Approach to the Patient with Low Urine Output

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Clinical Case

• It is 3:15 AM. You have just fallen asleep 2 minutes ago. Page from an RN in the ICU regarding patient X.

• “Urine output has dropped to 5 ccs/hr”

• What is your response?
Clinical Case: What to do?

- A) Let me sleep and call me later.
- B) Good for you, less emptying of the Foley bag!
- C) Give the patient 200mg Lasix IV.
- D) Give the patient a 2 Liter Fluid Bolus.
- E) Call Renal.
I WANT TO SEE SOME URINE!
Oliguria

- Urine output < 500ccs/day (about 20ccs/h)

- Average person excretes 600mOsm of solute per day.
- Maximal urinary concentration ability is 1200 mOsm/L -> Hence at least 0.5 Liters of urine needed.
Oliguria-some numbers

- Urine output < 0.3ml/kg/h for 24 hours.

50 kg person: 15ml/h = 360 mls/24hrs

70 kg person: 21ml/h = 504 mls/24hrs

100 kg person: 30ml/h = 720 mls/24hrs
Oliguria: Incidence

- 18% of patients in the medical-surgical ICU who have intact renal function.
- 69% of patients in the ICU who develop Acute Kidney Injury (Acute Renal Failure)

Zaloga GP et al: Anesthesiology 1990; (72):598-602
Oliguria: Pathophysiology

- Urine output is a function of glomerular filtration, tubular secretion and reabsorption.
- Glomerular filtration is directly depending on renal perfusion.
- Oliguria indicates a reduction in GFR or a mechanical obstruction to urine flow.
Differential Diagnosis of Oliguria

- **Pre-renal**
  - Not enough juice going to the kidneys.

- **Renal**
  - Kidneys not filtering properly.

- **Post-renal**
  - Urine can’t get out.
Oliguria Checklist: Postrenal

✓ Is the Foley Catheter working and in the right place?
Oliguria Checklist: Postrenal

✓ Is the Foley Catheter working and in the right place?
✓ Is there any other Obstruction present? Ureters, renal Pelvis, Bladder emptying etc.
✓ Consider getting a renal ultrasound.
Clinical Case

• Called to see a 50 year old woman POD#3 following Gastric Bypass surgery for decreased urine output (20 ccs/hour).

• The surgeons tell you that they have given her 7 Liters of Fluid POD#1 and 6 Liters of Fluid POD#2 and that she remains oliguric despite this. She is a total of 18 Liters fluid up.

• Her creatinine has increased from a baseline of 0.6 mg/dl to now 1.3 mg/dl.
Clinical Case

Primary team is very worried about the absence of urine in the bag!
Differential Diagnosis of Oliguria

- Pre-renal
- Renal
- Post-renal
Oliguria Checklist

✓ Foley OK? Obstruction?
✓ Enough juice going to the kidneys?
Is this Patient Prerenal?
Are the kidneys getting enough juice?

✓ **Blood Pressure, Heart Rate, Orthostatics**
  
  BP 140/70, HR 84, unable to sit up or stand

✓ **Filling Pressures, Neck Veins**
  
  No central line, unable to see neck veins

✓ **Evidence for CHF?**
  
  TTE done but unable to get good images given body habitus in this 500 lbs woman.
Is this Patient Prerenal?

✓ Blood Pressure, Heart Rate, Orthostatics
✓ Filling Pressures, Neck Veins
✓ Evidence for CHF?

ASK THE KIDNEY?
Investigations

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>140</td>
<td>109</td>
<td>15</td>
</tr>
<tr>
<td>3.8</td>
<td>26</td>
<td>1.3</td>
</tr>
</tbody>
</table>

$U_{Na}$ 10 mEq/L
$U_{K}$ 71
$U_{Cl}$ 12

$U_{Creat}$ 506 mg/dl
$U_{osm}$ 560 mOsm/kg

FENa=0.02%
## Interpretation of Urine Electrolytes

<table>
<thead>
<tr>
<th></th>
<th>Pre-Renal Uremia</th>
<th>Acute Tubular Necrosis</th>
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<tbody>
<tr>
<td><strong>Urine Sodium (mEq/L)</strong></td>
<td>&lt;10</td>
<td>&gt;20</td>
</tr>
<tr>
<td>(Urine Chloride)</td>
<td>(&lt;15)</td>
<td>(&gt;20)</td>
</tr>
<tr>
<td><strong>Fractional Excretion Sodium (FeNa)</strong></td>
<td>&lt;1%</td>
<td>&gt;2%</td>
</tr>
<tr>
<td><strong>Urine Osmolality</strong></td>
<td>&gt;500mOsm/kg</td>
<td>~300mOsm/kg</td>
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Normal Sodium Reabsorption

GFR 180L/d
27,000mEq Na filtered

65%
18,000mEq

5-7%
1000mEq

2-5%
450mEq

20-25%
6000mEq

1.5L urine containing 150mEq Na (FeNa 0.55%)
Increased Na and H₂O Reabsorption in Pre-Renal Azotemia

- **Angiotensin II**
- **SNS**
- **Aldosterone**
- **ADH**

↓GFR 14mls/min = 20L/d
2800 mEq Na filtered

< 500mls urine
< 10 mEq Na
FeNA < 1%
Uosm > 500

CORTEX
MEDULA
Low Perfusion States

Low renal perfusion

Hypovolemia
Cardiogenic
Peripheral vasodilation
Renovascular

Myocardial dysfunction
Valvular dysfunction
Tamponade
Sepsis
Cirrhosis
Anaphylaxis
Renal vasoconstriction
Drugs
Cyclosporine Mediated Vasoconstriction
DD for Low Urine Sodium in Oliguria

- Prerenal
- Hepatorenal
- CHF/Cardiorenal
- Radiocontrast
- Cyclosporine/Tacrolimus Toxicity
- Acute Glomerulonephritis
Clinical Case

- 52 year old man with hx of ESLD from ETOH.
- POD day #3 following OTLTx.
- Difficult Transplant with 24 units of PRC, 30 units of Platelets, 28 units of FFP and 15 Liters of Cristalloid.
- Nurse is concerned because UOP has dropped to 10 ccs/hour.
Clinical Case

- Exam:
  - Intubated, sedated, very edematous
  - BP 115/75  HR 75
Differential Diagnosis of Oliguria

- Pre-renal
- Renal
- Post-renal
Oliguria Checklist

- Foley OK? Obstruction?
- Enough juice going to the kidneys?
Is this Patient Prerenal?
Are the kidneys getting enough juice?

✔ Blood Pressure, Heart Rate, Orthostatics
  BP 115/75, HR 75, unable to sit up or stand

✔ Filling Pressures, Neck Veins
  CVP=18, PCWP= 22

✔ Evidence for CHF?
  Swan Ganz Readings: CO 5, CI 2.5
Is this Patient Prerenal?

- Blood Pressure, Heart Rate, Orthostatics
- Filling Pressures, Neck Veins
- Evidence for CHF?

ASK THE KIDNEY?
**Investigations**

<table>
<thead>
<tr>
<th>UNa</th>
<th>UK</th>
<th>UCl</th>
<th>Ucreat</th>
<th>Uosm</th>
<th>FENa</th>
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<td>60</td>
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<tr>
<td>15 mEq/L</td>
<td>35</td>
<td>13</td>
<td>35 mg/dl</td>
<td>510 mOsm/kg</td>
<td>0.4%</td>
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**Table:**

- UNa: 15 mEq/L
- UK: 35
- UCl: 13
- Ucreat: 35 mg/dl
- Uosm: 510 mOsm/kg
- FENa: 0.4%
Clinical Case

• Going back to the bedside.
• On exam patient has a very distended and tense abdomen.
• Could he have abdominal compartment syndrome?
• You transduce a bladder pressure which is 35 mmg Hg.
Abdominal Compartment Syndrome

- Organ Dysfunction caused by intraabdominal hypertension
- Normal intraabdominal pressure 5-7 mm Hg.
- Intraabdominal hypertension defined as pressure > 12mm Hg
- Kidney:
  - Oliguria with IAP > 15mm HG
  - Anuria with IAP > 30mm HG
Clinical Case

55yo male admitted following an alcoholic binge with severe abdominal and back pain. On examination, unwell with acute abdomen, P125, BP 95/42, T38.2ºC, ↑RR 28/min

- Amylase x10 normal → Dx acute pancreatitis. US → no gallstones or collection.
- Initial Rx includes analgesia and IV Abx.
- Further deterioration condition D3 of admission with respiratory distress and decreased urine output (10mls/hr) and transferred to ICU.
I want some liquid gold in that bag!
Oliguria Checklist

✓ Foley OK? Obstruction?
✓ Enough juice going to the kidneys?
Is this Patient Prerenal?
Are the kidneys getting enough juice?

- **Blood Pressure, Heart Rate, Orthostatics**
  - BP 100/50, HR 90, unable to sit up or stand

- **Filling Pressures, Neck Veins**
  - CVP 18 cm

- **Evidence for CHF?**
  - No S3 or S4 but pulmonary vascular congestion on CxRay and bilateral pleural effusions.
Differential Diagnosis of Oliguria

- Pre-renal
- Renal
- Post-renal
Differential Diagnosis of ARF

1. Prerenal azotemia

2. Renal artery

3. Small vessel disease

4. Glomerular disease

5. Acute tubular necrosis

6. Acute interstitial nephritis

7. Intratubular obstruction

8. Postrenal obstruction
What is the Diagnosis?
Ask the Kidney!

Repeat Creatinine went from 1 -> 2mg/dl
What to do?

- 55 year old man with pancreatitis and oliguric AKI from ATN who is volume overloaded. You should now:
  a) Give him more fluid.
  b) Give him Diuretics.
  c) Call Renal.
  d) Turn your pager to silent and take a nap.
Clinical Case

- 35 year old man with idiopathic dilated cardiomyopathy with EF=20% admitted with CHF exacerbation.
- Despite industrial doses of Diuretics his UOP has dropped off to 5 ccs/hour.
- The nurse wants you to restore a healthy flow of urine.
Oliguria Checklist

✓ Foley OK? Obstruction?
✓ Enough juice going to the kidneys?
Is this Patient Prerenal?
Are the kidneys getting enough juice?

- **Blood Pressure, Heart Rate, Orthostatics**
  BP 94/50, HR 70.

- **Filling Pressures, Neck Veins**
  JVP is to the angle of his jaw.

- **Evidence for CHF?**
  Known CHF with EF of 20%. Pulmonary edema and peripheral edema.
Is this Patient Prerenal?

✓ Blood Pressure, Heart Rate, Orthostatics
✓ Filling Pressures, Neck Veins
✓ Evidence for CHF?

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- $U_{Na}$: 10 mEq/L
- $U_{K}$: 71
- $U_{Cl}$: 12
- $U_{creat}$: 80 mg/dl
- $U_{osm}$: 510 mOsm/kg
What is the Diagnosis?

Cardiorenal Syndrome
What should you do now?

- 200 mg Torsemide IV followed by 500 mg of Diuril IV.
- 500 cc fluid bolus.
- Dobutamine and Nesiritide.
- Consider Ultrafiltration.
- Call Cardiology and Renal.
Oliguria-Summary

- **Pre-renal**: Not enough juice going to the kidneys.
- **Renal**: Kidneys not filtering properly.
- **Post-renal**: Urine can’t get out. Foley OK? Obstruction?
Oliguria-Summary

- Rule out an outflow problem.
- Make sure the tank is full but do not overfill the tank.
- Assess hemodynamics and ensure renal perfusion.
- Ask the kidney (urine lytes and urine sediment).