Complications of Urologic Surgery

Jay D. Raman, MD, FACS
Professor and Chief of Urology
Penn State Health
Milton S. Hershey Medical Center
@urojdr

Acknowledgement

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  – UC San Diego Health System
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  – Study site investigator – urine biomarker trial

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  – Study site investigator – Olympus trial
  – Strategic advisor board

• American Kidney Stone Management (AKSM)
  – Stock ownership

Resources

• AUA Guidelines
• AUA Core Curriculum
• AUA SASP Questions
• AUA Updates
• Contemporary or significant publications
Outline (Potpourri of topics)

- Nerve injury
  - Positional
  - Intra-operative
- Bowel injury
  - General MIS presentation
  - Rectal
- Air embolism (MIS)

Outline (Potpourri of topics)

- Venous thromboembolism (VTE)
- Rhabdomyolysis
- Stone Surgery
  - Ureteroscopy (URS)
  - Shock wave lithotripsy (SWL)
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• Nerve injury
  • Positional
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• Bowel injury
  • General MIS presentation
  • Rectal

• Air embolism (MIS)

Positional Nerve Injury

• Presentation
  – Immediately post-operatively with deficits in the affected nerve distribution
    • Paresthesias (numbness/tingling) – sensory
    • Weakness – motor

• Risk factors:
  – Improper positioning and padding
  – Obesity
  – Prolonged operative duration

Mills JT et al. JUrol 2013
## Lower Extremity Nerve Injury

### (Positional)

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Symptoms</th>
<th>Etiology</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obturator</td>
<td>Thigh weakness (adduction)</td>
<td>Hyperflexion of thigh at hip</td>
<td>Lithotomy</td>
</tr>
<tr>
<td>Posterior tibial</td>
<td>• Weak plantar flexion</td>
<td>Compression of posterior knee against stirrup</td>
<td>Lithotomy</td>
</tr>
<tr>
<td></td>
<td>• Sole &amp; lateral foot sensory loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Posterior calf paresthesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peroneal</td>
<td>• Foot eversion weakness</td>
<td>Stirrup pressure on fibular neck</td>
<td>Lithotomy</td>
</tr>
<tr>
<td></td>
<td>• Foot drop</td>
<td>OR Table pressure on dependent leg</td>
<td>Lateral</td>
</tr>
<tr>
<td>Pudendal</td>
<td>• Perineal sensory loss</td>
<td>Traction of legs and compression against stirrups</td>
<td>Lithotomy</td>
</tr>
<tr>
<td></td>
<td>• Incontinence</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Lower Extremity Nerve Injury (Positional)

<table>
<thead>
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<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sciatic</td>
<td>Lateral calf &amp; foot numbness</td>
<td>Inadequate padding</td>
<td>Supine</td>
</tr>
<tr>
<td>Anterior tibial</td>
<td>Foot drop</td>
<td>Feet in plantar flexion</td>
<td>Prone</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reverse Trendelenburg</td>
</tr>
<tr>
<td>Lateral femoral cutaneous</td>
<td>Numbness of anterior &amp; lateral thigh</td>
<td>Pressure against lateral thigh</td>
<td>Prone</td>
</tr>
</tbody>
</table>

**Chuang et al. AUA Update Series 2011**

## Upper Extremity Nerve Injury (Positional)

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<th>Nerve</th>
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<th>Etiology</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brachial plexus</td>
<td>Shoulder pain</td>
<td>Abduction of arm &gt; 90°</td>
<td>Supine</td>
</tr>
<tr>
<td></td>
<td>Arm weakness</td>
<td>Dependent shoulder and/or arm under rib cage</td>
<td>Lateral</td>
</tr>
<tr>
<td>Radial</td>
<td>Wrist drop</td>
<td>Arm falls off table in supination</td>
<td>Supine</td>
</tr>
</tbody>
</table>

**Chuang et al. AUA Update Series 2011**
### Upper Extremity Nerve Injury (Positional)

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<th>Etiology</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulnar</td>
<td>Weak grip</td>
<td>Hyperextension of forearm, pronation</td>
<td>Supine</td>
</tr>
<tr>
<td></td>
<td>“Claw hand”</td>
<td>Arms folded across chest with elbow flexion 90°</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>Weak hand grip</td>
<td>Arm not secure: suspended off table in pronation</td>
<td>Supine</td>
</tr>
<tr>
<td></td>
<td>Decreased palmar sensation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chuang et al. AUA Update Series 2011

### Operative Nerve Injury

- **Genitofemoral**
  - Function: sensation to scrotum and medial thigh
  - At risk during psoas hitch operation!
Operative Nerve Injury

• Obturator
  – Function: adduction of the leg (i.e. car pedals)
  – At risk during pelvic lymph node dissection

Operative Nerve Injury

• Ilioinguinal
  – Function: sensation to inguinal region and lateral hemiscrotum
  – At risk during orchiectomy or hernia operation!
Outline (Potpourri of topics)

- Nerve injury
  - Positional
  - Intra-operative

- Bowel injury
  - General MIS presentation
  - Rectal

- Air embolism (MIS)

MIS Bowel Injury

- Unrecognized bowel injury after MIS surgery often has an atypical presentation
  - Absence of peritonitis, acute abdomen or leukocytosis

- Symptoms typically 24-48 hrs after surgery
  - Abdominal distention
  - Diarrhea
  - Single trocar-site pain out of proportion to exam without purulence or erythema

Bishoff JT et al. J Urol 1999
MIS Bowel Injury

• Diagnostics
  – CBC: Leukopenia with left shift
  – CT scan of the abdomen and pelvis:
    • Oral contrast at a minimum; triple contrast (IV, oral, and per rectum) preferred
    • Delayed images can be considered
    • Intra-abdominal gas can be expected up to 7 days post-insufflation

Bishoff JT et al. J Urol 1999

MIS Bowel Injury

• Management
  – General surgery consultation
  – Immediate surgical exploration with bowel repair and/or resection
Rectal Injury

- Most common bowel complication of radical prostatectomy
- Posterior dissection particularly the apex is highest risk area
- Surgical approach (MIS vs open) does not impact risk but salvage RP does!
  - 6.86% salvage RP vs. 0.47% for open/MIS

Rectal Injury Management

- Determine if primary closure possible
- Multilayer non-overlapping closure
  - Absorbable for rectal mucosa and serosa
  - Non-absorbable for perirectal tissues
- Investigate integrity using “bubble test” with air bubbles suggesting persistent defect

Mandel P et al. Eur Urol Focus 2017
Liatsikos et al. World J Urol 2008
Rectal Injury Management

- Omental or fat interposition if possible
- Post-operative drain
- Low residue diet for 3-5 days

Outline (Potpourri of topics)

- Nerve injury
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  - General MIS presentation
  - Rectal
- Air embolism (MIS)
Air Embolism

• Results from large volume of insufflation agent (CO₂) entering blood stream
  – Improperly positioned Veress needle
  – Large venous injury

• Gas bubble may travel to right heart or pulmonary artery

Air Embolism

• Impact of gas embolus
  • Obstruct venous return causing reduction in cardiac output
  • Block pulmonary blood flow causing pulmonary HTN or right heart failure

• Clinical clues
  • Sudden hypoxia, hypercarbia, arrhythmia, hypotension, or cyanosis during insufflation
  • “Mill wheel murmur”
Air Embolism

- **Diagnosis**
  - Reduction in ETCO₂
  - TEE: can detect a gas bubble as small as 0.02cc in size

- **Treatment**
  - Immediately desufflate
  - 100% FIO2
  - Place patient right side up in Trendelenburg
    » Air bubble “trapped” in right atrium
  - Central venous catheter to aspirate gas bubble.

Outline (Potpourri of topics)

- **Venous thromboembolism (VTE)**
- **Rhabdomyolysis**
- **Stone Surgery**
  - Ureteroscopy (URS)
  - Shock wave lithotripsy (SWL)
Venous Thromboembolism (VTE)

Venous stasis from Trendelenberg
- Pelvic surgery
- Malignancy
- Obese
- Longer cases

Venous return

DVT

IAP

VTE

• NSQIP based study 2005 – 2012 dataset
  - Upper-tract (RN/PN/RNU): 1.1%
  - Prostatectomy: 1.1%
  - Radical cystectomy: 5.5%

Alberts BD et al. Urology 2014
VTE

- Majority of VTE events occurred after surgical discharge

Alberts BD et al. Urology 2014

VTE Prophylaxis

- No consensus guidelines!
- Important to recognize individual hospital policy
- Recommended resource
  - Up to Date (https://www.uptodate.com)
  - Prevention of venous thromboembolic disease in adult nonorthopedic surgical patients (Pai et al.)
    - Last updated July 12, 2018 (accessed August 5, 2018)

VTE Risk Stratification

- **Risk factors**
  - Increasing age
  - Prior VTE in patient or family members
  - Presence of malignancy or obesity
  - Inherited or acquired hypercoagulable state
  - ≥ 1 significant medical comorbidities
    - heart disease, infection, inflammatory conditions, recent stroke, preoperative sepsis

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**Caprini Score**

<table>
<thead>
<tr>
<th>Each Risk Factor Represents 1 Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 41-60 years</td>
</tr>
<tr>
<td>Varicose veins</td>
</tr>
<tr>
<td>Obesity (BMI &gt; 25)</td>
</tr>
<tr>
<td>Minor surgery planned</td>
</tr>
<tr>
<td>Sepsis (&lt;1 month)</td>
</tr>
<tr>
<td>Pregnancy or postpartum (&lt;1 month)</td>
</tr>
<tr>
<td>Other risk factors</td>
</tr>
</tbody>
</table>

Subtotal: 

<table>
<thead>
<tr>
<th>Each Risk Factor Represents 5 Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke (&lt;1 month)</td>
</tr>
<tr>
<td>Hip, pelvis or leg fracture (&lt;1 month)</td>
</tr>
</tbody>
</table>

Subtotal: 

**TOTAL RISK FACTOR SCORE:**

Caprini JA. Am J Surg 2010
VTE Prophylaxis Recommendation

- **Caprini Score**

  ![Caprini Score Table](https://www.uptodate.com/contents/prevention-of-venous-thromboembolic-disease-in-adult-nonorthopedic-surgical-patients)

- **Very low risk**
  - Early and frequent ambulation

- **Low risk**
  - Mechanical prophylaxis, preferably with intermittent pneumatic compression

- **Moderate risk**
  - LMW heparin, low dose unfractionated heparin, or fondaparinux

VTE Prophylaxis Recommendation

• **High risk**
  - LMW heparin, low dose unfractionated heparin, or fondaparinux
  - In patients with multiple VTE risk factors, a pharmacologic method may be combined with mechanical methods (i.e. intermittent pneumatic compression).

VTE Prophylaxis is Variable...

- Population based observational study of ~ 100,000 patients undergoing prostatectomy
  - Methods of VTE prophylaxis
    - 52.2% mechanical only
    - 7.2% pharmacologic
    - 10.6% combination
    - **30.0% none !!!**

Weinberg A et al. World J Urol 2014
Outline (Potpourri of topics)

- Venous thromboembolism (VTE)
- **Rhabdomyolysis**
- Stone Surgery
  - Ureteroscopy (URS)
  - Shock wave lithotripsy (SWL)

Rhabdomyolysis

- Complication of improper positioning
  - Prolonged compression causes muscle ischemia
- May result in acute renal failure
  - Myoglobinuria with tubular obstruction by myoglobin casts
### Rhabdomyolysis risk factors

**Baseline (Pre-op)**
- Obesity
- Muscular build
- Male gender
- Diabetes
- Hypertension
- Renal insufficiency

**Surgical (Intra-op)**
- Exaggerated position
- Long OR duration
  - > 5 hrs
- Hypovolemia

### Rhabdomyolysis Presentation

- **Severe muscle pain out of proportion to exam!**
- Dark urine
- Oliguria
- Labs
  - Elevated creatinine kinase (CK) and myoglobin
- Renal insufficiency and/or failure
Rhabdomyolysis Management

• Supportive with vigorous hydration

• Monitor renal function
  • Electrolytes (hyperkalemia)
  • Potential transient dialysis

• Monitor for compartment syndrome
  • Fasciotomies rarely required

• Debate on role of urinary alkalinization

Outline (Potpourri of topics)

• Venous thromboembolism (VTE)

• Rhabdomyolysis

• Stone Surgery
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  • Shock wave lithotripsy (SWL)
URS Complications (Acute)

- Infection prophylaxis

SURGICAL MANAGEMENT OF STONES:
AMERICAN UROLOGICAL ASSOCIATION/
ENDourologicalSOCIETY GUIDELINE

4. Clinicians are required to obtain a urinalysis prior to intervention. In patients with clinical or laboratory signs of infection, urine culture should be obtained. **Strong Recommendation; Evidence Level Grade B**

37. Antimicrobial prophylaxis should be administered prior to stone intervention and is based primarily on prior urine culture results, the local antibiogram, and in consultation with the current Best Practice Policy Statement on Antibiotic Prophylaxis. **Clinical Principle**


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URS Complications (Acute)

- Infection prophylaxis

Best Practice Policy Statement on
UROLOGIC SURGERY
ANTIMICROBIAL PROPHYLAXIS

<table>
<thead>
<tr>
<th>Procedure</th>
<th>GU Tract</th>
<th>All</th>
<th>Fluoroquinolone</th>
<th>DMP-SMN</th>
<th>Aminoglycoside (Aminonat)</th>
<th>ß-lactam/β-lactamase inhibitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ureteroscopy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

≤24 hours


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URS Complications (Acute)

• Infection
  • If purulent urine encountered:
    • Abort
    • Drainage: ureteral stent or PCN tube
    • Urine culture (selective)
    • Continue antibiotic therapy

38. Clinicians should abort stone removal procedures, establish appropriate drainage, continue antibiotic therapy, and obtain a urine culture if purulent urine is encountered during endoscopic intervention. (Index Patients1-15) Strong Recommendation; Evidence Level Grade C


URS Complications (Acute)

• Ureteral Perforation
URS Complications (Acute)

• Ureteral Perforation
  • Approximately 4% of cases
  • Risk factors:
    • Proximal calculi
    • Impacted calculi
    • “Aggressive” stone extraction
    • Balloon dilation
    • Use of access sheaths generally not associated

URS Complications (Acute)

• Ureteral Perforation
  • Management (Intra-op)
    • STOP!
    • Place ureteral stent for 2-6 weeks
      – If unable, antegrade PCN tube
    • Complete stone extrusion
      – Do not retrieve it!
    • Partial stone extrusion
      – Can attempt to remove to prevent formation of granuloma and stricture
URS Complications (Acute)

- Ureteral Avulsion
  - Very rare: < 1% of cases
  - Aggressive manipulation of large stones
    - Basketing proximal stones with semi-rigid ureteroscope
  - Management: STOP! ... but needs urgent operative intervention ...

URS Complications (Chronic)

- Ureteral Stricture
  - 1-3% reported likelihood
  - Risk factors:
    - Stone impacted for ≥ 2 months
    - Ureteral injury
  - Renal ultrasound recommended 4-8 weeks post-URS to assess for ipsilateral hydroureteronephrosis
    - Can be “silent obstruction”

Barbour M et al. Urology 2015
SWL Complications (Acute)

• Renal Hematoma
  • 1 – 20% of cases depending on lithotripter and number of shocks
  • Variable presentation
    • Pain
    • Hematuria
  • Generally self limiting

SWL Complications (Acute)

• Renal Hematoma
  • May require admission with observation
  • Management: usually supportive care with bed rest, serial imaging, serial blood counts, transfusions
    • Let the bleed tamponade in the retroperitoneum
  • Rare: ongoing bleeding with need for IR consultation
SWL Complications (Acute)

- Steinstrasse
  - “Street of stones”
  - Up to 10% of cases
    - Risk correlates with:
      - stone size/burden
  - Presentation variable
    - Asymptomatic, severe renal colic, infection, and/or renal obstruction

Management: ureteral stent, nephrostomy tube, or ureteroscopy with extraction

SWL Complications (Chronic)

• Hypertension
  • Debated ...
  • Primary risk factor: age > 60 years.
  • Mechanism not well elucidated: subcapsular hematomas can induce hypertension, but these changes are transient.

• Diabetes and renal failure
  • Not supported by the evidence

Questions
ARS-Q1

After several unsuccessful attempts to place a Veress needle for transperitoneal right laparoscopic nephrectomy, you confirm needle position with the saline drop test and begin insufflation. The patient rapidly develops tachycardia, hypotension, and decreased end-tidal CO₂. All of the following maneuvers are indicated except:

a) Place patient in Trendelenburg right-lateral decubitus position
b) Stop insufflation and release the pneumoperitoneum
c) Initiate CPR as indicated
d) Increase minute ventilation and administer 100% O₂
e) Attempt air aspiration through a central venous catheter

ARS-Q2

A patient undergoes a robotic-assisted radical prostatectomy. Post-operatively the patient complains of right foot weakness and foot drop. The nerve most likely injured was:

a) Obdurator
b) Femoral
c) Peroneal
d) Lateral femoral cutaneous
e) Pudendal
ARS-Q3

All of the following are typical post-operative symptoms and signs of unrecognized laparoscopic bowel injury except:

a) Elevated WBC
b) Fevers
c) Nausea and vomiting
d) Lack of peritoneal signs
e) Single trocar-site pain

ARS-Q4

You are performing elective semi-rigid right ureteroscopy and laser lithotripsy on a healthy 29 year-old woman for an impacted 4 mm right UVJ stone. Pre-operative urine culture was negative. She received one dose of ciprofloxacin 400 mg IV in the OR. After placing a guide wire into the right ureter, you note purulence extruding from the right ureteral orifice. The next best steps are:

a) Obtain urine culture and continue the URS procedure
b) Broaden coverage with gentamicin 1.5 mg/kg and continue the URS procedure
c) Obtain urine culture, administer ceftriaxone IV, and continue the URS procedure
d) Obtain urine culture and terminate the procedure
e) Obtain urine culture, attempt to place right ureteral stent, and terminate the procedure
ARS-Q5

A 68 year-old obese, African-American man with hypertension undergoes left partial nephrectomy in a flank position, which requires 5 ½ hours to complete due to dense perinephric adhesions. Post-operatively, he develops dark urine and persistent oliguria despite fluid boluses. The next best step is:

a) Initiate urinary alkalinization therapy
b) Obtain serum creatine kinase level
c) Check urinary myoglobin
d) Nephrology consultation
e) Serum electrolytes and EKG

Thank you!

jraman@pennstatehealth.psu.edu