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# Complications of Urologic Surgery

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



## Acknowledgement

- **J. Kellogg Parsons, MD, MHS, FACS**
  - Professor and Endowed Chair
  - Moores Comprehensive Cancer Center
  - UC San Diego Health System



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## Disclosures

- **MDxHealth**
  - Study site investigator – urine biomarker trial
- **Urogen Pharma Ltd**
  - Study site investigator – Olympus trial
  - Strategic advisor board
- **American Kidney Stone Management (AKSM)**
  - Stock ownership



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## Resources

- **AUA Guidelines**
- **AUA Core Curriculum**
- **AUA SASP Questions**
- **AUA Updates**
- **Contemporary or significant publications**



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## Outline (Potpourri of topics)

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



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## Outline (Potpourri of topics)

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



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## 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**



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Mills JT et al. J Urol 2013  
Sukhu T et al. Curr Urol Rep 2014

## Lower Extremity Nerve Injury (Positional)

Nerve	Symptoms	Etiology	Position
Obturator	Thigh weakness (adduction)	Hyperflexion of thigh at hip	Lithotomy
Posterior tibial	<ul style="list-style-type: none"> <li>• Weak plantar flexion</li> <li>• Sole &amp; lateral foot sensory loss</li> <li>• Posterior calf paresthesia</li> </ul>	Compression of posterior knee against <u>stirrup</u>	Lithotomy



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Chuang et al. AUA Update Series 2011

## Lower Extremity Nerve Injury (Positional)

Nerve	Symptoms	Etiology	Position
Peroneal	<ul style="list-style-type: none"> <li>• Foot eversion weakness</li> <li>• Foot drop</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Stirrup</u> pressure on fibular neck</li> <li>• OR Table pressure on dependent leg</li> </ul>	Lithotomy Lateral
Pudendal	<ul style="list-style-type: none"> <li>• Perineal sensory loss</li> <li>• Incontinence</li> </ul>	Traction of legs and compression against <u>stirrups</u>	Lithotomy



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## Lower Extremity Nerve Injury (Positional)

Nerve	Symptoms	Etiology	Position
Sciatic	Lateral calf & foot numbness	Inadequate padding	Supine
Anterior tibial	Foot drop	Feet in plantar flexion	Prone Reverse Trendelenburg
Lateral femoral cutaneous	Numbness of anterior & lateral thigh	Pressure against lateral thigh	Prone



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## Upper Extremity Nerve Injury (Positional)

Nerve	Symptoms	Etiology	Position
Brachial plexus	Shoulder pain	Abduction of arm > 90°	Supine
	Arm weakness	Dependent shoulder and/or arm under rib cage	Lateral
Radial	Wrist drop	Arm falls off table in supination	Supine



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## Upper Extremity Nerve Injury (Positional)

Nerve	Symptoms	Etiology	Position
Ulnar	Weak grip "Claw hand"	Hyperextension of forearm, pronation  Arms folded across chest with elbow flexion 90°	Supine
Median	Weak hand grip  Decreased palmar sensation	Arm not secure: suspended off table in pronation	Supine

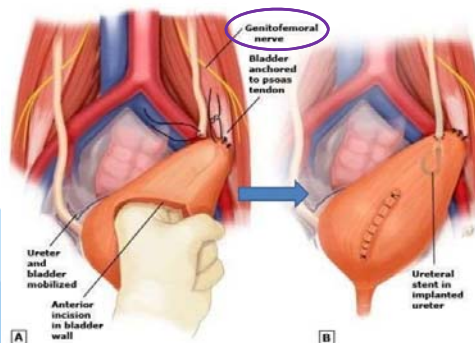


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Chuang et al. AUA Update Series 2011

## Operative Nerve Injury

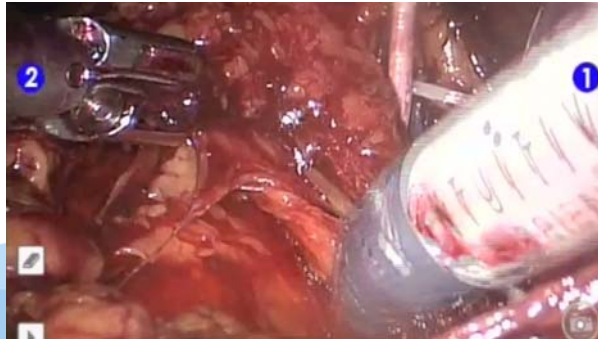
- **Genitofemoral**
  - Function: sensation to scrotum and medial thigh
  - At risk during **psaos hitch** operation!



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## Operative Nerve Injury

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

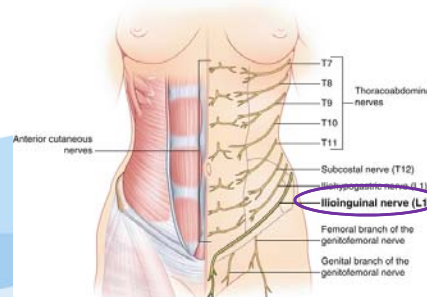


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Courtesy of Rene Sotelo, MD (USC)

## Operative Nerve Injury

- **Ilioinguinal**
  - Function: sensation to inguinal region and lateral hemiscrotum
  - At risk during **orchiectomy or hernia operation!**



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## Outline (Potpourri of topics)

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- Bowel injury
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  - Rectal
- Air embolism (MIS)



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## 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*



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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**



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## MIS Bowel Injury

- **Management**
  - **General surgery consultation**
  - **Immediate surgical exploration with bowel repair and/or resection**



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## 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



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Mandel P et al. Eur Urol Focus 2017

## 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



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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



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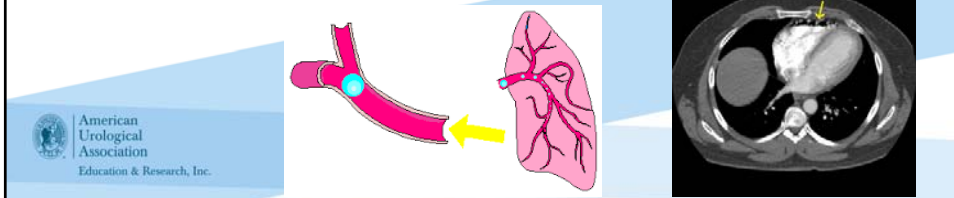
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## Air Embolism

- Results from large volume of insufflation agent (CO<sub>2</sub>) 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  $\text{ETCO}_2$
  - TEE : can detect a gas bubble as small as 0.02cc in size
- **Treatment**
  - **Immediately desufflate**
  - 100%  $\text{FIO}_2$
  - **Place patient right side up in Trendelenburg**
    - » **Air bubble “trapped” in right atrium**
  - Central venous catheter to aspirate gas bubble.



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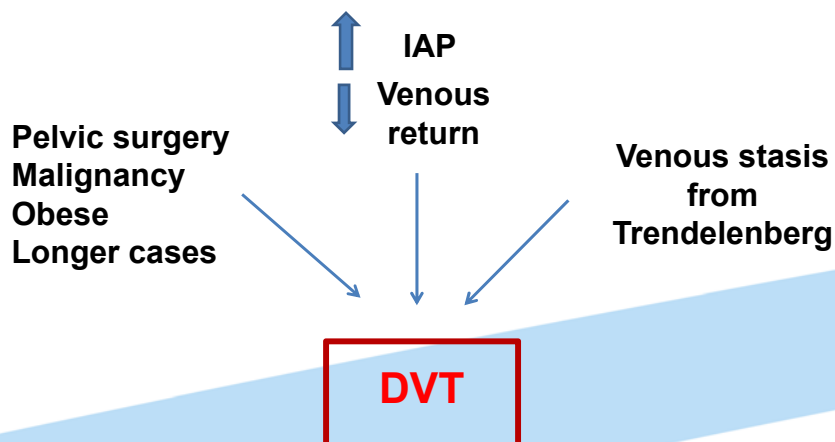
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## Venous Thromboembolism (VTE)



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## VTE

### Venous Thromboembolism After Major Urologic Oncology Surgery: A Focus on the Incidence and Timing of Thromboembolic Events After 27,455 Operations



Blake D. Alberts, Solomon L. Woldu, Aaron C. Weinberg, Matthew R. Danzig, Ruslan Korets, and Ketan K. Badani

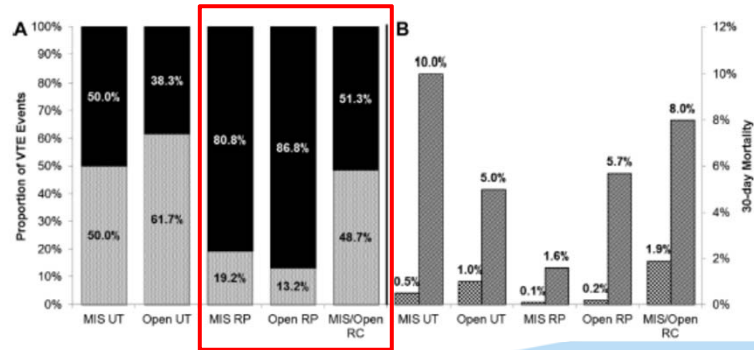
- NSQIP based study 2005 – 2012 dataset
  - Upper-tract (RN/PN/RNU) : 1.1%
  - Prostatectomy: 1.1%
  - Radical cystectomy: **5.5%**



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Alberts BD et al. Urology 2014

## VTE



- Majority of VTE events occurred after surgical discharge



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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)



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<https://www.uptodate.com/contents/prevention-of-venous-thromboembolic-disease-in-adult-nonorthopedic-surgical-patients>



# VTE Risk Stratification

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

# VTE Risk Stratification

## • Caprini Score

Each Risk Factor Represents 1 Point		Each Risk Factor Represents 2 Points	
<input type="checkbox"/> Age 41-60 years	<input type="checkbox"/> Acute myocardial infarction	<input type="checkbox"/> Age 61-74 years	<input type="checkbox"/> Central venous access
<input type="checkbox"/> Swollen legs (current)	<input type="checkbox"/> Congestive heart failure (<1 month)	<input type="checkbox"/> Arthroscopic surgery	<input type="checkbox"/> Major surgery (>45 minutes)
<input type="checkbox"/> Varicose veins	<input type="checkbox"/> Medical patient currently at bed rest	<input type="checkbox"/> Malignancy (present or previous)	Subtotal:
<input type="checkbox"/> Obesity (BMI >25)	<input type="checkbox"/> History of inflammatory bowel disease	<input type="checkbox"/> Laparoscopic surgery (>45 minutes)	
<input type="checkbox"/> Minor surgery planned	<input type="checkbox"/> History of prior major surgery (<1 month)	<input type="checkbox"/> Patient confined to bed (>72 hours)	
<input type="checkbox"/> Sepsis (<1 month)	<input type="checkbox"/> Abnormal pulmonary function (COPD)	<input type="checkbox"/> Immobilizing plaster cast (<1 month)	
<input type="checkbox"/> Serious Lung disease including pneumonia (<1 month) <input type="checkbox"/> Oral contraceptives or hormone replacement therapy <input type="checkbox"/> Pregnancy or postpartum (<1 month) <input type="checkbox"/> History of unexplained stillborn infant, recurrent spontaneous abortion ( $\geq 3$ ), premature birth with toxemia or growth-restricted infant <input type="checkbox"/> Other risk factors _____		<b>Each Risk Factor Represents 3 Points</b> <input type="checkbox"/> Age 75 years or older <input type="checkbox"/> Family History of thrombosis* <input type="checkbox"/> History of DVT/PE <input type="checkbox"/> Positive Prothrombin 20210A <input type="checkbox"/> Positive Factor V Leiden <input type="checkbox"/> Positive Lupus anticoagulant <input type="checkbox"/> Elevated serum homocysteine <input type="checkbox"/> Heparin-induced thrombocytopenia (HIT) (Do not use heparin or any low molecular weight heparin) <input type="checkbox"/> Elevated anticardiolipin antibodies <input type="checkbox"/> Other congenital or acquired thrombophilia If yes: Type _____	
<b>Each Risk Factor Represents 5 Points</b> <input type="checkbox"/> Stroke (<1 month) <input type="checkbox"/> Multiple trauma (<1 month) <input type="checkbox"/> Elective major lower extremity arthroplasty <input type="checkbox"/> Hip, pelvis or leg fracture (<1 month) <input type="checkbox"/> Acute spinal cord injury (paralysis) (<1 month)		* most frequently missed risk factor <b>TOTAL RISK FACTOR SCORE:</b> <span style="border: 1px solid black; display: inline-block; width: 50px; height: 20px; vertical-align: middle;"></span>	

# VTE Prophylaxis Recommendation

- **Caprini Score**

**CLINICAL CONSIDERATIONS FOR THE USE OF SEQUENTIAL COMPRESSION DEVICES (SCD)**

Patient may not be a candidate for SCDs & alternative prophylactic measures should be considered.

Patients with Severe Peripheral Arterial Disease, CHF, Acute Superficial DVT

Total Risk Factor Score	Risk Level	Prophylaxis Regimen
0	VERY LOW	<input type="checkbox"/> Early ambulation
1-2	LOW	<input type="checkbox"/> Sequential Compression Device (SCD)
3-4	MODERATE	Choose <b>ONE</b> of the following medications +/- compression devices: <input type="checkbox"/> Sequential Compression Device (SCD) - Optional <input type="checkbox"/> Heparin 5000 units SQ TID <input type="checkbox"/> Enoxaparin [redacted]: <input type="checkbox"/> 40mg SQ daily (WT < 150kg, CrCl > 30mL/min) <input type="checkbox"/> 30mg SQ daily (WT < 150kg, CrCl = 10-29mL/min) <input type="checkbox"/> 30mg SQ BID (WT > 150kg, CrCl > 30mL/min) (Please refer to Dosing Guidelines on the back of this form)
5 or more	HIGH	Choose <b>ONE</b> of the following medications <b>PLUS</b> compression devices: <input type="checkbox"/> Sequential Compression Device (SCD) <input type="checkbox"/> Heparin 5000 units SQ TID ( <b>Preferred with Epidurals</b> ) <input type="checkbox"/> Enoxaparin [redacted] ( <b>Preferred</b> ): <input type="checkbox"/> 40mg SQ daily (WT < 150kg, CrCl > 30mL/min) <input type="checkbox"/> 30mg SQ daily (WT < 150kg, CrCl = 10-29mL/min) <input type="checkbox"/> 30mg SQ BID (WT > 150kg, CrCl > 30mL/min) (Please refer to Dosing Guidelines on the back of this form)



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Caprini JA. Am J Surg 2010

# VTE Prophylaxis Recommendation

- **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



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<https://www.uptodate.com/contents/prevention-of-venous-thromboembolic-disease-in-adult-nonorthopedic-surgical-patients>

## 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).



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<https://www.uptodate.com/contents/prevention-of-venous-thromboembolic-disease-in-adult-nonorthopedic-surgical-patients>

## VTE Prophylaxis is Variable...

Nationwide practice patterns for the use of venous thromboembolism prophylaxis among men undergoing radical prostatectomy

Aaron Weinberg · Jason Wright · Christopher Deibert ·  
Yu-Shiang Lu · Dawn Hershman · Alfred Neugut ·  
Benjamin Spencer

- **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 !!!**



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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

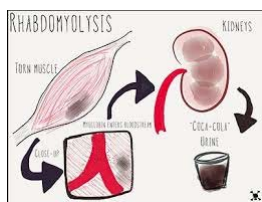
- **Complication of improper positioning**
  - Prolonged compression causes muscle ischemia
- **May result in acute renal failure**
  - Myoglobinuria with tubular obstruction by myoglobin casts

## 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



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## URS Complications (Acute)

- Infection prophylaxis

### SURGICAL MANAGEMENT OF STONES: AMERICAN UROLOGICAL ASSOCIATION/ ENDOUROLOGICAL SOCIETY 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*



Assimos D et al. J Urol 2016

## URS Complications (Acute)

- Infection prophylaxis

### Best Practice Policy Statement on UROLOGIC SURGERY ANTIMICROBIAL PROPHYLAXIS

Ureteroscopy	GU Tract	All	Fluoroquinolone - TMP-SMX	- Aminoglycoside (Aztreonam <sup>®</sup> ) ± Ampicillin - 1st/2nd gen. Cephalosporin - Amoxicillin/Clavulanate	≤24 hours
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Wolf JS et al. J Urol 2008

## 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 Patients 1-15) *Strong Recommendation; Evidence Level Grade C*

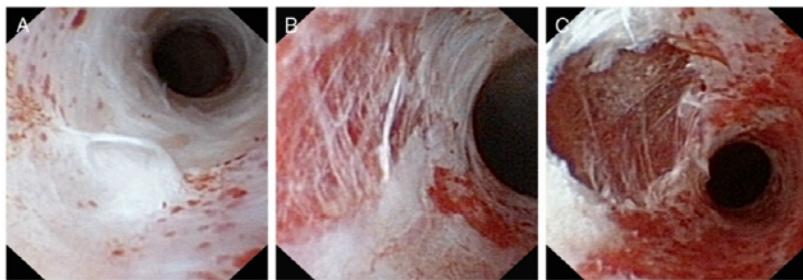


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Assimos D et al. J Urol 2016

## URS Complications (Acute)

- Ureteral Perforation

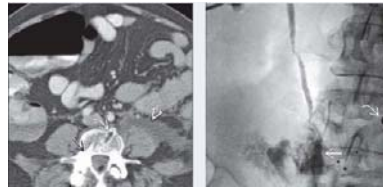


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## URS Complications (Acute)

- 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
    - Baskets proximal stones with semi-rigid ureteroscope
  - Management: **STOP ! ... but needs urgent operative intervention ...**



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FIG. 1. "Scalbard" of ureter on the withdrawn semi-rigid ureteroscope, with ureteral orifice intact.



## URS Complications (Chronic)

- **Ureteral Stricture**
  - 1-3% reported likelihood
  - Risk factors:
    - Stone impacted for  $\geq 2$  months
    - Ureteral injury
  - Renal ultrasound recommended 4-8 weeks post-URS to assess for ipsilateral hydronephrosis
    - Can be "silent obstruction"

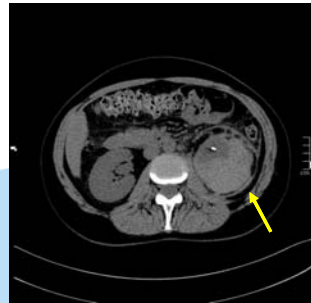


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Fulgham P et al. J Urol 2013  
Barbour M et al. Urology 2015

## SWL Complications (Acute)

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



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## 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**



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## 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**



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## SWL Complications (Acute)

- **Steinstrasse**

13. Routine stenting should not be performed in patients undergoing SWL. (Index Patients 1-6) *Strong Recommendation; Evidence Level Grade B*

25. In patients with total renal stone burden >20 mm, clinicians should not offer SWL as first-line therapy. (Index Patient 8) *Moderate Recommendation; Evidence Level Grade C*

40. Clinicians may prescribe  $\alpha$ -blockers to facilitate passage of stone fragments following SWL. *Moderate Recommendation; Evidence Level Grade B*

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



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Assimos D et al. J Urol 2016

## 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



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Denburg MR et al. Kidney Int 2016

## Questions



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## 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 CO<sub>2</sub>. 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% O<sub>2</sub>
- e) Attempt air aspiration through a central venous catheter



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## 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) Obturator
- b) Femoral
- c) Peroneal
- d) Lateral femoral cutaneous
- e) Pudendal



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## 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



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## 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



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## 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



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# Thank you !



[jraman@pennstatehealth.psu.edu](mailto:jraman@pennstatehealth.psu.edu)