A TANGO with RHABDOMYOLYSIS
AN AKI CASE

GLENNIS FIONA JAVELOSA-TAN
And the people rose all that day and all night and all the next day, and gathered the quail…

While the meat was yet between their teeth, before it was consumed, the anger of the LORD was kindled against the people, and the LORD struck down the people with a very great plague.

– Numbers 11:32-33
WHAT IS RHABDOMYOLYSIS?
PART OF A CONTINUUM

DEFINITION

Rhabdo = straited
myo = muscle
lysis = breakdown

A continuum...

CK elevation

>10,000 IU/L
1/10,000 (0.01)

>10X ULN
1/1000 (0.1)

Normal or increased

Normal

Myalgia

Myositis

Myopathy

R

Source: J Am Pharm Assoc © 2006 American Pharmacists Association
Rhabdomyolysis

- Leakage of muscle cell contents into the circulation
  - Electrolytes
  - Myoglobin
  - Sarcoplasmic proteins (Creatine kinase, aldolase, LDH, AST, ALT)

- Massive necrosis manifests as:
  - Limb weakness
  - Myalgia
  - Muscle swelling
  - Gross pigmenturia without hematuria

COMMONLY REPORTED CAUSES

- Trauma
- Exertion
- Muscle Hypoxia
- Genetic Defects
- Infection
- Body Temperature changes
- Metabolic and Electrolyte Disorders
- Drugs and Toxins
- Idiopathic (sometimes Recurrent)

CASE

- B.O.
- 28/M
- Single, Roman Catholic, from Caloocan City
- No known co-morbids
- No previous hospitalization or check-ups
- No regular exercise for the past 3 months
B.O., 28/M

CC: Cramps of both lower extremities

- 3.5 L of water
- 0.5 L Gatorade
- 1 L water

Dizziness
Thigh pain

Bureau of Fire Protection
B.O., 28/M

1 day PTA
3.5 L of water
0.5 L gatorade
1 L water

2 days PTA

Admission

Dizziness
Thigh pain
B.O., 28/M

- 1 day PTA
- 2 days PTA
- Admission

3.5 L of water
0.5 L gatorade
1 L water

IVF: PNSS 1 Liter

- CBC
- Creatinine, BUN
- Na, K, Chloride
- Urinalysis
- KUB Ultrasound

- Dizziness
- Thigh pain
# LABORATORY RESULTS

<table>
<thead>
<tr>
<th>CBC</th>
<th>8/2/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hgb</td>
<td>15.4</td>
</tr>
<tr>
<td>WBC</td>
<td>16.5</td>
</tr>
<tr>
<td>Neutrophils</td>
<td>71.6</td>
</tr>
<tr>
<td>Platelet</td>
<td>270</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blood Chem</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>2.2 mg/dL</td>
</tr>
<tr>
<td>BUN</td>
<td>17 mg/dL</td>
</tr>
<tr>
<td>Sodium</td>
<td>134 meq/L</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.3 meq/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>100 meq/L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Urinalysis</th>
<th>8/2/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Light brown</td>
</tr>
<tr>
<td>Clarity</td>
<td>Cloudy</td>
</tr>
<tr>
<td>Sp. gravity</td>
<td>1.025</td>
</tr>
<tr>
<td>pH</td>
<td>5.0</td>
</tr>
<tr>
<td>Protein</td>
<td>1+</td>
</tr>
<tr>
<td>Glucose</td>
<td>2+</td>
</tr>
<tr>
<td>Blood</td>
<td>2+</td>
</tr>
<tr>
<td>Ketone</td>
<td>Negative</td>
</tr>
<tr>
<td>WBC</td>
<td>0-2/hpf</td>
</tr>
<tr>
<td>RBC</td>
<td>25-30/hpf</td>
</tr>
</tbody>
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**Ultrasound, 8/2/17**

Normal-sized kidneys with parenchymal disease and non-obstructing microlithiases
B.O., 28/M

1 day PTA

3.5 L of water
0.5 L gatorade

1 L water

2 days PTA

Admission

Sent Home
Advised Uro consult

IVF: PNSS 1 Liter

Dizziness
Thigh pain

Sent Home
Advised Uro consult

Admit
ROS

• No fever
• No headache
• No cough or colds
• No dysuria or flank pains
• No weight loss or easy fatigability
• Past Medical History
  No known co-morbid 
  No intake of any medications/herbal supplements/tea/coffee

• Family History
  Hypertension

• Social History
  Non-smoker, non-alcoholic beverage drinker
  Previously jogged daily but he has no routine exercise for the past 3 months
PHYSICAL EXAMINATION

Awake, alert, ambulatory

Vital Signs: BP 150/90, HR 71, RR 21, T 36.5

Dry oral mucosa, No cervicolympadenopathies

Equal chest expansion, Clear breath sounds

Soft non-tender abdomen

Tenderness over the lower extremities, more on the thighs

Full equal pulses, No Edema
IMPRESSION

Acute Kidney Injury secondary to

1. Rhabdomyolysis (Intrinsic)
2. Dehydration (Pre-renal)
## LABORATORY RESULTS

### CBC 8/2/17, AM 8/2/17, PM

<table>
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<th>Parameter</th>
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<th>8/2/17, PM</th>
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<tbody>
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<td>Hgb</td>
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### Blood Chem 8/2/17 8/3/17

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<td>4/hpf</td>
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<tr>
<td>Ep cells</td>
<td>1/hpf</td>
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<tr>
<td>Hyaline cast</td>
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<td>0</td>
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<tr>
<td>Bacteria</td>
<td></td>
<td>7/hpf</td>
</tr>
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<td>CPK-MB (N 0-25iu/L)</td>
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### IMPRESSION

**Acute Kidney Injury secondary to Rhabdomyolysis**
THE PATIENT HAD…

• Inciting event → Strenuous exercise

• Presenting symptoms:
  ✓ Myalgia
  ✓ Limb weakness

• Labs
  ✓ CPK = 4,482 iu/L
  ✓ Urine Color: Light Brown;
  ✓ Urine Blood 4+; RBCs 4/hpf

WHAT IS MYOGLOBIN?

• Myoglobin
  - A heme-containing respiratory protein, dark red
  - Freely filtered by the glomerulus
  - Renal threshold: 0.5 - 1.5mg/dL
  - >100mg/dL = Reddish-brown urine (tea-colored)

* Not all cases of rhabdomyolysis will have myoglobinuria
* Myoglobinuria occurs only in the context of rhabdomyolysis

WHAT HAPPENS IN RHABDOMYOLYSIS?

Direct cell membrane damage → Calcium influx → ATP depletion

Parekh R, Caro D, Tainter C (2012). Rhabdomyolysis: Advances in Diagnosis and Treatment. Emergency Medicine Practice 14:3.
ACUTE KIDNEY INJURY
AKI SECONDARY TO MYOGLOBINURIA

High incidence of AKI among Rhabdomyolysis patients if due to:
- Illicit drug use or alcohol abuse
- Trauma
- Multiple causal factors

46% of 475 patients hospitalized for rhabdomyolysis

The **early** kidney lesion is **afferent arteriole vasoconstriction**

- Intravascular volume depletion
- Fluid sequestration within damaged muscle
- Deficit in nitric oxide
- Scavenging effect of myoglobin

Hyperkalemia
Hyperphosphatemia
Hyperuricemia
High anion gap acidosis
Hypocalcemia

10 Liters of fluid per limb
Acidic Urine

Distal Tubule Obstruction

Proximal tubule toxic & ischemic injury
RENAL MANIFESTATIONS

**↑ Creatine Kinase**
- Peak values are weakly correlated with kidney injury

**Myoglobinuria**
- Dipstick (+) for blood; no RBCs in sediment
- Sensitivity: 80% for rhabdomyolysis

**Low FeNA (<1%)**
- Reflecting primary **preglomerular** vasoconstriction & tubular occlusion rather than tubular necrosis

---

**Blood Chem 8/3/17**

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<th>Level</th>
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PREVENTION & TREATMENT

- Hydrate
- Mannitol
- HCO₃
- RRT
HOW TO PREVENT EXERTION RHABDOMYOLYSIS

- **Hydrate**
- **Warm-up & Cool down**
- **Pace**
  - Periodic repetition of eccentric exercises could reduce the level of muscle damage
  - Consider interval time between each exercise
- Type of exercise that can prevent rhabdomyolysis? **UNKNOWN**
- **Avoid**: High-intensity, longer duration, and weight-bearing exercise
  - Hot environment

HANDLING ELECTROLYTES

- Correct Hyperkalemia
- Correction of hyperphosphatemia
  - Do not use calcium-containing chelators
- Do not correct Hypocalcemia
  - Unless symptomatic or with severe hyperkalemia
  - Correction can increase precipitation of calcium phosphate in injured muscle

**HYPERCALCEMIA** during recovery of renal function
-- Mobilization of calcium deposited in muscle, normalization of Ph levels, increase in calcitriol

2003, magnitude 6.6 earthquake stuck the city of Bam in southeastern Iran. At least 26,271 people were killed and 30,000 injured.

- 638 patients: 134 (21%) with AKI, and 110 of 134 needed dialysis.
- ↑ Intensity of trauma
  - ↑ Delay of fluid therapy
    - ↑ AKI and need for dialysis (P < .001)
- ↑ Volume of fluid therapy → ↓ AKI & need for dialysis (P = .005)
- **Severe Rhabdomyolysis:** > 6 L/day
- **Moderate rhabdomyolysis:** > 3 L/day

Severe: CPK > 15,000 IU/L
Moderate: 1,000-14,999 IU/L
**Bicarbonate and mannitol treatment for traumatic rhabdomyolysis revisited.**

Nielsen JS¹, Sally M², Mullins RJ¹, Slater M¹, Groat T³, Gao X¹, de la Cruz JS¹, Ellis MK¹, Schreiber M¹, Malinoski DJ⁴.

**Bicarbonate**
- Correct acidosis
- Prevent precipitation of myoglobin in tubules
- Reduce the risk of hyperkalemia

**Mannitol**
- Increases renal blood flow and GFR
- Reducing muscle swelling
- Prevents obstructive myoglobin casts
- Scavenges free radicals

Bicarbonate and mannitol treatment for traumatic rhabdomyolysis revisited.

Mannitol

HCO₃

- Oregon Health & Science University, USA
- 77 rhabdomyolysis patients over a 10-year period (1993 to 2002)
- Diagnosed with rhabdomyolysis and Creatine kinase >2,000 U/L
- Rhabdomyolysis Protocol initiated for CK >10,000 U/L:
  - Goals
    1. Brisk flow of urine on the 1st hour (>2-3 mL/Kg/hr )
    2. Raise urine pH > 6.0
Bicarbonate and mannitol treatment for traumatic rhabdomyolysis revisited.

Nielsen JS, Sally M, Mullins RJ, Slater M, Groat T, Gao X, de la Cruz JS, Ellis MK, Schreiber M, Malinoski DJ.

56 patients w/ CK > 10,000 IU/L

Rhabdo Protocol
N=46
12 (26%) needed dialysis

No protocol
N=10
7 (70%) needed dialysis

p=0.008

IVF 2-3 mL/Kg/hr + HCO3 + Mannitol
• Article

• Myoglobin has a very low diffusion coefficient, requiring transport by convection

• High-flux membranes should be used

• Naka et al (2005):
  • Case report: 53/F with Severe rhabdomyolysis secondary to serotonin syndrome
  • Use of a continuous RRT in conjunction with a hyperpermeable membrane

  • ↑ Myoglobin clearance with hyperpermeable membrane
China; Quasi-RCT; Therapy duration not reported

22 participants

Treatment group (N = 10)
- CVVH therapy: 10 to 16 hours
- Conventional therapy (fasciotomy when necessary; fluid resuscitation; therapy for shock, hyperkalemia, acidosis; diuresis; antibiotics)

Control group (N = 12)
- Conventional therapy & intermittent hemodialysis when necessary

CVVH

- Shorter hospital stay (21.8 vs 34.1 days)
- ↓ serum myoglobin and creatine on day 10 of treatment (161 vs 502 g/L)
- ↓ Serum Creatine kinase on day 10 (205 vs 1931 g/L)
- ↓ Duration of oliguria phase on day 10 (12 vs 23 days)
OTHER SUGGESTED THERAPIES

- Allopurinol
- Pentoxifylline
- N-acetyl-cysteine
- Antioxidants

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>CK (mg/dL)</th>
<th>CK-MB (mg/dL)</th>
<th>Creatinine (mg/dL)</th>
<th>Hemoglobin (g/dL)</th>
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<tbody>
<tr>
<td>DOA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4th HD</td>
<td></td>
<td>44,820</td>
<td>25,521</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8th</td>
<td></td>
<td></td>
<td>133</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12th</td>
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<td>16th</td>
<td></td>
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<td></td>
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<tr>
<td>18th</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>OPD</td>
<td></td>
<td>167</td>
<td></td>
<td></td>
<td>10.5</td>
</tr>
</tbody>
</table>

- **Hemodialysis**
- **Creatinine (mg/dL)**
- **Thigh pain**

**Sickle Cell Trait?**

- Cipro (Ciprofloxacin)
- Piperacillin-tazobactam
- CRO
- HAP
- UTI

**HCO3**

**Hgb: 10.5 g/dL**
SUMMARY

• Rhabdomyolysis is preventable
• Hydration is not enough; Avoid high-intensity, long duration exercise routine
• With Rhabdomyolysis, hydrate with 2-3mL/Kg/hr saline to target urine output of 2-3 mL/Kg/hr
• Use of HCO3 and Mannitol may be considered especially in non-oliguric patients
• If RRT is needed, CRRT (CVVH) may provide best results
SOURCES


• Parekh R, Caro D, Tainter C (2012). Rhabdomyolysis: Advances in Diagnosis and Treatment. Emergency Medicine Practice 14:3.
SOURCES

THANK YOU

O give thanks unto the lord, for he is good; for his mercy endures forever.

Psalms 136:1
CHAMP GUIDELINES FOR RETURN TO SPORT FOLLOWING EXERTIONAL RHABDOMYOLYSIS

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Rest for 72 hours and encouragement of oral hydration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 8 hours of sleep nightly</td>
</tr>
<tr>
<td></td>
<td>• Remain in a thermally controlled environment if the episode of ER was in relation to heat illness</td>
</tr>
<tr>
<td></td>
<td>• Follow-up after 72 hours with a repeat serum CK level and UA</td>
</tr>
<tr>
<td></td>
<td>• If the CK has dropped to below 5 times the upper limit of normal and the UA is negative, the athlete can progress to phase 2; if not, reassessment in 72 additional hours is warranted</td>
</tr>
<tr>
<td></td>
<td>• Should the UA remain abnormal or the CK remain elevated for 2 weeks, expert consultation is recommended</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 2</th>
<th>Begin light activities, no strenuous activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Physical activity at own pace/distance</td>
</tr>
<tr>
<td></td>
<td>• Follow-up with a care provider in 1 week</td>
</tr>
<tr>
<td></td>
<td>• If there is no return of clinical symptoms, the athlete can progress to phase 3; if not, the athlete should remain in phase 2 checking with the health care professional every week for reassessment; if muscle pain persists beyond the fourth week, consider expert evaluation to include psychiatry</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase 3</th>
<th>Gradual return to regular sport/physical training</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>• Follow-up with care provider as needed</td>
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CHAMP: Consortium for Health and Military Performance
B.O., 28/M

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<th>DOA</th>
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<tr>
<td>UO/day</td>
<td>3,050cc</td>
<td>1,050cc</td>
<td>1,900cc</td>
<td>1,690cc</td>
<td>810cc</td>
<td>1,250cc</td>
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- **Hemodialysis**: [Starts DOA and continues every 4th HD]
- **Creatinine (mg/dL)**
- **Thigh pain**

- **CK**: 44,820
- **CK-MB**: 25,521
- **Hgb**: 10.5 g/dL

**Medications**
- **CRO**: Piperacillin-tazobactam
- **UTI**: Cipro
- **HAP**: Cipro
### COMPLETE BLOOD COUNT

<table>
<thead>
<tr>
<th></th>
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<tr>
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<td>Albumin</td>
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<td>PT; INR</td>
<td>13.4 vs 12.3; 1.12</td>
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<td>PTT</td>
<td>31.9 vs 32.7</td>
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## BLOOD CHEMISTRY

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<td>5817.48</td>
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<tr>
<td>BUN</td>
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</tr>
<tr>
<td>Sodium</td>
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<td>Potassium</td>
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<td>3.7</td>
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<td>Calcium</td>
<td>7.2</td>
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<td>Albumin</td>
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<tr>
<td>Phosphorus</td>
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<tr>
<td>Urine Uric acid (37-92)</td>
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<td></td>
<td>15.9 mg/dL</td>
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<tr>
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</tr>
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<td>Color</td>
<td>Light brown</td>
<td>Light yellow</td>
<td>Light yellow</td>
<td>Colorless</td>
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<tr>
<td>Clarity</td>
<td>Clear</td>
<td>Cloudy</td>
<td>Clear</td>
<td>hazy</td>
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<tr>
<td>Sp. gravity</td>
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<tr>
<td>Protein</td>
<td>2+</td>
<td>1+</td>
<td>Trace</td>
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<tr>
<td>Glucose</td>
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<td>Negative</td>
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<td>2+</td>
<td>2+</td>
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<tr>
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<tr>
<td>L.E.</td>
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<td>1+</td>
<td>Negative</td>
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<tr>
<td>WBC</td>
<td>6/hpf</td>
<td>7</td>
<td>6</td>
<td></td>
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<tr>
<td>RBC</td>
<td>4/hpf</td>
<td>164</td>
<td>16</td>
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<tr>
<td>Ep cells</td>
<td>1/hpf</td>
<td>1</td>
<td>1</td>
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<td>Hyaline cast</td>
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<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bacteria</td>
<td>7/hpf</td>
<td>97</td>
<td>1</td>
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## ARTERIAL BLOOD GAS

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<th>8/3/17, 2 AM</th>
<th>8/3/17, 3 PM</th>
<th>8/10/17</th>
<th>8/12/17</th>
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<tr>
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<td>30</td>
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<td>PO2</td>
<td>99</td>
<td>104</td>
<td>54</td>
<td>213</td>
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<td>O2 sat</td>
<td>97%</td>
<td>97%</td>
<td>89%</td>
<td>100%</td>
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<tr>
<td></td>
<td>Room Air</td>
<td>Room air</td>
<td>6 lpm</td>
<td>Bipap 100%</td>
</tr>
</tbody>
</table>
Urine CS 8/9/17

- Klebsiella pneumoniae
  - Sensitive to: Amikacin, cefotaxime, Ceftriaxone, Ciprofloxacin, gentamicin, norfloxacine, co-
    trimoxazole, meropenem, piperacillin/tazobactam, aztreonam
  - Resistant to: Nitrofurantoin, Co-amox, AmpiSul
SPUTUM GS/CS, 8/14/17

PMN >25/lpf
Epithelial cells >10/lpf
gram (-) diplococci = many
gram (-) coccobacilli = moderate
gram (-) bacilli = moderate
gram (+) coccobacilli = few
yeast cells = few

Specimen/Site : SPUTUM
Result : Moderate growth of Acinetobacter baumanii.

Bacteria 1 :

<table>
<thead>
<tr>
<th>Category</th>
<th>Antibiotics</th>
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<tr>
<td>SENSITIVE</td>
<td>AMIKACIN, CIPROFLOXACIN, GENTAMICIN, SULBACTAM/AMPI, CEFEPIME, TAZOBAC/PIPERACILLIN</td>
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<tr>
<td>INTERMEDIATE</td>
<td>CEFOTAXIME, CEFTAZIDIME</td>
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<tr>
<td>RESISTANT</td>
<td>CEFTRIAXONE, CO-TRIMOXAZOLE</td>
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</table>
LOWER ABDOMEN ULTRASOUND

History: Elevated creatinine
Comparison: None

Right kidney = 11.0 x 6.1 x 5.7 cm
  Parenchymal thickness = 2.1 - 2.3 cm
  Cortical thickness = 1.1 - 1.2 cm
Left kidney = 11.9 x 5.1 x 5.4 cm
  Parenchymal thickness = 1.6 - 2.0 cm
  Cortical thickness = 0.9 - 1.0 cm
Urinary bladder volume = 41 cc
Prostate gland = 3.4 x 3.9 x 2.9 cm (20.8 g)

Both kidneys are normal in size with increased parenchymal echogenicity relative to the liver and spleen. Smooth cortical outlines are noted. There is prominence of the medullary pyramids. Corticomedullary and parenchymal-sinus demarcations are intact. The central echo complex is dense and centrally-oriented. Parenchymal thickness is intact. No calculus, dilatation or focal lesion is seen.

The urinary bladder is underfilled precluding its proper evaluation. A foley catheter balloon is seen intraluminally.

The prostate gland is normal in size.

No ascites is seen.

IMPRESSION:
1. Normal-sized kidneys with parenchymal disease
2. Underfilled urinary bladder
3. Normal-sized prostate gland
Clinical data: to consider AKI secondary to CIU

Follow-up study to previous lower abdomen ultrasound since 08/03/2017 shows the following findings:

Right midhepatic length = 17.9 cm  Left midhepatic length = 10.4 cm
Right kidney = 11.7 x 6.8 x 6.1 cm  (Parenchymal Thickness = 2.3 cm)
Left kidney = 11.3 x 6.6 x 6.2 cm  (Parenchymal Thickness = 2.5 cm)
Spleen = 9.9 x 4.9 cm

The liver is enlarged but with normal echopattern. Hepatic outline is smooth. No discrete mass or calcification seen. The portal vein and its tributaries are normal in caliber.

The gallbladder is normal in size. A calculus is noted intraluminally, measuring approximately 1.7 cm. Wall is not thickened. The common bile duct is not dilated.

The pancreas and spleen are normal in size and parenchymal echopattern. No focal lesion is seen in these organs.

Both kidneys are normal in size with smooth cortical outlines but hyperdense parenchyma relative to the liver and spleen. Cortico-medullary and parenchymal sinus demarcation are intact. The central echo complex is dense and centrally-oriented. Parenchymal thickness is intact. No calculus, dilatation or focal lesion is seen.

The visualized segment of the abdominal aorta is normal in course and caliber with no dilatation, narrowing nor thrombus seen. No enlarged para-aortic lymph nodes detected.

Minimal fluid collection is noted in the abdominopelvic cavity.

**IMPRESSION:**
1. Non-specific hepatomegaly
2. Cholelithiasis
3. Normal-sized kidneys with parenchymal disease
4. Minimal ascites
5. Normal ultrasound of the pancreas, spleen and abdominal aorta
CHEST PA X-RAY

No previous study for comparison.

Image taken in suboptimal inspiration.

Pulmonary vascular markings are prominent with confluent hazy densities in both parahilar and paracardiac areas.

Heart is magnified.

The right costophrenic sulcus is blunted with a lateral ascending pleural density in the lower lateral thoracic wall.

The left costophrenic sulcus and hemidiaphragm are indistinct.

Visualized osseous structures and soft tissues are unremarkable.

A right internal jugular vein catheter is now seen with its tip in the right atrium.

IMPRESSION:

Pulmonary congestion and edema, concomitant pneumonia cannot be ruled out.

Bilateral pleural effusion, more in the left. Underlying parenchymal pathology cannot be ruled out in the left.
CHEST PA X-RAY

Follow-up study since 08/10/2017 shows the following findings:

- Image taken in suboptimal inspiration.
- There is significant progression of the pulmonary congestion and edema.
- There is also increase in the bilateral pleural effusion.
- True heart size cannot be ascertained.
- A right internal jugular vein catheter is again seen with its tip in the right atrium.
- There are no other remarkable interval findings.

- END OF REPORT-
CHEST PA X-RAY

Follow-up study since 08/10/2017 shows the following findings:

Pulmonary congestion and edema is again noted; concurrent pneumonia is not ruled out.

There is resolution of the bilateral pleural effusion.

The heart is not enlarged.

A right internal jugular vein catheter is again seen.

No other remarkable interval findings.