Avoidable Imaging Wave II
Renal Colic (Clinical Topic)
PE CT (Clinical Topic)
Presenters

Chris Moore MD

Jeff Kline MD
Avoidable imaging in renal colic?

E-QUAL Webinar

May 25th 2017
Chris Moore MD
Associate Professor, Department of Emergency Medicine
Disclosures

• I am currently funded by the Agency for Healthcare Research and Quality (AHRQ) under R18HS023778 “Minimizing unnecessary irradiation from renal colic CT scans in the United States”

• I am currently consulting with Philips Healthcare on automated image recognition of ultrasound images

• I am collaborating on research with support via equipment loans from GE Healthcare and BK Medical
“You can observe a lot by just watching”

Yogi Berra 1925-2015
Case

- 37 y.o. white male, no past medical history, presents with acute onset of right flank pain and vomiting. Urine is clear but dip shows hematuria. He is getting fluids, toradol, morphine, and zofran.

Imaging?
Urinary Stone Disease

- Common: 1 in 11 people, increasing in U.S. and worldwide
- Recurrent: >50% will recur within 5y
- Is an ED dx: >1M dx per year; >2M visits per year for flank pain concern for renal colic
- Painful: “worse than labor”
- Expensive: ~$10B in annual costs
- Lots of CT: 70% of USD get CT
- Controversial: dx and management
CONCLUSION. Unenhanced CT is a valuable technique for examining patients with acute flank pain in whom a clinical diagnosis is uncertain. It can accurately determine the presence or absence of ureteral stones as well as extraurinary causes of acute flank pain. In most cases, other imaging studies are not required.
“First Time” renal colic

IMPACT OF CT SCAN IN PATIENTS WITH FIRST EPISODE OF SUSPECTED NEPHROLITHIASIS

Michael Ha, MD* and Russell D. MacDonald, MD, MPH, CCIFP, FRCPCT†‡


Patients presenting with a first episode of clinically suspected nephrolithiasis should undergo CT scanning because it enhances diagnostic certainty by identifying alternate diagnoses not suspected on clinical grounds alone.
National Trends in Use of Computed Tomography in the Emergency Department

Keith E. Kocher, MD, MPH, William J. Meurer, MD, MS, Reza Fazel, MD, MSc, Phillip A. Scott, MD, Harlan M. Krumholz, MD, SM, Brahmadee K. Nallamothu, MD, MPH

Smith article, 1996

Figure 1. Number of ED visits and CT use by year, with 95% CI.
“Bad Things”
**“First Time” renal colic**

**IMPACT OF CT SCAN IN PATIENTS WITH FIRST EPISODE OF SUSPECTED NEPHROLITHIASIS**

<table>
<thead>
<tr>
<th>Other significant pathology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesenteric and retroperitoneal lymphadenopathy, possible lymphoma</td>
</tr>
<tr>
<td>Right adrenal adenoma</td>
</tr>
<tr>
<td>Right ovarian neoplasm with liver mass</td>
</tr>
<tr>
<td>Enlarged prostate</td>
</tr>
<tr>
<td>Right adrenal mass</td>
</tr>
<tr>
<td>Multiple liver lesions, possibly metastatic</td>
</tr>
<tr>
<td>Left renal cell carcinoma, abdominal aortic aneurysm</td>
</tr>
<tr>
<td>Splenomegaly, cause not yet determined</td>
</tr>
<tr>
<td>Right adrenal adenoma</td>
</tr>
<tr>
<td>Mesenteric lymphadenopathy, possible lymphoma</td>
</tr>
<tr>
<td>Possible ulcerative colitis</td>
</tr>
<tr>
<td>Left periureteric mass with hydronephrosis, liver metastasis</td>
</tr>
<tr>
<td>Right renal cysts, possible malignancy</td>
</tr>
<tr>
<td>Right adrenal adenoma</td>
</tr>
<tr>
<td>Right renal mass, possible malignancy</td>
</tr>
<tr>
<td>Retrocecal lymphadenopathy, possible metastatic testicular cancer</td>
</tr>
<tr>
<td>Left ovarian cancer</td>
</tr>
<tr>
<td>Lesion in right hepatic lobe</td>
</tr>
<tr>
<td>Splenomegaly, cause not yet determined</td>
</tr>
</tbody>
</table>
Prevalence and Clinical Importance of Alternative Causes of Symptoms Using a Renal Colic Computed Tomography Protocol in Patients With Flank or Back Pain and Absence of Pyuria

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>All (n = 5,383)</th>
<th>% of all</th>
<th>% of all</th>
</tr>
</thead>
<tbody>
<tr>
<td>No cause of pain seen on CT</td>
<td>2,331</td>
<td>43.3</td>
<td>39.6</td>
</tr>
<tr>
<td>Kidney stone as cause of pain</td>
<td>2,569</td>
<td>47.7</td>
<td>54.9</td>
</tr>
<tr>
<td>Small stone (5 mm or less)</td>
<td>1,834</td>
<td>34.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Large stone (&gt;5 mm)</td>
<td>492</td>
<td>9.1</td>
<td>7.7</td>
</tr>
<tr>
<td>CT signs of passed stone</td>
<td>243</td>
<td>4.5</td>
<td>4.9</td>
</tr>
<tr>
<td>Non–kidney stone cause of pain</td>
<td>4,833</td>
<td>9.0</td>
<td>5.4</td>
</tr>
<tr>
<td>Acutely important cause</td>
<td>329</td>
<td>6.1</td>
<td>2.8</td>
</tr>
<tr>
<td>Follow-up recommended</td>
<td>119</td>
<td>2.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Unimportant cause</td>
<td>35</td>
<td>0.7</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Back pain or flank pain and no pyuria

Is CT helping?

Radiological Imaging of Patients With Suspected Urinary Tract Stones: National Trends, Diagnoses, and Predictors  

Conclusions: From 1996 to 2007, there was a 10-fold increase in the utilization of CT scan for patients with suspected kidney stone without an associated change in the proportion of diagnosis of kidney stone, diagnosis of significant alternate diagnoses, or admission to the hospital.

CT in Detecting Urinary Tract Calculi: Influence on Patient Imaging and Clinical Outcomes

Conclusion: Use of imaging for suspected UTC has increased markedly since the introduction of unenhanced CT, with little effect on acute care of patients in the ED.
“Bad things”

<table>
<thead>
<tr>
<th>Acutely important alternate causes</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverticulitis</td>
<td>55</td>
<td>16.7</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>23</td>
<td>7.0</td>
</tr>
<tr>
<td>Mass concerning for new malignancy</td>
<td>34</td>
<td>10.3</td>
</tr>
<tr>
<td>Ovarian/adnexal/uterine</td>
<td>21</td>
<td>6.4</td>
</tr>
<tr>
<td>CT evidence pyelonephritis</td>
<td>95</td>
<td>28.9</td>
</tr>
<tr>
<td>Peri/intrarenal hemorrhage</td>
<td>9</td>
<td>2.7</td>
</tr>
<tr>
<td>Hydronephrosis w/o stone</td>
<td>22</td>
<td>6.7</td>
</tr>
<tr>
<td>Biliary (cholecystitis or choledocholithiasis)</td>
<td>8</td>
<td>2.4</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>15</td>
<td>4.6</td>
</tr>
<tr>
<td>Bowel perforation</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>Bowel obstruction</td>
<td>9</td>
<td>2.7</td>
</tr>
<tr>
<td>Retroperitoneal pathology</td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>Colitis or enterocolitis (treated)</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>10</td>
<td>3.0</td>
</tr>
<tr>
<td>Other (renal vein thrombosis, large mesenteric cyst, foreign body)</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>Aneurysm or dissection</td>
<td>4</td>
<td>1.2</td>
</tr>
<tr>
<td>Abscess (thoracoabdominal)</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>Traumatic injury</td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>Post-operative findings (urgent)</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Total acutely important alternate causes (% of all CTs):</td>
<td>329</td>
<td>6.1</td>
</tr>
</tbody>
</table>

2.8% with BP/FP no pyuria

Incidental Findings

• Prevalence of 12.7% (95% CI 11.8-13.6%)
• 1 in 8 CT Renal Colic will have in incidental finding with follow-up imaging recommended
Incidental Findings

• “Incidentalomas”

LESS IS MORE
Better Off Not Knowing

Improving Clinical Care by Limiting Physician Access to Unsolicited Diagnostic Information

VOMIT (victims of modern imaging technology)—an acronym for our times

BMJ 2003; 326 doi: 10.1136/bmj.326.7401.1273 (Published 5 June 2003)
cancer risk

• The estimated risk of a future malignancy from the CT scan in this 37 year-old patient is estimated to be:

1) About 1 in 100
2) About 1 in 1000
3) About 1 in 10,000
4) About 1 in 100,000
## Table 4. Estimated Number of Patients Undergoing Computed Tomography (CT) That Would Lead to the Development of 1 Radiation-Induced Cancer, by Type of CT Examination and Age at the Time of Exposure, Based on the Median and Interquartile Radiation Dose Observed

<table>
<thead>
<tr>
<th>Anatomic Area, Type of CT Study</th>
<th>Patients, Median (Interquartile Range), No.</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age, 20 y</td>
<td>Age, 40 y</td>
<td>Age, 60 y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Head and neck</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routine head</td>
<td>4360 (3290-5110)</td>
<td>7350 (5540-8620)</td>
<td>9100 (6110-9500)</td>
<td>11 090 (8350-12 990)</td>
</tr>
<tr>
<td>Routine neck</td>
<td>2390 (1640-3540)</td>
<td>4020 (2770-5970)</td>
<td>4430 (3050-6680)</td>
<td>6040 (4750-8590)</td>
</tr>
<tr>
<td>Suspected stroke</td>
<td>660 (460-900)</td>
<td>1120 (773-1650)</td>
<td>1230 (850-1820)</td>
<td>1680 (1170-2490)</td>
</tr>
<tr>
<td>Chest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routine chest, no contrast</td>
<td>390 (290-530)</td>
<td>1040 (770-1870)</td>
<td>720 (540-1160)</td>
<td>1580 (1170-2520)</td>
</tr>
<tr>
<td>Routine chest, with contrast</td>
<td>380 (270-850)</td>
<td>1020 (710-1740)</td>
<td>720 (560-1210)</td>
<td>1530 (1070-2620)</td>
</tr>
<tr>
<td>Suspected pulmonary embolism</td>
<td>330 (230-480)</td>
<td>880 (610-1220)</td>
<td>820 (420-850)</td>
<td>1330 (920-1840)</td>
</tr>
<tr>
<td>Coronary angiogram</td>
<td>150 (130-230)</td>
<td>350 (350-610)</td>
<td>270 (250-420)</td>
<td>595 (450-920)</td>
</tr>
<tr>
<td>Abdomen and pelvis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RT abdomen-pelvis, no contrast</td>
<td>500 (380-770)</td>
<td>660 (510-1024)</td>
<td>330 (710-1430)</td>
<td>1002 (770-1540)</td>
</tr>
<tr>
<td>RT abdomen-pelvis, with contrast</td>
<td>470 (380-700)</td>
<td>620 (510-930)</td>
<td>870 (710-1300)</td>
<td>942 (770-1400)</td>
</tr>
<tr>
<td>Multiphase abdomen-pelvis</td>
<td>250 (180-370)</td>
<td>330 (240-490)</td>
<td>490 (330-680)</td>
<td>498 (360-730)</td>
</tr>
<tr>
<td>Suspected aneurysm or dissection</td>
<td>320 (210-390)</td>
<td>420 (280-510)</td>
<td>590 (390-710)</td>
<td>628 (420-770)</td>
</tr>
</tbody>
</table>

*Arch Intern Med. 2009;169(22):2078-2086*
Ultrasonography versus Computed Tomography for Suspected Nephrolithiasis


RESULTS
A total of 2759 patients underwent randomization: 908 to point-of-care ultrasonography, 893 to radiology ultrasonography, and 958 to CT. The incidence of high-risk diagnoses with complications in the first 30 days was low (0.4%) and did not vary according to imaging method. The mean 6-month cumulative radiation exposure was

CONCLUSIONS
Initial ultrasonography was associated with lower cumulative radiation exposure than initial CT, without significant differences in high-risk diagnoses with complications, serious adverse events, pain scores, return emergency department visits, or hospitalizations. (Funded by the Agency for Healthcare Research and Quality; ClinicalTrials.gov number, NCT01451931.)
An ultrasound is performed

- The following ED US is performed. Patient is improving but still some pain. Would you order further imaging in the ED?

- 1) No further ED imaging
- 2) KUB
- 3) CT
- 4) Other
An ultrasound is performed

- The following ED US is performed. Patient is improving but still has pain. Would you order further imaging in the ED?

- 1) No further ED imaging
- 2) KUB
- 3) CT
- 4) Other
NEJM US vs. CT Study

Ultrasound:

• Reduced radiation
• No increase in adverse outcomes
• But… urologists are not happy with referrals to their clinic without a CT
Why Get a CT?

• Concerned this is not a kidney stone, may be something “bad”

• Pretty sure it is a kidney stone/ not something “bad”, but want to know how big the stone is, where it is located

What can help you with this?
S.T.O.N.E. Score

- **Sex**
  - Male +2
- **Timing**
  - <6h +3
  - 6-24h +1
- **Origin**
  - Non-black +3
- **Nausea**
  - Nausea alone +1
  - With vomiting +2
- **Erythrocytes**
  - Any blood on UA dip +3

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**Table 3| STONE score, factors, and categories**

<table>
<thead>
<tr>
<th>STONE score by factors and categories</th>
<th>Odds ratio (95% CI)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Male</td>
<td>4.31 (3.13 to 5.96)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Timing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of pain to presentation:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;24 hours</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6-24 hours</td>
<td>1.85 (1.27 to 2.70)</td>
<td>1</td>
</tr>
<tr>
<td>&lt;6 hours</td>
<td>6.34 (4.26 to 9.33)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Origin</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Non-black</td>
<td>6.77 (3.79 to 12.64)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Nausea</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea and vomiting:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Nausea alone</td>
<td>1.99 (1.36 to 2.96)</td>
<td>1</td>
</tr>
<tr>
<td>Vomiting alone</td>
<td>5.26 (3.53 to 7.93)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Erythrocytes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hematoma (on urine dipstick):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Present</td>
<td>5.61 (3.96 to 8.04)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0-13</td>
<td></td>
</tr>
</tbody>
</table>

S.T.O.N.E. Score

- **Sex**
  - Male +2
- **Timing**
  - <6h +3
  - 6-24h +1
- **Origin**
  - non-black +3
- **Nausea**
  - Nausea alone +1
  - With vomiting +2
- **Erythrocytes**
  - any blood on UA dip +3

S.T.O.N.E. PLUS
(point-of-care limited ultrasound)
low dose ct

- ~85% CT radiation dose decrease (~11mSv to ~1.5mSv)
- Overall sensitivity 90.2%; specificity 98.9%
- 96.0% sensitive for stones requiring 90d intervention
Dose Variation in Renal Colic CT 2011-2012

- 49,903 CTs from Dose Index Registry
- “Low dose” defined as <3mSv
- 2% of CT Renal Colic “low dose” (DLP ~200mGy*cm)
- Average 11.2mSv

low dose ct

- Background (1 year)
- RDCT
- Avg KSCT
- Abd/Pelv CT
- Head CT

Effective Dose, mSv
low dose ct
2015-2016
(1) Initial Presentation

- Abdominal / Flank / Back Pain

  - BMI ≤ 35

  - Non-contrast CT abdomen and pelvis/KUB
    - Standard protocol

  - Ureteral calculus
    - Yes
      - Non-contrast CT abdomen and pelvis/KUB
        - Low dose protocol
    - No
      - Further workup for etiology of symptoms as indicated

- Exceptions:
  - Known radio-opaque stone former
  - Contrast allergy
  - Renal insufficiency
  - Pregnancy (ACOG)
  - Pediatric patients

- Management
  - Definitive Interventional Management
  - Observation / Medical Management

- Report:
  - Stone size
  - Stone location
  - Stone attenuation
  - Gain to stone distance
  - Hydroureter
  - Congenital anomalies
  - Extravasation
  - Stranding

- Further workup for etiology of symptoms as indicated
# ACR Appropriateness Criteria® Acute Onset Flank Pain—Suspicion of Stone Disease

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT abdomen and pelvis without contrast</td>
<td>8</td>
<td>Reduced-dose techniques preferred.</td>
<td>******</td>
</tr>
<tr>
<td>CT abdomen and pelvis with contrast</td>
<td>6</td>
<td>If CT without contrast does not explain pain or if without has abnormality that should be further assessed with contrast (ex. stone versus phleboliths).</td>
<td>******</td>
</tr>
<tr>
<td>US kidneys and bladder retroperitoneal with Doppler and KUB</td>
<td>6</td>
<td>Preferred examination in pregnancy, in patients who are allergic to iodinated contrast, and if NCCT is not available.</td>
<td>**</td>
</tr>
<tr>
<td>X-ray intravenous urography</td>
<td>4</td>
<td></td>
<td>****</td>
</tr>
<tr>
<td>MRI abdomen and pelvis without contrast (MR urography)</td>
<td>4</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>MRI abdomen and pelvis with contrast (MR urography)</td>
<td>4</td>
<td>See statement regarding contrast in text under “Anticipated Exceptions.”</td>
<td>0</td>
</tr>
<tr>
<td>CT abdomen and pelvis with contrast</td>
<td>2</td>
<td>Most useful in patients with known stone disease.</td>
<td>******</td>
</tr>
<tr>
<td>X-ray abdomen and pelvis (KUB)</td>
<td>1</td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate.

*Relative Radiation Level.

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33
# Table 2. ACEP and American College of Radiology approaches to acute onset of flank pain.

<table>
<thead>
<tr>
<th>Imaging section</th>
<th>Rating</th>
<th>Comments</th>
<th>Relative radiation level</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT abdomen/pelvis wo contrast</td>
<td>8</td>
<td>Use reduced dose</td>
<td>🌟🌟🌟🌟🌟</td>
</tr>
<tr>
<td>CT abdomen/pelvis w/wo contrast</td>
<td>6</td>
<td>Contrast helps assess cause of pain if noncontrast CT does not show stone</td>
<td>🌟🌟🌟🌟</td>
</tr>
<tr>
<td>US kidneys/bladder and KUB</td>
<td>6</td>
<td>Good combination for pts with known stone disease</td>
<td>🌟🌟</td>
</tr>
</tbody>
</table>

**Clinical section**

**Clinical presentation**

<table>
<thead>
<tr>
<th>Imaging recommended</th>
<th>Comments</th>
<th>KUB, kidneys, ureters, and bladder. NCCT, non-contrast CT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>First stone passage (suspected)</td>
<td>Benefit in establishing diagnosis exceeds radiation risk</td>
<td></td>
</tr>
<tr>
<td>Recurrent stone passage (similar clinical presentation to initial)</td>
<td>KUB may show size and location of stone; US will typically show degree of hydronephrosis and can confirm ureteral urine flow into bladder; radiation exposure eliminated or reduced</td>
<td></td>
</tr>
<tr>
<td>US kidneys/bladder plus/minus KUB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complicated clinical cases (consider NCCT)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
An Imaging Algorithm

Patient with suspected uncomplicated renal colic: pre-test probability (gestalt or STONE score)

- **LOW (<10% risk of stone)**
  - STONE score <5
  - Perform Renal PLUS
    - No Hydronephrosis
    - Hydronephrosis
      - Contrast CT
      - Moderate likelihood of stone, consider reduced dose CT.

- **MODERATE (~50% risk of stone)**
  - STONE score 6-9
  - No Hydronephrosis
  - Hydronephrosis
    - Low Dose CT
    - Urinary stone very unlikely, consider alternate imaging and/or diagnosis.

- **HIGH (~80% risk of stone)**
  - STONE score 10-13
  - No CT
  - Urinary stone very likely, consider trial of passage without further imaging.
  - If characterization of stone size and location desired, obtain reduced dose CT.
Take Home…

- First time renal colic with classic presentation does **NOT** require a CT
- Be aware of the benefits (?) and downsides of CT (IF, radiation, $)
- An objective clinical prediction rule (the STONE score) and bedside US may help determine need for CT
- Be aware of the challenges of diagnosing hydro on ultrasound
- If you do a CT, consider reduced dose; understand what your institution does, and offers (email me if you don’t have)
The risk of avoiding all risk

Jeffrey A. Kline
Indiana University School of Medicine
@Klinelab
Case

- 29 year old presents with palpitations, tight chest, increases with breathing, post long-haul flight
- HR 99
- No PMH
- Physical exam normal except VS
History of Present Illness

Palpitations, chest discomfort and dyspnea since last night, "tightness in chest," acute onset went to work today, symptoms off/on, felt like she couldn't take a deep breath, described as nausea this am, BP high before coming to ED (SBP 170), "everything went black," denies intermittent palpitations all morning with some dizziness
denies similar priors, no chest pain
PE red flags: recently got back from honeymoon in Italy 2 days ago, has been taking OCPs
no abdominal symptoms, no fevers
no h/o blood clots
took two ASA 81mg pta

Review of Systems

Constitutional symptoms: Decreased activity, no fever, no chills, no sweats.
Eye symptoms: No recent vision problems,
Respiratory symptoms: Shortness of breath no wheeze no cough no hemoptysis
### Vital Signs

<table>
<thead>
<tr>
<th>Vital Signs</th>
<th>1/07/13 00:00</th>
<th>1/07/13 23:00</th>
<th>1/07/13 22:00</th>
<th>1/07/13 20:42</th>
<th>1/07/13 20:06</th>
<th>1/07/13 19:53</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core</td>
<td>98.4 DegC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Heart Rate</strong></td>
<td>88 bpm</td>
<td>87 bpm</td>
<td>82 bpm</td>
<td>92 bpm</td>
<td>94 bpm</td>
<td></td>
</tr>
<tr>
<td><strong>Respiratory Rate</strong></td>
<td>17 br/min</td>
<td>16 br/min</td>
<td>16 br/min</td>
<td>16 br/min</td>
<td>15 br/min</td>
<td></td>
</tr>
<tr>
<td><strong>SpO2</strong></td>
<td>97 %</td>
<td>98 %</td>
<td>98 %</td>
<td>99 %</td>
<td>100 %</td>
<td></td>
</tr>
<tr>
<td><strong>CO2 Delivery Device</strong></td>
<td>Room air</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Pain Score</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Blood Pressure #1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Systolic</td>
<td>127 mmHg</td>
<td></td>
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<tr>
<td>Diastolic Blood Pressure #1</td>
<td>H:145 mmHg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP # 1 MAP</td>
<td>90 mmHg</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>BP # 1 MAP Calculated</td>
<td>95 mmHg</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>BP # 1 Position</td>
<td>102 mmHg</td>
<td></td>
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<tr>
<td>BP # 1 Location</td>
<td></td>
<td></td>
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<tr>
<td>BP # 1 Method</td>
<td>Automatic/Non Invasive</td>
<td>Automatic/Non Invasive</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Body Measurements</strong></td>
<td></td>
<td></td>
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<tr>
<td>Weight for Calculation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>55 kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>167.6 cm</td>
</tr>
</tbody>
</table>
Non-pregnant PE exclusion algorithm
The PERC rule

Gestalt low suspicion and:

- Age < 50
- Heart rate < 100
- No hemoptysis
- No estrogen use
- No recent surgery
- No prior PE or DVT
- No unilateral leg swelling
- Room air pulse oximetry $\geq 95$

Initial assessment

• Awareness growing about the problem of overtesting
• When can we do nothing?
• Which bedside variables have predictive power?
Risk Factors for PE

• Epidemiological studies vs. symptomatic ED patients

Doubts and Certainties

Certain increased risk IN ED

- Recent surgery (GETA or epidural)
- Prior VTE
- **Estrogen use**
- Non-O blood type
- Extremity immobility
- Post-partum (<5 days)
- Active cancer

Not a risk or uncertain IN ED

- **Travel**
- Smoking
- Obesity
- Family history
- Pregnancy
- Lines, infection, nursing home
- Heart failure and a-fib

Immobility

Comparison of risks

Sudden onset
Pleuritic CP
Substern. CP
Estrogen
Inactive CA
Obesity
Smoking
Dyspnea
Family Hx VTE

Effecting change in overtesting

1. Knowledge creation- create rules
2. Translating the knowledge into practice-validate, prove effectiveness
3. Implementation- Guidelines, endorsements and systems adoption
4. Individual level behavior change- Influenced by personal experience and values.
“Don’t start”?

Jeffrey Kline @klinlab Aug 15
No chest pain & no dyspnea now or recently, normal vital signs at all times and no leg swelling = No PE workup, regardless of risk factors.

Mark Yoffe MD @MarkYoffe Aug 15
@klinlab same circumstances, but with unexplained syncope and unexplained RV strain on ECG. Would that change anything?

View other replies

Jeffrey Kline @klinlab Aug 15
@MarkYoffe I think it would for me, but with everything that I described, I still think that the outcome prob of PE in that scenario is <2%.

Mel @uscnuising Aug 15
@klinlab @emlkhnote I have to DISAGREE!!! My mother died of a passive PE that completely occluded her right pulmonary artery. No DVT

Em Jay Hermane @EmJayHermane Aug 15
@klinlab what is your definition of ‘recently’?

Denise Campbell @campbell96 Aug 15
@faisalhanja, really? Struggle to articulate SOB? Maybe it’s your question?

Mel @uscnuising Aug 15
@uscnuising @emlkhnote I’m very sorry for your loss.

@klinlab Thank u

Alexander Latev @AlexLatev Aug 17
@klinlab r-r however 1 day ago, can’t PERC due to age, well 6, L shoulder and several DLBP, dissection CT with bilateral segmental PEs
Case, continued
– D-dimer was 2,913 ng/mL $\rightarrow$ CT scan
• IMPRESSION: CT chest with intravenous contrast.

• 1. Somewhat limited examination secondary to timing of the contrast bolus. No large central pulmonary artery filling defect to suggest pulmonary embolism.

• 2. No acute cardiopulmonary abnormality.
Case, continued

- LMWH, prescribed rivaroxaban, referred to KLOT clinic
- I recommended no anticoagulation
- Internist later restarted and referred to a hematologist→thrombophilia panel→APS, FVL, F2, Proteins C, S, AT normal, but found 4G/5G gain of function mutation in PAI-1
- Tried to get pregnant
More follow-up

- Has had 7 repeat CT scans, all negative
- Has had >10 D-dimer tests, all highly elevated
- Has been on and off of every oral anticoagulant known
- Still not pregnant
- Has suffered severe psychological stress as a direct result
Issues raised by this case

• Unintended consequences of testing
• Population risks may not equate to emergency care risks
• Diagnostic testing often in the grey zone
• Thrombophilia testing
What's Next?

• Complete portal activities

• Register for the June Webinar
  www.acep.org/equal

• Questions? Contact the E-QUAL team at
equal@acep.org