Avoiding Kidney Injury: Obstetric Patients
Objectives

• Discuss incidence and impact of acute kidney injury & chronic kidney disease in obstetric patients
• Review the pathophysiology related to pregnancy and risk for developing AKI
• Summarize neuraxial and general anesthesia recommendations supported by the literature for obstetric patients with AKI or CKD
For more information....

- For a more in-depth overview of kidney disease, including staging and definitions, reference: [MPOG Avoiding Kidney Injury - Overview, Pathophysiology, Definitions](#)
- For other specialty specific recommendations, reference the following sections of the toolkit:
  - [Avoiding Kidney Injury - Pediatrics](#)
  - [Avoiding Kidney Injury - Cardiac](#)
  - [Avoiding Kidney Injury - Recommendations for Adult Surgical Patients](#)
Kidney Disease in Obstetric Patients

- Kidney disease is an independent risk factor for maternal and fetal morbidity and mortality\(^1\)
- Multiple renal physiologic changes in pregnancy
- AKI in pregnancy is rare, hard to define, and difficult to measure
Renal Function Changes in Pregnancy $^{2,3}$

- $\uparrow$ Renal Blood Flow
  - $\uparrow$ GFR (30-50%)
  - $\downarrow$ Scr
  - $\uparrow$ Protein excretion (up to 300mg/24h)
  - $\downarrow$ Plasma osmolality and plasma sodium levels
  - $\uparrow$ Uric Acid Excretion
Renal Function Changes in Pregnancy \(^{3,4,5}\)

- Progesterone causes smooth muscle relaxation
- Gravid uterus causes partial ureteral obstruction
- Kidney volume increases up to 30% and dilation of calyces, pelvis and ureters occurs
- Stasis, resulting in increased risk of urinary tract infection
CKD in Pregnancy
# CKD in Obstetric Patients

<table>
<thead>
<tr>
<th>CKD is estimated to affect 3% of all pregnant women(^6)</th>
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</thead>
<tbody>
<tr>
<td>Maternal Outcomes</td>
</tr>
<tr>
<td>• 5x more likely to experience(^7):</td>
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<tr>
<td>• Gestational HTN</td>
</tr>
<tr>
<td>• Preeclampsia</td>
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<tr>
<td>• Eclampsia</td>
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<tr>
<td>• Maternal Mortality</td>
</tr>
<tr>
<td>Fetal Outcomes</td>
</tr>
<tr>
<td>• 2x greater risk of adverse fetal outcomes(^7)</td>
</tr>
<tr>
<td>• Risk proportional to degree of maternal CKD(^8,9)</td>
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</table>
**CKD in Pregnancy**

- Obstetric complications increase proportionally with the extent of the mother’s preexisting renal disease and hypertension\(^\text{10}\)
- Women with CKD at increased risk for preeclampsia and preterm delivery\(^\text{11}\)
- There is a 4.7x greater risk of progression to ESRD for patients with CKD that develop preeclampsia\(^\text{12}\)

<table>
<thead>
<tr>
<th>Maternal Renal Function</th>
<th>Associated Risks (^\text{11, 13, 14, 15, 16, 17})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild elevated creatinine (1.2-1.4mg/dL)</td>
<td>Small risk for decline in renal function</td>
</tr>
<tr>
<td>Moderate renal insufficiency (1.4-2.5mg/dL)</td>
<td>20-30% increased risk of preeclampsia and preterm delivery</td>
</tr>
<tr>
<td>Severe renal insufficiency (Cr &gt;2.5mg/dL)</td>
<td>70% experience preterm delivery, 40% experience loss of renal function during pregnancy or postpartum leading to dialysis</td>
</tr>
</tbody>
</table>
## Perioperative Management of Obstetric patients with CKD

### Periop Eval
- Include assessment of changes to renal function and related systems\(^\text{18}\)

### Consults
- Consult nephrology team to assist early in pregnancy\(^\text{19}\)

### Anesthetic Management
- Dependent on severity of CKD \(^\text{18}\)
- Typically euvolemic patients with stable mild to moderate renal insufficiency and well controlled HTN do well with minimal special interventions \(^\text{11}\)
- Dialysis dependent patients present greater anesthetic challenge \(^\text{11}\)

### Nephrotoxic Drugs
- Avoid nephrotoxic drugs in patients with residual kidney function\(^\text{11}\)
Neuraxial Anesthesia Considerations for Obstetric patients with CKD

- Determine fluid status before anesthesia\textsuperscript{11}
  - If euvoletic, treat hypotension with a vasopressor instead of fluids to reduce risk of fluid overload
- Assess coagulation status
  - At risk for abnormal bleeding\textsuperscript{11}
  - May have residual heparin from HD catheter that precludes regional anesthesia \textsuperscript{11}
- Documentation of pre-existing neuropathy prior to neuraxial anesthesia \textsuperscript{18}
- Insufficient evidence to recommend spinal vs epidural\textsuperscript{18}
Intraop Management of Obstetric patients with CKD

- Non invasive BP monitoring appropriate for early CKD with well controlled HTN
- Pad and protect HD fistula, no blood pressures on that arm
- Check serum K before OR, succinylcholine will cause a 0.5-0.7 mEq/L increase
- Magnesium sulfate prolongs NMB
- Morphine and meperidine can cause accumulation of toxic metabolites in renal failure
- Fentanyl, sufentanil, remifentanil are considered safe to use in renal failure
- Neuraxial opioids are a good choice for postop pain relief if not contraindicated
- NSAIDs may worsen renal function
AKI in Pregnancy
AKI In Pregnancy

• **Causes of AKI**
  – In developing countries, septic abortions are the most prevalent cause of pregnancy related AKI\textsuperscript{24,25}
  – In developed countries, the most common causes are severe preeclampsia-eclampsia, acute pyelonephritis of pregnancy, and bilateral renal cortical necrosis\textsuperscript{26,27}

• The majority of women who experience AKI in pregnancy have comorbid conditions or pregnancies complicated by kidney disease, hypertension, diabetes, preeclampsia, HELLP syndrome, hemorrhage or infections\textsuperscript{28}
### Pregnancy Specific Causes of AKI

<table>
<thead>
<tr>
<th></th>
<th>Early Causes (&lt;20 weeks)</th>
<th>Late Causes (&gt;20 weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Renal</strong></td>
<td>Hemorrhage (abortion, ectopic pregnancy)</td>
<td>Hemorrhage (antepartum: placenta previa, placental abruption, placenta accreta)</td>
</tr>
<tr>
<td></td>
<td>Sepsis/Septic Shock (abortion, retained products of conception, pyelonephritis, etc)</td>
<td>(postpartum: atony, trauma, uterine rupture)</td>
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<tr>
<td></td>
<td>Hypovolemia (d/t hyperemesis gravidarum)</td>
<td>Sepsis (pyelonephritis, chorioamnionitis, puerperal sepsis)</td>
</tr>
<tr>
<td><strong>Intrinsic</strong></td>
<td>Acute tubular necrosis (d/t septic abortion)</td>
<td>Preeclampsia</td>
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<tr>
<td></td>
<td></td>
<td><strong>HELLP Syndrome (most common cause of AKI in pregnancy)</strong></td>
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<tr>
<td></td>
<td></td>
<td>Acute fatty liver disease of pregnancy</td>
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<td></td>
<td></td>
<td>Thrombotic thrombocytopenic purpura (TTP)</td>
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<tr>
<td></td>
<td></td>
<td>Atypical hemolytic uremic syndrome (aHUS)</td>
</tr>
<tr>
<td><strong>Post-Renal</strong></td>
<td>n/a</td>
<td>Uteropelvic obstruction (gravid uterus, masses, renal stone, normally seen with a pelvic pathology)</td>
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<tr>
<td></td>
<td></td>
<td>Surgical (ureter damage, post surgical obstruction)</td>
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<td>Neoplasm</td>
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AKI in Pregnancy

- Non-pregnant AKI definitions (ie KDIGO) not appropriate during pregnancy
- No consensus definition of AKI in pregnancy, making it difficult to establish incidence rate
- Acute renal failure was found in 4.52 per 10,000 US births from 2008-2009

<table>
<thead>
<tr>
<th>Normal Ref Range Creatinine (mg/dL)</th>
<th>0.05–0.09</th>
<th>0.4–0.7</th>
<th>0.4–0.8</th>
<th>0.4–0.9</th>
</tr>
</thead>
</table>

ACOG Renal Insufficiency Definition

\[ \text{↑SCr} > 1.1 \text{mg/dL or doubling SCr in the absence of other renal disease} \]

Definition used as part of diagnostic criteria for severe preeclampsia
AKI in Pregnancy

Increased renal function may mask early AKI symptoms

Lab values considered normal in non-pregnant women may indicate worsening renal function in pregnant patients

Increasing proteinuria in pregnant patients with CKD may be normal in the progression of pregnancy and not indicative of worsening function

Difficult to establish baseline GFR in pregnancy without 24h collection

Oliguria in preeclampsia is part of disease pathology in response to intravascular depletion and may not indicate worsening renal function
Management of AKI in Pregnancy

- Management of AKI in pregnancy should focus on management of the cause of AKI and consider multiple causes\(^2\)
- Should also consider non-pregnancy related causes of AKI\(^{29}\)
- Renal biopsy rarely indicated, usually delayed until after delivery\(^{29}\)
- Should use multidisciplinary approach
- Renal therapy\(^2\):
  - Low dose dopamine - Not recommended
  - Furosemide - Not recommended
  - Fenoldopam - Needs further research
  - N-acetylcysteine - Needs further research
  - Albumin - Needs further research
Clinical Assessment of Pregnant Women with Raised Creatinine

- **Absolute or relative hypovolemia**
  - Yes: Likely pre-renal etiology
    - Resuscitation according to blood/fluid loss and supportive measures
      - Recovery in renal fn: pre-renal AKI confirmed
      - No recovery: Consider ATN, cortical necrosis, CKD
  - No: Suspect renal cause, particularly if active urinary sediment
    - Pre-eclampsia is most likely diagnosis. Limit fluid challenges due to risk of pulm edema. Consider further investigations or referral if atypical features/severe disease
    - Features suggesting underlying renal disease:
      - Presentation at any gestation, active urinary sediment, involvement of other organs, raised autoantibodies, reduced complement levels, heavy proteinuria (>2g/24h)
      - Consideration of empirical treatment or renal biopsy (when appropriate) for confirmation of diagnosis
    - Exclude obstruction (US KUB)
AKI in Pregnancy Management

- Consider transfer to specialty center if not responding to initial conservative measures\(^2^9\)
- Review medications and discontinue nephrotoxic drugs if possible\(^2^9\)
  - Renally cleared medications may need adjustment
  - A single loading dose of magnesium sulfate for preeclampsia considered safe even in renal failure
- Should optimize status before delivery\(^1^8\)
  - If BUN >80 mg/dL or K >5.5mEq/L, dialysis should be performed before elective vaginal or c-section delivery
- Neuraxial anesthesia is preferred to general anesthesia\(^1^8\)
- Considerations for general anesthesia in the setting of AKI similar to that for CKD
Obstetric Kidney Disease Summary

- Kidney disease in pregnancy increases risk of adverse outcomes to both the mother and the fetus.
- Perioperative management of obstetric patients with CKD should consider CKD staging and related physiologic changes.
- Intraop management of CKD should consider individual need for CVP monitoring dependent on fluid status, adjustments of anesthetic medications as appropriate, and protection of HD fistula if present.
- Multiple renal physiologic changes in pregnancy make AKI in pregnancy hard to define and difficult to measure. Lab values considered normal in non-pregnant women may be indicative of AKI in pregnancy.
- Obstetric AKI management should be individualized to consider the cause of the AKI.
- Considerations should be made to discontinue nephrotoxic drugs as appropriate and monitor bleeding risk related to neuraxial anesthesia.
References


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