American Urological Association

Education & Research, Inc.

Complications of Urologic Surgery

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Acknowledgement

- **J. Kellogg Parsons, MD, MHS, FACS**
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  - UC San Diego Health System

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**

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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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
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	• Weak plantar flexion • Sole & lateral foot sensory loss • Posterior calf paresthesia	Compression of posterior knee against stirrup	Lithotomy

Chuang et al. AUA Update Series 2011

Lower Extremity Nerve Injury (Positional)

Nerve	Symptoms	Etiology	Position
Peroneal	• Foot eversion weakness • Foot drop	• Stirrup pressure on fibular neck • OR Table pressure on dependent leg	Lithotomy Lateral
Pudendal	• Perineal sensory loss • Incontinence	Traction of legs and compression against stirrups	Lithotomy

Chuang et al. AUA Update Series 2011

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

Chuang et al. AUA Update Series 2011

Upper Extremity Nerve Injury (Positional)

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

Chuang et al. AUA Update Series 2011

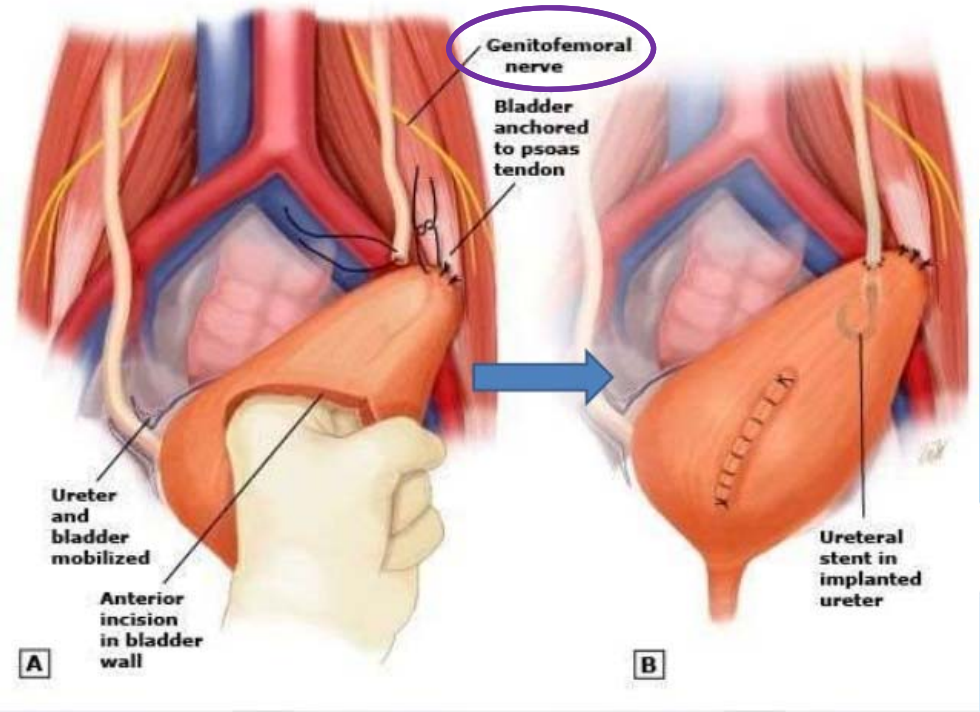
Upper Extremity Nerve Injury (Positional)

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

Chuang et al. AUA Update Series 2011

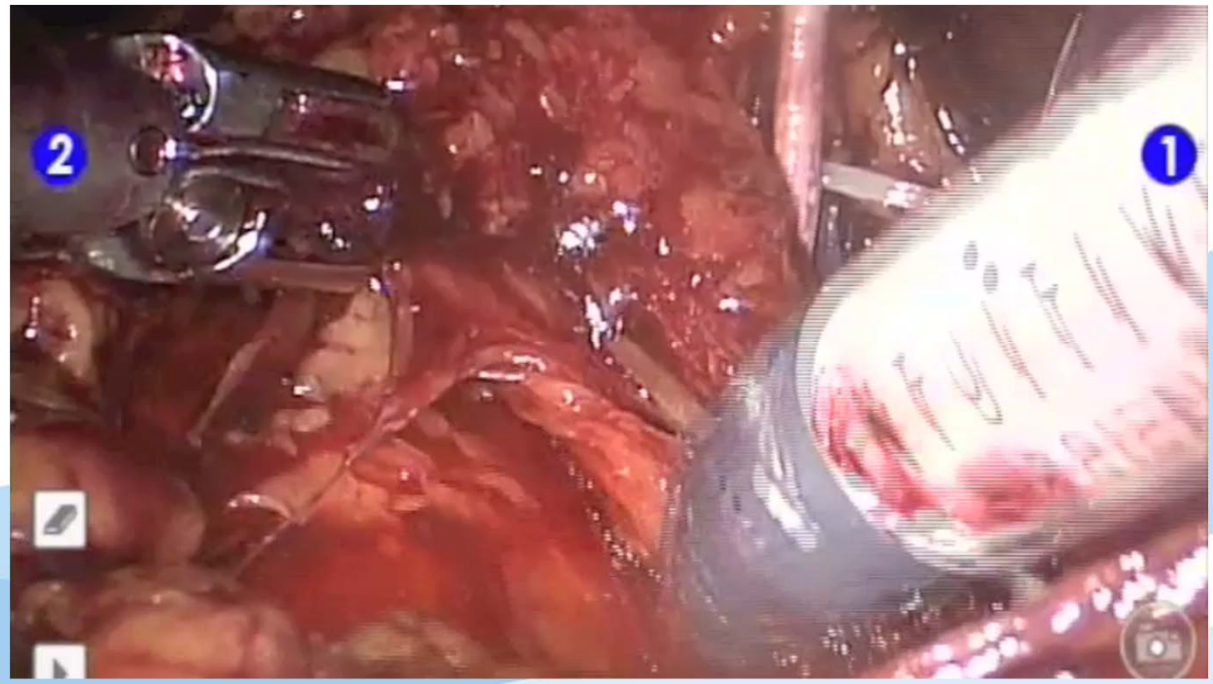
Operative Nerve Injury

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



Operative Nerve Injury

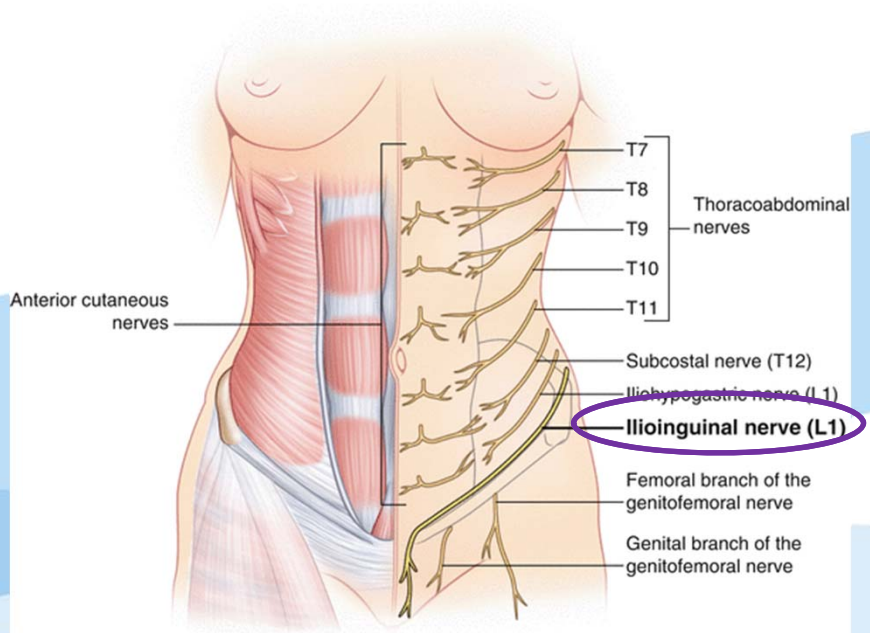
- **Obturator**
  - **Function: adduction of the leg (i.e. car pedals)**
  - **At risk during pelvic lymph node dissection**



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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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**

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

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

Courtesy of Rene Sotelo, MD (USC)

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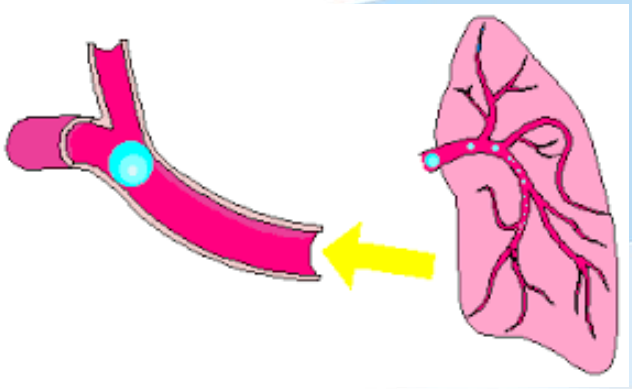
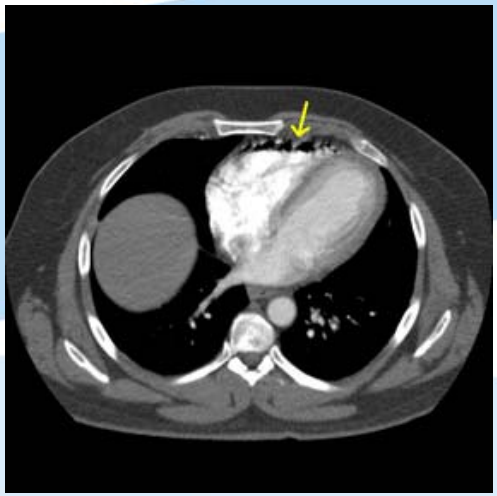
Air Embolism

- **Results from large volume of insufflation agent (CO_2) 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 $ETCO_2$**
  - **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.**

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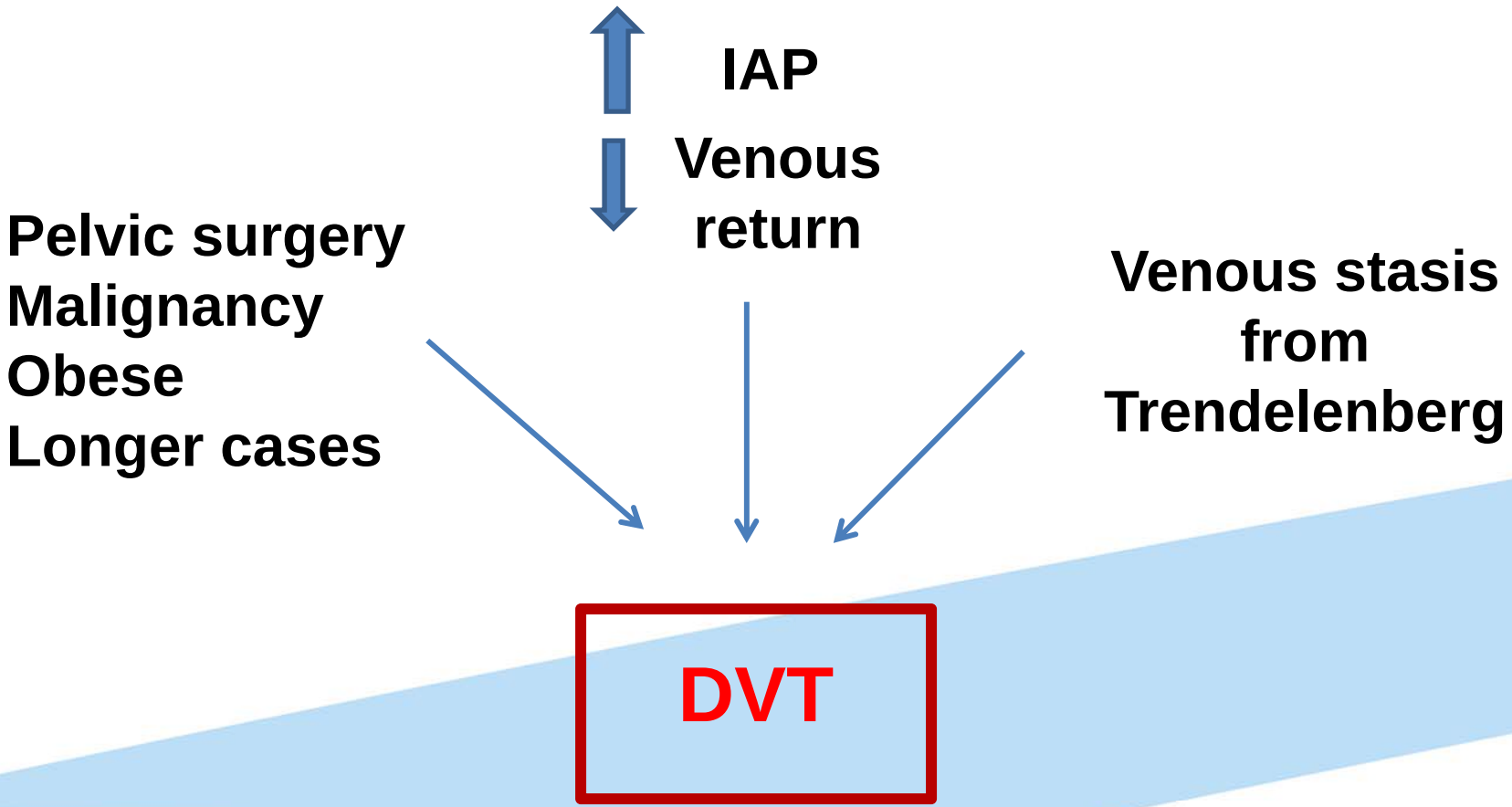
Venous Thromboembolism (VTE)



VTE

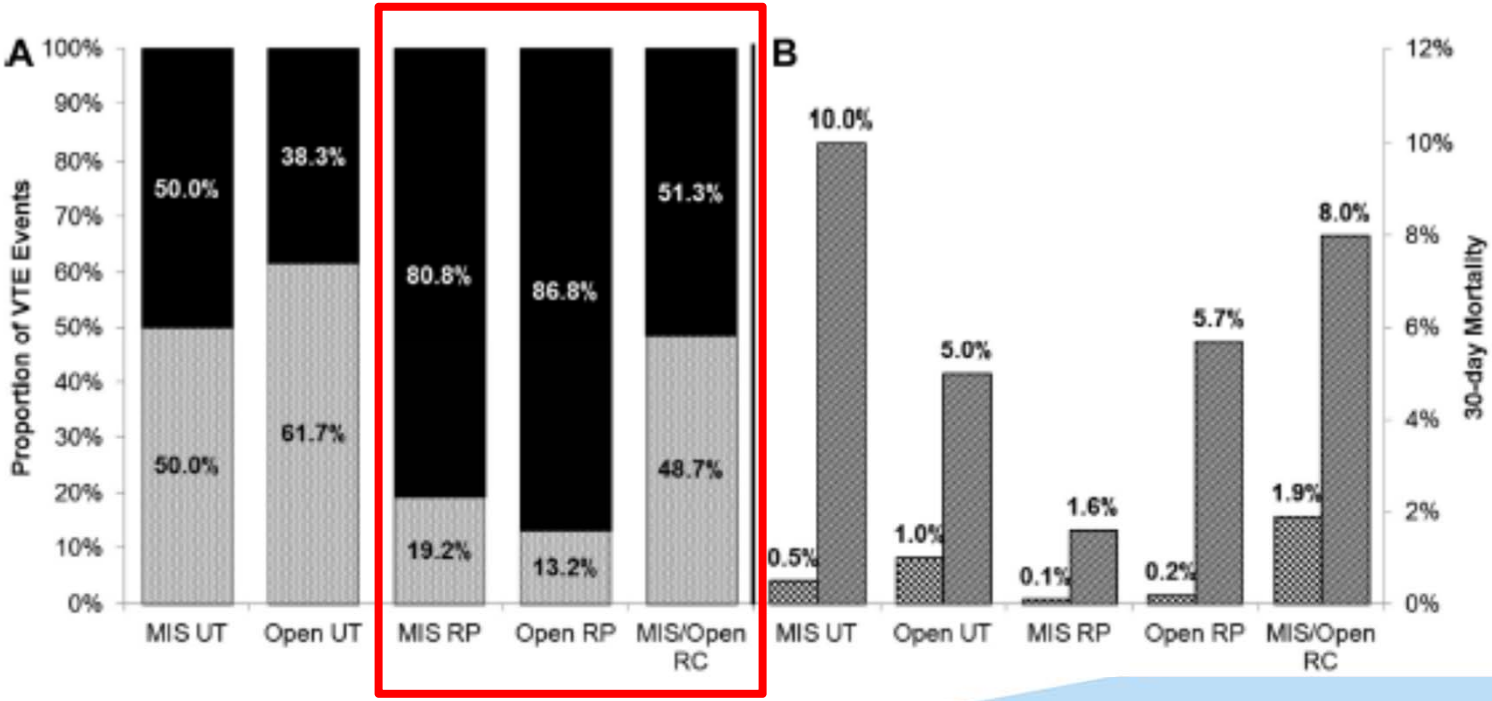
Venous Thromboembolism After Major Urologic Oncology Surgery: A Focus on the Incidence and Timing of Thromboembolic Events After 27,455 Operations

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%**

Alberts BD et al. Urology 2014

VTE



- **Majority of VTE events occurred <u>after</u> 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)

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**
  - **≥ 1 significant medical comorbidities**
    - **heart disease, infection, inflammatory conditions, recent stroke, preoperative sepsis**

VTE Risk Stratification

- **Caprini Score**

Each Risk Factor Represents 1 Point

- ❑ Age 41-60 years
- ❑ Swollen legs (current)
- ❑ Varicose veins
- ❑ Obesity (BMI >25)
- ❑ Minor surgery planned
- ❑ Sepsis (<1 month)
- ❑ Acute myocardial infarction
- ❑ Congestive heart failure (<1 month)
- ❑ Medical patient currently at bed rest
- ❑ History of inflammatory bowel disease
- ❑ History of prior major surgery (<1 month)
- ❑ Abnormal pulmonary function (COPD)
- ❑ Serious Lung disease including pneumonia (<1 month)
- ❑ Oral contraceptives or hormone replacement therapy
- ❑ Pregnancy or postpartum (<1 month)
- ❑ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant
- ❑ Other risk factors_____

Subtotal:

Each Risk Factor Represents 5 Points

- ❑ Stroke (<1 month)
- ❑ Multiple trauma (<1 month)
- ❑ Elective major lower extremity arthroplasty
- ❑ Hip, pelvis or leg fracture (<1 month)
- ❑ Acute spinal cord injury (paralysis) (<1 month)

Subtotal:

Each Risk Factor Represents 2 Points

- ❑ Age 61-74 years
- ❑ Arthroscopic surgery
- ❑ Malignancy (present or previous)
- ❑ Laparoscopic surgery (>45 minutes)
- ❑ Patient confined to bed (>72 hours)
- ❑ Immobilizing plaster cast (<1 month)
- ❑ Central venous access
- ❑ Major surgery (>45 minutes)

Subtotal:

Each Risk Factor Represents 3 Points

- ❑ Age 75 years or older
- ❑ History of DVT/PE
- ❑ Positive Factor V Leiden
- ❑ **Family History of thrombosis***
- ❑ Positive Prothrombin 20210A
- ❑ Positive Lupus anticoagulant
- ❑ Elevated serum homocysteine
- ❑ Heparin-induced thrombocytopenia (HIT) (Do not use heparin or any low molecular weight heparin)
- ❑ Elevated anticardiolipin antibodies
- ❑ Other congenital or acquired thrombophilia

If yes: Type_____

*** most frequently missed risk factor**

Subtotal:

TOTAL RISK FACTOR SCORE:

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Caprini JA. Am J Surg 2010

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

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

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).**

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 !!!**

Weinberg A et al. World J Urol 2014

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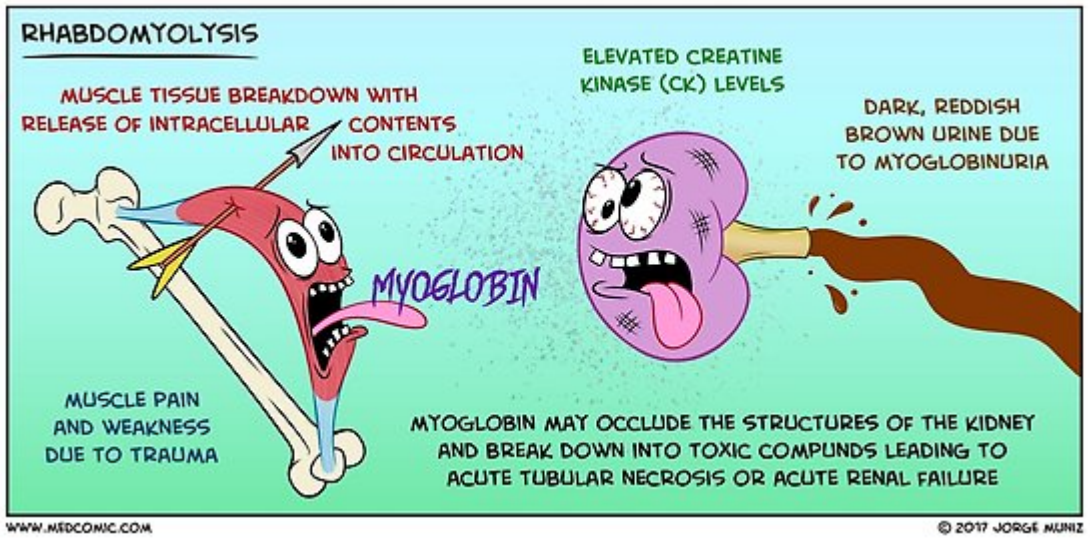
- Venous thromboembolism (VTE)
- Rhabdomyolysis
- Stone Surgery
  - Ureteroscopy (URS)
  - Shock wave lithotripsy (SWL)

Rhabdomyolysis

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

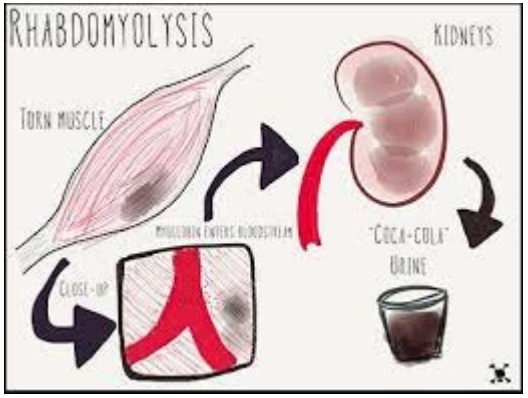


Rhabdomyolysis risk factors

- 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¥) ± Ampicillin - 1st/2nd gen. Cephalosporin - Amoxacillin/Clavulanate	≤24 hours

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Wolf JS et al. J Urol 2008

URS Complications (Acute)

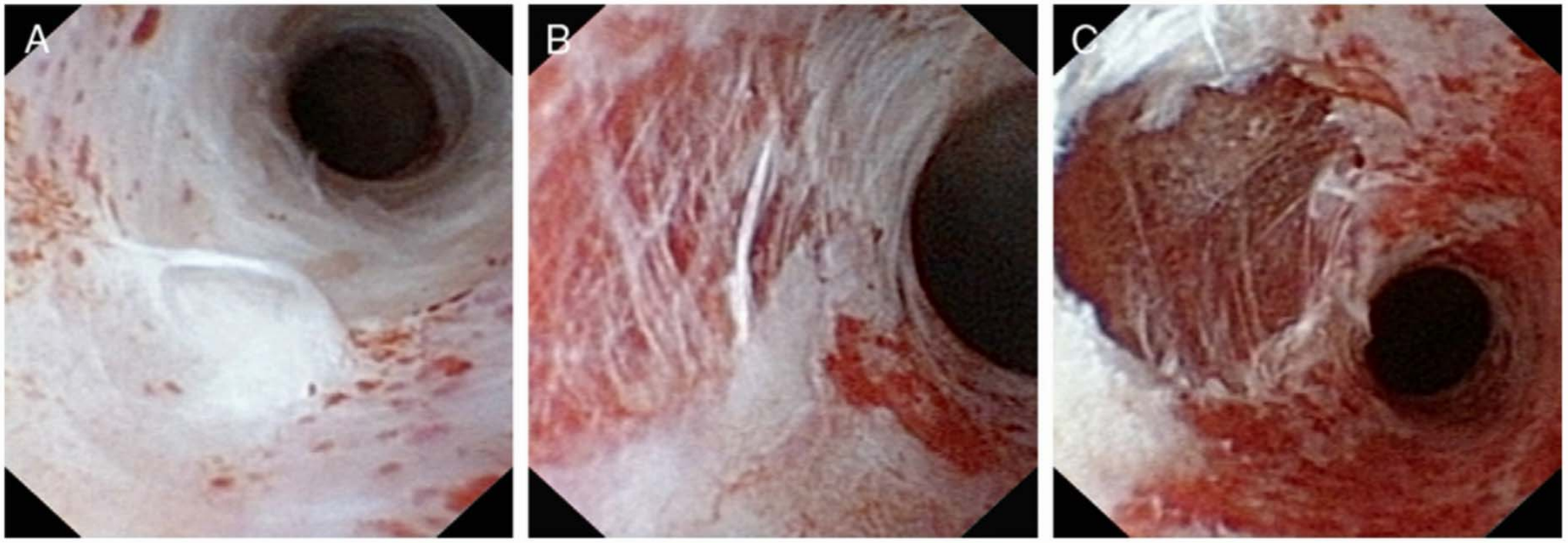
- Infection
  - If purulent urine encountered:
    - Abort
    - Drainage: ureteral stent or PCN tube
    - Urine culture (selective)
    - Continue antibiotic therapy

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 Patients1-15) ***Strong Recommendation; Evidence Level Grade C***

Assimos D et al. J Urol 2016

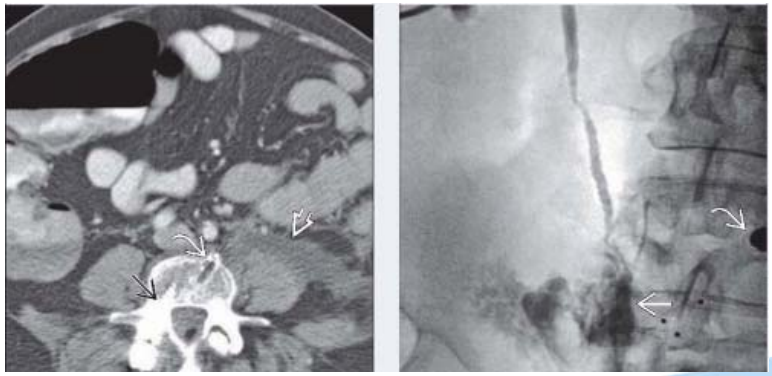
URS Complications (Acute)

- **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 <u>not</u> 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 …**

FIG. 1. "Scabbard" of ureter on the withdrawn semirigid ureteroscope, with ureteral orifice intact.

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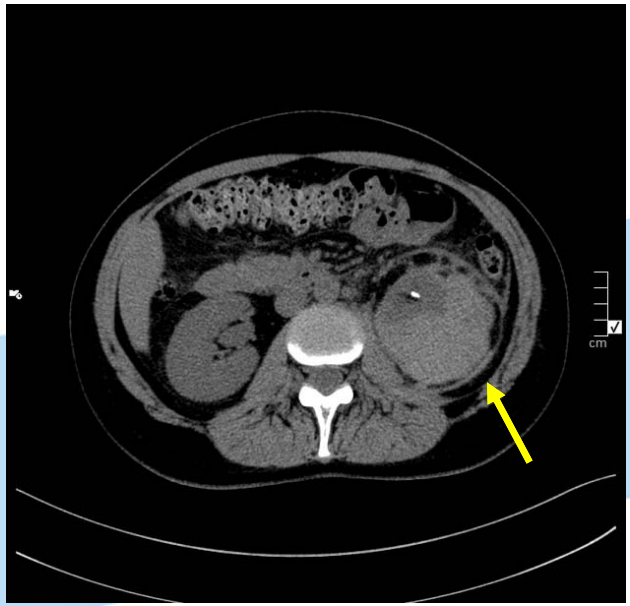
URS Complications (Chronic)

- **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 hydronephrosis**
    - **Can be "silent obstruction"**

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**



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

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 α-blockers to facilitate passage of stone fragments following SWL.** ***Moderate Recommendation; Evidence Level Grade B***

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

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**

Denburg MR et al. Kidney Int 2016

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_2. 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_2
e) Attempt air aspiration through a central venous catheter

Answer: A

A. Place patient in Trendelenburg right-lateral decubitus position

The correct position for management of suspected air embolism is head-down, left lateral decubitus.

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

Answer: C

C. Peroneal

The peroneal nerve courses lateral to the fibular neck and can be compressed by stirrups in the lithotomy position thereby giving ipsilateral foot weakness and even foot drop.

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

Answer: A

A. Elevated WBC

Rather than leukocytosis, patients with unrecognized bowel injury presenting after laparoscopy typically manifest leukopenia with a left shift

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

Answer: E

E. Obtain urine culture, attempt to place right ureteral stent, and terminate the procedure

In situations in which infection is unexpectedly encountered during ureteroscopy, the goals of the procedure are then to:

1. Obtain culture
2. Drain upper-tract with ureteral stent or nephrostomy tube
3. Consider continuing current antibiotics or increasing to broad-spectrum coverage

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

Answer: E

E. Serum electrolytes and EKG

In a patient with suspected rhabdomylosis, stat electrolytes (including K+) and EKG are indicated to evaluate for life-threatening hyperkalemia in the setting of possible acute renal failure. Serum creatine kinase and urine myoglobin levels will establish the diagnosis, and nephrology consultation may be needed to help manage this condition over the longer term, particularly if dialysis is needed. There are no definitive data to support urinary alkalinization therapy in the treatment of rhabdomyolysis.