiha, M.D.²

¹ Division of Oncology, Veterans Affairs Medical Center, Palo Alto, California.
² Department of Urology, Stanford Medical Center, Stanford, California.

METHODS

• Compared 23 patients with continent diversion to 19 patients with ileal loop for toxicity to methotrexate / cisplatin and vinblastine (CMV)
• None of continent diversion were drained with catheter
**TABLE 2**

Toxicity Profile

<table>
<thead>
<tr>
<th>Toxicities</th>
<th>Continent diversion</th>
<th>Ileal conduits</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucositis</td>
<td>4 (17)</td>
<td>5 (26)</td>
<td>0.707</td>
</tr>
<tr>
<td>Creatinine elevation</td>
<td>9 (38)</td>
<td>6 (32)</td>
<td>0.611</td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td>10 (43)</td>
<td>6 (32)</td>
<td>0.479</td>
</tr>
<tr>
<td>Fever/neutropenia</td>
<td>3 (13)</td>
<td>6 (32)</td>
<td>0.257</td>
</tr>
<tr>
<td>Neutropenia</td>
<td>15 (65)</td>
<td>11 (57)</td>
<td>0.626</td>
</tr>
<tr>
<td>Thrombocytopenia</td>
<td>2 (1)</td>
<td>2 (1)</td>
<td>1.0</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>2 (1)</td>
<td>4 (2)</td>
<td>0.384</td>
</tr>
<tr>
<td>Delay in chemotherapy</td>
<td>14 (60)</td>
<td>16 (84)</td>
<td>0.091</td>
</tr>
<tr>
<td>Dose Modification</td>
<td>10 (43)</td>
<td>9 (47)</td>
<td>0.901</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

- No difference in toxicity between continent diversion and ileal conduit
OSTEOMALACIA

- Potential long term complication
- Children and adults
- Bone demineralization
- Mineralized component of bone is replaced with osteoid

OSTEOMALACIA: RF

- Bowel segment used:
  - Ureterosigmoidostomies most commonly
  - Colon or ileal cytoplasties
  - Colon or ileal conduits
  - Colon or ileal neobladders
- Renal failure
- Chronic untreated metabolic acidosis
OSTEOMALACIA: MOA

- Bone buffering of chronic metabolic acidosis
- Vitamin D resistance – less Ca absorption by GIT
- Vitamin D deficiency – acidosis limits Vit D production
- Sulphate in urine inhibits Ca and Mg re-absorption
- Resistance to PTH
- =Calcium loss

OSTEOMALACIA: LABS

- HCO3 levels not necessarily important
- Base deficit of >2.5mEq should be corrected
- Ca and Mg levels may be normal or only slightly low
- Alkaline phosphatase high
- P04 low
- PTH and Vit D levels often normal
- Often difficult to detect with lab tests
OSTEOMALACIA: IMAGING

- Bone densitometry – often normal

OSTEOMALACIA: SYMPTOMS

- Diffuse skeletal pain
- Bone tenderness
- Fractures
- Gait disturbances
- Proximal muscle weakness
OSTEOMALACIA: Prevention

- Particularly important in postmenopausal women and children
- Treat underlying metabolic acidosis
- Vitamin C
- Vitamin D

OSTEOMALACIA: TREATMENT

- Activated Vitamin D metabolite
  - 1-alpha-hydroxycholecalciferol
- Calcium supplementation
VITAMIN DEFICIENCY

- ADEK - fat soluble lost in malabsorption of fat
- Vit B12 – absorbed in distal ileum

VIT B12 DEFICIENCY: ETIOLOGY

- Not synthesized by mammals – only dietary source
- B12 released from food by enzymes in stomach
- Bound to IF in duodenum
- Absorbed in terminal ileum
- Stored mainly in liver
- Total body stores 2-5 mg, loss of 0.1% daily
- Takes 2-4 years for deficiency to take effect
- 3-20% incidence after terminal ileum resection
VIT B12: SYMPTOMS

- Neurological
  - Peripheral neuropathy
  - Degenerative changes / demyelination in spinal cord (dorsal and lateral columns)
  - Voiding dysfunction
  - Optic neuropathy
- Hematological
  - Megaloblastic anemia
  - Inflammation of tongue / mouth
- Psychiatric disturbances
VIT B12: LABS

- MCV > 120
- Often neutropenia and thrombocytopenia
- Hyper-segmented neutrophils
- Low serum B12

VIT B12: BOWEL SEGMENT

- Continent diversion increased risk
  - Larger bowel segment used
- Terminal ileum / ileocecal junction resected
- Resection of >50cm appears to be a major risk
**VIT B12: TREATMENT**

- **Prevention**
  - Replace with 100ug cobalamin IM monthly starting 1 year after surgery if >50cm ileum removed

- **Treatment**
  - Neurological symptoms may precede any others
  - Treat if the least bit concerned
  - Treat if lab values abnormal but asymptomatic

**SURGICAL COMPLICATIONS:**

**Early**

- Wound infection
- Intra-abdominal abscess
- Pyelonephritis
- Hemorrhage
- Urine leak / fistula
- Bowel leak / fistula
- Ileus
- Bowel obstruction
- Stomal bleeding / necrosis
SURGICAL COMPLICATIONS: LATE

- Wound hernia or dehiscence
- Bowel obstruction
- Ureteral stricture / obstruction
- Urinary infections / Pyelonephritis
- Urinary stones
- Excessive conduit length
- Renal deterioration
- Stomal stenosis / parastomal hernia / dermatitis
- Increased malignancy risk
- Excessive mucous production
- Hematuria dysuria syndrome (gastric)

STOMAL COMPLICATIONS

- Early
  - Bleeding
  - Necrosis
- Late
  - Dermatitis
  - Retraction
  - Prolapse
  - Parastomal hernia
  - Stomal stenosis
STOMAL BLEEDING

- Early
  - Conservative treatment
  - Most will stop with pressure / time
- Late
  - Liver disease – superficial dilated veins
  - Correct underlying coagulopathy
  - Ligation
  - Porto-systemic shunts

PARASTOMAL HERNIAS

- Incidence
  - 10% ileal conduit
  - 20% colon conduit
- Risk Factors
  - Wound infection
  - Steroid use
  - Malnutrition
  - Obesity
  - Chronic cough
  - Advanced age
  - Stoma not brought out through rectus muscle
PARASTOMAL HERNIAS: Symptoms

- Mainly asymptomatic
- Pain
- Poor fitting appliance
- Peri-stomal skin irritation
- Bowel strangulation or obstruction

PARASTOMAL HERNIA: Treatment

- Conservative
  - Observation
  - Stoma belt
- Indications for surgical repair
  - Large hernia
  - Appliance not fitting properly
  - Symptoms (pain or GI)
  - Cosmetic
PARASTOMAL HERNIA: Treatment

- Repair at original site open
  - Circumscribe mucosa and fascial attachments
  - Close fascial defect
- Repair at original site MIS
  - Close defect with Gore-Tex mesh
  - High failure rate
- Move stoma to new site
  - Contralateral side of abdomen
  - Mesh repair of defect at original site

<table>
<thead>
<tr>
<th>Approach</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary fascial repair</td>
<td>Technically simple</td>
<td>Highest failure rate</td>
</tr>
<tr>
<td></td>
<td>Low morbidity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avoids stoma relocation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avoids laparotomy</td>
<td></td>
</tr>
<tr>
<td>Stoma relocation</td>
<td>Lower recurrence rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repair with mesh</td>
<td>Lowest recurrence rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concurrent incisional hernia can be repaired with mesh</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>May require a laparotomy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mesh erosion into bowel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mesh infection</td>
</tr>
</tbody>
</table>
Recurrence Rates After Repair

- Primary fascial repair
  - 76% for 1\textsuperscript{st} time
  - 90-100% 2\textsuperscript{nd} or greater
- Mesh Repair (Peristomal / Lateral / Laparotomy)
  - 5-40%
- Stomal Relocation
  - 40-50%
- MIS
  - 50%

Laparoscopic repair of parastomal hernias

Early results

B. Safadi

Department of Surgery, Stanford University, Veteran Affairs Palo Alto Health Care System, 3801 Miranda Avenue, 112G, Palo Alto, CA 94304, USA

Received: 1 April 2003/Accepted: 22 September 2003/Online publication: 19 March 2004

DOI: 10.1007/s00464-003-8518-x

© Springer-Verlag New York, LLC 2004
Methods

- 9 patients
  - 5 ileal conduits
  - 2 ileostomies
  - 2 sigmoid colostomies
  - Mean follow up 24 months

Methods

- Supine
- Hassan port on opposite side from stoma
- Foley in stoma and balloon inflated
- Adhesions taken down
- Any omentum or bowel contents in hernia sac taken down
- Gore-Tex mesh (either prepared inside or outside the patient)
- Mesh either cut with slit (no 360 degree coverage) or hole cut in middle
- Suture fixation of mesh to abdominal wall
Table 1. Results of laparoscopic repair of parastomal hernia

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age (yr)</th>
<th>Stoma</th>
<th>OR time (min)</th>
<th>Incisional hernia repair</th>
<th>Immediate complication</th>
<th>LOS (d)</th>
<th>Follow-up</th>
<th>Further intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>61</td>
<td>Ileostomy</td>
<td>136 +</td>
<td>Urinary retention</td>
<td>6</td>
<td>18 mo, NR</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>77</td>
<td>Ileostomy</td>
<td>177</td>
<td>Ileus</td>
<td>7</td>
<td>21 mo, NR</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>53</td>
<td>Sigmoid colostomy and mucous fistula</td>
<td>360 +</td>
<td>None</td>
<td>2</td>
<td>33 mo, NR</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>54</td>
<td>Ileal conduit</td>
<td>237</td>
<td>None</td>
<td>4</td>
<td>Recurrence&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Redo lap repair with mesh—failed</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>63</td>
<td>Ileal conduit</td>
<td>225</td>
<td>None</td>
<td>6</td>
<td>Recurrence&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Asymptomatic bulge—none</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>77</td>
<td>Ileal conduit</td>
<td>300</td>
<td>None</td>
<td>5</td>
<td>Died @ 16 mo, NR</td>
<td>Redo lap repair with mesh—failed</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>75</td>
<td>Sigmoid colostomy</td>
<td>237</td>
<td>Ulnar neuropathy</td>
<td>6</td>
<td>Recurrence&lt;sup&gt;a&lt;/sup&gt;</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>73</td>
<td>Ileal conduit</td>
<td>273 +</td>
<td>None</td>
<td>2</td>
<td>Urostomy prolapse&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Local repair</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>64</td>
<td>Ileal conduit</td>
<td>239</td>
<td>None</td>
<td>5</td>
<td>Recurrence&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Redo lap repair (sutures)—failed</td>
<td></td>
</tr>
</tbody>
</table>

OR, operating room; LOS, length of stay; NR, no recurrence; NA, not applicable; lap, laparoscopic
<sup>a</sup> Within 6 months of date of operation

Conclusion

- High failure rate
  - Attributed to technical failures with mesh
  - Inadequate margins around hernia
  - Not secured properly
  - Bowel sliding through slit
  - Mesh retraction
- Technical improvements may increase success
### Table 3. Review of the literature on laparoscopic parastomal hernia repair

<table>
<thead>
<tr>
<th>First author [ref]</th>
<th>Year</th>
<th>No. of patients</th>
<th>Stoma</th>
<th>Mesh</th>
<th>Recurrence</th>
<th>Follow-up (mo)</th>
<th>Morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hansson [8]</td>
<td>2003</td>
<td>3</td>
<td>NA</td>
<td>Gore-Tex Dual</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Doel [5]</td>
<td>2003</td>
<td>1</td>
<td>Ileal conduit</td>
<td>Polyene</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Gould [7]</td>
<td>2003</td>
<td>1</td>
<td>Colectomy</td>
<td>Gore-Tex Dual</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Pekmezci [16]</td>
<td>2002</td>
<td>1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>LeBlanc [10]</td>
<td>2002</td>
<td>3</td>
<td>Colectomy (2), ileostomy (1)</td>
<td>Gore-Tex Dual</td>
<td>0</td>
<td>3-11</td>
<td>0</td>
</tr>
<tr>
<td>Dunet [6]</td>
<td>2001</td>
<td>1</td>
<td>Ileal conduit</td>
<td>PTFE</td>
<td>0</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>Votik [22]</td>
<td>2000</td>
<td>4</td>
<td>Colectomy</td>
<td>Prolene</td>
<td>0</td>
<td>2-12</td>
<td>0</td>
</tr>
<tr>
<td>Bickel [3]</td>
<td>1989</td>
<td>1</td>
<td>Colectomy</td>
<td>Prolene</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Porcheron [17]</td>
<td>1988</td>
<td>1</td>
<td>Colectomy</td>
<td>PTFE</td>
<td>0</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>

NA, not available; PTFE, polytetrafluoroethylene
Methods

- Supine
- Lateral incision 10 cm away from stoma
- Dissected onto external oblique fascia and followed this medially to stoma
- Hernia sac supero-lateral in all cases to stoma
- Circumscribed intact and reduced
- Fascial defect closed with interrupted non-absorbable sutures
- Re-inforced with mesh (not around entire circumference of stoma)

Complications

- 2 patients with large hernia developed ischemia
  - 1 required re-fashioning stoma
  - 1 required new conduit creation
Results

- 3/15 failures
- 2/15 had serious complication

Conclusions

- Good early results
- Avoids contact with stoma bud
- Reduced chance of infection?
- Incision provides good access to most common location of defect – superolateral
- In large defects – ensure the fascia is not overtightened
Incidence and Risk Factors of Stomal Complications in Patients Undergoing Cystectomy With Ileal Conduit Urinary Diversion for Bladder Cancer

Erik Kouba, Matt Sands, Aaron Lentz, Eric Wallen and Raj S. Pruthi

From the Division of Urologic Surgery, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina
### Table 2. Patient demographics

<table>
<thead>
<tr>
<th></th>
<th>No Complications</th>
<th>Complications</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. gender (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>82 (71)</td>
<td>15 (85)</td>
<td>0.917</td>
</tr>
<tr>
<td>Female</td>
<td>34 (29)</td>
<td>5 (25)</td>
<td></td>
</tr>
<tr>
<td>Mean pt age (median)</td>
<td>68.9 (71.0)</td>
<td>71.5 (75.0)</td>
<td>0.344</td>
</tr>
<tr>
<td>Mean kg/m² BMI (median)</td>
<td>26.5 (26.0)</td>
<td>30.8 (28.8)</td>
<td>0.012*</td>
</tr>
<tr>
<td>Mean mg/dl preop creatinine (median)</td>
<td>1.2 (1.1)</td>
<td>1.2 (1.1)</td>
<td>0.814</td>
</tr>
<tr>
<td>No. XRT (%)</td>
<td>26 (22)</td>
<td>5 (25)</td>
<td>0.784</td>
</tr>
<tr>
<td>No. race (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>12 (10)</td>
<td>1 (5)</td>
<td>0.743</td>
</tr>
<tr>
<td>White</td>
<td>101 (86)</td>
<td>18 (80)</td>
<td>0.927</td>
</tr>
<tr>
<td>Other</td>
<td>4 (4)</td>
<td>1 (5)</td>
<td>0.727</td>
</tr>
</tbody>
</table>

* p <0.05.

### Table 3. Complication rates stratified by BMI

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Overweight</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. pts</td>
<td>45</td>
<td>55</td>
<td>33</td>
</tr>
<tr>
<td>Mean age</td>
<td>70.3</td>
<td>71.2</td>
<td>64.3*</td>
</tr>
<tr>
<td>Mean BMI (kg/m²)</td>
<td>21.8</td>
<td>27.1†</td>
<td>35.4†</td>
</tr>
<tr>
<td>% Complication rate</td>
<td>4.1</td>
<td>16.4*</td>
<td>27.3†</td>
</tr>
</tbody>
</table>

* p <0.05 compared to normal.
† p <0.01 compared to normal.
STOMAL STENOSIS

- Incidence
  - 3-25% of ileal conduits
  - 10-20% of colon conduits
  - Catheterizable stomas 50%
  - Brooke > Turnbull Loop

STOMAL STENOSIS: Risk Factors

- Type of Stoma
  - Catheterizable > End > Loop
- Technical
  - Protruding stoma better than flush for non-continent
  - Insufficient fascial opening
- Muscle spasms
- Ischemia
- Infection
- Poor stomal hygiene
- Improperly fitting appliance
STOMAL STENOSIS: Symptoms

- Suspect in
  - Metabolic derangements
  - Infections / Pyelonephritis / Sepsis
  - Urolithiasis
  - Renal decline

STOMAL STENOSIS: Work Up

- Conduit residual urine volume with catheterization
- Loopogram
  - Elongation
  - Reflux
  - Upper tract dilation
  - Filling defects
  - Intestinal segment stenosis
STOMAL STENOSIS:

Treatment

- Typically requires surgical repair

RENAL DETERIORATION AND REFLUXING ANASTOMOSIS

- Renal function required for urine diversion
  - Cr < 200 and normal urine protein
- If Cr >200 require
  - Urine Osm >600 with water deprivation
  - Urine pH <5.8 with NH4Cl challenge
  - GFR >35ml/min
  - “Minimal urine protein”
CAUSES OF RENAL DECLINE

- Pre-renal and renal causes
- Obstruction
  - Stomal stenosis
  - Urethral stricture
  - Ureteroanastomotic stricture
  - Ureteral stricture
  - Ureteral stones
- Urinary infection / pyelonephritis
- Lack of ureteral motility (infection / ischemia)
- Reflux +/- of colonized urine

INCIDENCE OF RENAL DECLINE

- Normal decline in GFR 1ml/min / year at age >50
- Most studies – renal decline is >25% of pre-op GFR
- Varying reports
- On average 10-40% incidence at 10 years
REFLUXING VS NONREFLUXING
ANASTOMOSIS AND CRF

- Controversial topic
- Conflicting evidence
- Different consequences depending on diversion type

Ureterosigmoidostomy

- Very high pressures generated during defecation (up to 200cmH20)
- Reflux of fecal contaminated urine to kidney
- High chance of pyelonephritis
- Non-refluxing anastomosis important
Colon Conduits

- Conflicting Reports
- Retrospective evidence
- Elder 1979
  - Retrospective study
  - 79% refluxing units
  - 22% non-refluxing units
- Hill and Ransley
  - 18% of refluxing units
  - 17% non-refluxing units

Ileal Conduits

- Conflicting data
- Mansson 1984
  - No difference in renal function between refluxing and non-refluxing ureters at 5 years
- Kristjansson 1995 BJU
  - No difference in renal decline in ileal conduit pt’s randomized to refluxing or non-refluxing anastomosis
  - Non-refluxing anastomosis did lessen upper tract bacterial colonization and scarring by DMSA – more pronounced in conduits than continent
- No RCT / Prospective studies
Neobladders

- Is reflux prevention in neobladders as important as native bladders?
  - No coordinated contraction during voiding
  - Simultaneous pressure increase in abdomen/pelvis, renal pelvis and neobladder during valsalva voiding
  - Neobladder – urethostomy (in absence of scar) acts as “pop off valve” for high pressures
  - Ureteral contraction should prevent some pressure transmission

Neobladders

- Studor
  - 3% obstruction rate for refluxing
  - 13% obstruction with non-refluxing
- Pantuck 2000
  - 1.7% stricture in refluxing
  - 13% in non-refluxing
- Hautmann
  - 9.5% stricture rate with Le Duc technique (363 pt’s)
  - 1% stricture in direct end-side (194 pt’s)
ADVANTAGES OF REFLUXING ANASTOMOSIS

- Monitoring for anastomotic or upper tract malignancy
  - Loopogram – reflux enables retrograde ureteropyelography
- Easier to perform / faster
- Less incidence of stricture

URETEROENTERIC ANASTOMOSIS IN CONTINENT URINARY DIVERSION: LONG-TERM RESULTS AND COMPLICATIONS OF DIRECT VERSUS NONREFLUXING TECHNIQUES

ALLAN J. PANTUCK, KEN-RYU HAN, MICHAEL PERROTTI, ROBERT E. WEISS AND KENNETH B. CUMMINGS

From the Division of Urology, Robert Wood Johnson Medical School, New Brunswick, New Jersey

- Prospective study
- Non-randomized
- 4 surgeons
- Indiana Pouch
  - Refluxing and non-refluxing
- Ileal Neobladder
  - Refluxing and non-refluxing
ENDPOINTS

- Renal function
  - Cr pre and post OP
- Complications
  - Pyelonephritis
  - Uretero-anastomotic stricture
  - Hydronephrosis
  - Urinary stones
  - Azotemia
- Mean follow up 41 months

FIG. 1. Nesbit non-tunneled, end-to-side anastomosis
Fig. 2. Le Duc tunneled anastomosis into mucosal trough

Fig. 4. Goodwin tunneled transcolonic anastomosis
**Complications of direct and tunneled ureterointestinal anastomosis**

<table>
<thead>
<tr>
<th></th>
<th>% Direct Anastomosis (No. pts.)</th>
<th>Tunneled Anastomosis (No. pts.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anastomotic stricture</td>
<td>1.7 (1)</td>
<td>13 (8)</td>
</tr>
<tr>
<td>Pyelonephritis</td>
<td>5.4 (3)</td>
<td>6.6 (5)</td>
</tr>
<tr>
<td>Nonobstructive upper tract dilatation</td>
<td>7 (4)</td>
<td>3.3 (3)</td>
</tr>
<tr>
<td>Stone formation</td>
<td>1.8 (1)</td>
<td>1.6 (1)</td>
</tr>
<tr>
<td>Azotemia</td>
<td>0 (0)</td>
<td>6.7 (4)</td>
</tr>
</tbody>
</table>

Differences between groups were not significant except in cases with strictures (p <0.05).
CONCLUSIONS

- Strictures posed greater risk to upper tracts than refluxing anastomosis
- Preferred method of uretero-intestinal anastomosis in continent diversion is direct / refluxing

URETEROENTERIC ANASTOMOTIC STRICTURES: Incidence

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Stricture%</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLON</td>
<td></td>
</tr>
<tr>
<td>Leadbetter-Clarke</td>
<td>14%</td>
</tr>
<tr>
<td>Strickler</td>
<td>14%</td>
</tr>
<tr>
<td>Pagano</td>
<td>7%</td>
</tr>
<tr>
<td>SMALL BOWEL</td>
<td></td>
</tr>
<tr>
<td>Bricker</td>
<td>7%</td>
</tr>
<tr>
<td>Wallace</td>
<td>3%</td>
</tr>
<tr>
<td>Nipple</td>
<td>8%</td>
</tr>
<tr>
<td>Le Duc</td>
<td>18%</td>
</tr>
</tbody>
</table>
Risk Factors

- Technical
  - Tension
  - Stripping ureteric blood supply
  - Insufficient window through colon mesentery
  - No mucosa to mucosa apposition
- Infection
- Stone passage
- Radiation
- IBD
- Previous urine leak

Symptoms

- Stones acute
- Stricture chronic
- Back pain
- Infections
- Sepsis
Differential Diagnosis

- Ureteral stone
- TCC recurrence

Imaging

- US - Hydroureteronephrosis
  - Does not differentiate reflux from obstruction
- Loopogram
- IVP / CT IVP
- Diuretic renogram
- Antegrade nephrostogram
  - Most useful
  - Therapeutic and diagnostic
  - Tract for antegrade procedures
Treatment: Endoscopic vs Open

- Endoscopic
  - Antegrade vs Retrograde
  - Balloon dilation alone
  - Cold knife incision
  - Laser incision
- Open

Advantages of Endoscopic

- Reasonable 1st line
- Less morbidity
- Shorter hospital stay
- Less OR time
- Less blood loss
- Pt’s with metastatic disease
Disadvantages of Endoscopic

- Higher failure rate
- May complicate future open repair

Factors Associated with Failure of Endoscopic Techniques

- Length >1cm
- Strictures presenting <6 months since surgery
- Left sided strictures
Balloon Dilation

- May assist in stent placement in severe stricture
- High failure rate when used as sole treatment
- DiMarco
  - 85% recurrence at 1 year

COLD-KNIFE ENDOURETEROTOMY FOR NONMALIGNANT URETEROINTESTINAL ANASTOMOTIC STRICTURES

VASSILIS POULAKIS, ULRICH WITZSCH, RACHELLE DE VRIES, AND EDUARD BECHT
Methods

- 40 pt’s
- Non malignant ureterointestinal stricture
- Percutaneous nephrostomy
- Mean stricture length 1.8cm
- Wire passed from above
- Grasped cystoscopically from below
- Cold knife mounted on wire
- Stricture cut 3-6 times
- Stent placed

**FIGURE 2. Algorithm showing outcome of CNI in our patients (n = 40) with UASs (n = 43).**
### TABLE I. Statistical analysis of categorical variables in success of cold-knife incision in group 1 *

<table>
<thead>
<tr>
<th>Variable</th>
<th>Success (n)</th>
<th>Failure (n)</th>
<th>P Value</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>9 (37)</td>
<td>6 (35)</td>
<td>0.966</td>
<td>0.971 (0.269-3.496)</td>
</tr>
<tr>
<td>Male</td>
<td>17 (63)</td>
<td>11 (65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>9 (37)</td>
<td>7 (41)</td>
<td>0.189</td>
<td>1.322 (0.375-4.658)</td>
</tr>
<tr>
<td>Left</td>
<td>17 (63)</td>
<td>10 (50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irradiation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1 (4)</td>
<td>5 (42)</td>
<td>0.018</td>
<td>0.096 (0.010-0.015)</td>
</tr>
<tr>
<td>No</td>
<td>25 (96)</td>
<td>12 (58)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney function</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25%</td>
<td>25 (96)</td>
<td>8 (47)</td>
<td>&lt;0.001</td>
<td>28.125 (3.073-257.426)</td>
</tr>
<tr>
<td>&gt;25%</td>
<td>1 (4)</td>
<td>9 (55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydroureter grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-II</td>
<td>25 (96)</td>
<td>6 (35)</td>
<td>&lt;0.001</td>
<td>45.853 (4.915-427.361)</td>
</tr>
<tr>
<td>III-IV</td>
<td>1 (4)</td>
<td>11 (65)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stricture type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete</td>
<td>7 (27)</td>
<td>14 (82)</td>
<td>&lt;0.001</td>
<td>0.079 (0.017-0.360)</td>
</tr>
<tr>
<td>Partial</td>
<td>19 (73)</td>
<td>3 (18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urinary infection at presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8 (31)</td>
<td>11 (65)</td>
<td>0.028</td>
<td>0.242 (0.066-0.887)</td>
</tr>
<tr>
<td>No</td>
<td>18 (69)</td>
<td>6 (25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of ureter implantation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflexive</td>
<td>20 (77)</td>
<td>14 (92)</td>
<td>0.669</td>
<td>0.714 (0.152-3.340)</td>
</tr>
<tr>
<td>Antirefluxive</td>
<td>6 (23)</td>
<td>5 (18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotic duration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perioperatively</td>
<td>6 (23)</td>
<td>7 (41)</td>
<td>0.206</td>
<td>0.429 (0.114-1.618)</td>
</tr>
<tr>
<td>After discharge</td>
<td>20 (77)</td>
<td>10 (59)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extravasation during cold-knife incision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8 (31)</td>
<td>6 (25)</td>
<td>0.757</td>
<td>0.845 (0.225-2.982)</td>
</tr>
<tr>
<td>No</td>
<td>18 (69)</td>
<td>11 (77)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data presented as the number of patients, with the percentage in parentheses unless otherwise noted.

* Pearson chi-square test.

### TABLE II. Statistical analysis of continuous variables in success of cold-knife incision in group 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>Success</th>
<th>Failure</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>67.68 (5.16)</td>
<td>68.12 (4.99)</td>
<td>66.93 (5.51)</td>
<td>0.948*</td>
</tr>
<tr>
<td>Stricture length (cm)</td>
<td>1.71 (0.67)</td>
<td>1.33 (0.42)</td>
<td>2.29 (0.55)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Interval to stricture formation (mo)</td>
<td>18.63 (13.58)</td>
<td>26.19 (12.47)</td>
<td>7.06 (2.35)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Incisions (n)</td>
<td>3.63 (1.61)</td>
<td>4.23 (1.07)</td>
<td>2.71 (0.47)</td>
<td>0.001*</td>
</tr>
<tr>
<td>Stent width (F)</td>
<td>8.65 (1.29)</td>
<td>8.58 (1.30)</td>
<td>8.76 (1.31)</td>
<td>0.275*</td>
</tr>
<tr>
<td>Stent duration (wk)</td>
<td>7.81 (1.56)</td>
<td>7.54 (1.03)</td>
<td>8.24 (2.11)</td>
<td>0.424*</td>
</tr>
</tbody>
</table>

Data presented as the mean, with the standard deviation in parentheses.

* Student's t test.

† Wilson's exact test.
Conclusions

- 60% success at 3 years follow up
- Failures should be treated with open repair