Paraclinical evaluation of kidney diseases in pregnancy

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Introduction:

- Pregnancy is characterized by physiologic changes, of which the emergence of a placenta and growing fetus are the most dramatic.
- Hypertension and renal disease occurring in the setting of pregnancy present a unique set of clinical challenges.

Physiologic Changes of Pregnancy

Physiologic Changes in Pregnancy

Physiologic Variable	Change in Pregnancy
Hemodynamic Parameters	
Plasma volume	Increases 30%–50% above baseline
Blood pressure	Decreases by approximately 10 mm Hg below prepregnancy level, with nadir in second trimester; gradual increase toward prepregnancy levels by term
Cardiac output	Increases 30%–50%

Heart rate	Increases by 15–20 beats/min
Renal blood flow	Increases to 80% above baseline
Glomerular filtration rate	150–200 mL/min (increases to 40%–50% above baseline)
Serum Chemistry and Hematologic Changes	
Hemoglobin	Decreases by an average of 2 g/L (from 13 to 11 g/L) owing to plasma volume expansion out of proportion to the increase in red blood cell mass
Creatinine	Decreases to 0.4–0.5 mg/dL
Uric acid	Decreases to a nadir of 2.0–3.0 mg/dL by 22–24 weeks, then increases back to nonpregnant levels toward term

pH	Increases slightly to 7.44
Partial pressure of carbon dioxide (pCO_2)	Decreases by approximately 10 mm Hg to an average of 27–32 mm Hg
Calcium	Increased calcitriol stimulates increases in both intestinal calcium reabsorption and urinary calcium excretion
Sodium	Decreases by 4–5 mEq/L below nonpregnancy levels
Osmolality	Decreases to a new osmotic set point of approximately 270 mOsm/kg

Renal Adaptation to Pregnancy

- In pregnancy, the kidney length increases by 1–1.5 cm and kidney volume increases by up to 30%.
- There is physiologic dilatation of the urinary collecting system in approximately 50% of pregnant women, more frequently on the right than the left

- These changes may be due to mechanical compression of the ureters between the gravid uterus and the linea terminalis and the effects of estrogen, progesterone, and prostaglandins on ureteral structure and peristalsis.
- Hydronephrosis of pregnancy is usually asymptomatic,but abdominal pain can occur.


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Respiratory Alkalosis of Pregnancy

- Minute ventilation begins to rise by the end of the first trimester, and continues to increase until term. Progesterone mediates this response by direct stimulation of respiratory drive and by increasing sensitivity of the respiratory center to CO2.
- This results in a mild respiratory alkalosis—partial pressure of carbon dioxide (pCO2) falls to approximately 27–32 mm Hg—and a compensatory

Diabetes Insipidus of Pregnancy

- For reasons that are obscure, circulating levels of vasopressinase, an enzyme that hydrolyzes arginine vasopressin, are increased during normal pregnancy.

resulting in the polyuria and polydipsia of diabetes insipidus.

This syndrome of transient diabetes insipidus presents during the second trimester and disappears after delivery.

It is important to recognize this entity because affected women may become dangerously hypernatremic, especially with cesarean section using general anesthesia and/or water restriction in the delivery room.

The polyuria can be controlled by the administration of deamino-8-D-arginine vasopressin, which is not destroyed by vasopressinase.

Hyponatremia

- The plasma osmolality in normal pregnancy falls to new set point 270
- From normal level 275 to 290 mos/kg with decrease in plasma sodium concentration to 4-5 meq/l

Proteinuria

- Urinary protein excretion rises in normal pregnancy from nonpregnant level of 100mg mg/day to approximately 150 to 200mg/day in the third trimestre.
- urinary protein excretion greater than 300 mg /day is considered abnormal

Glucosuria:

• Glucosuria by dipstick is seen in approximately 50 percent of pregnant Patients and is not a useful for diabetes mellitus .

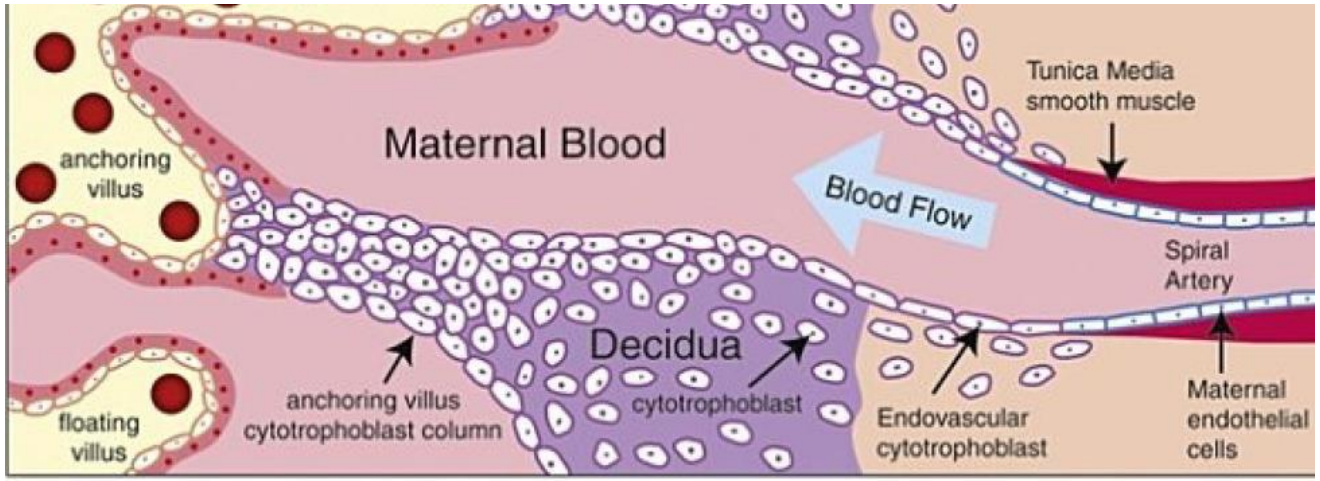
Glucosuria is due to decreased proximal tubular glucose reabsorption

Decrease in serum anion gap and albumin

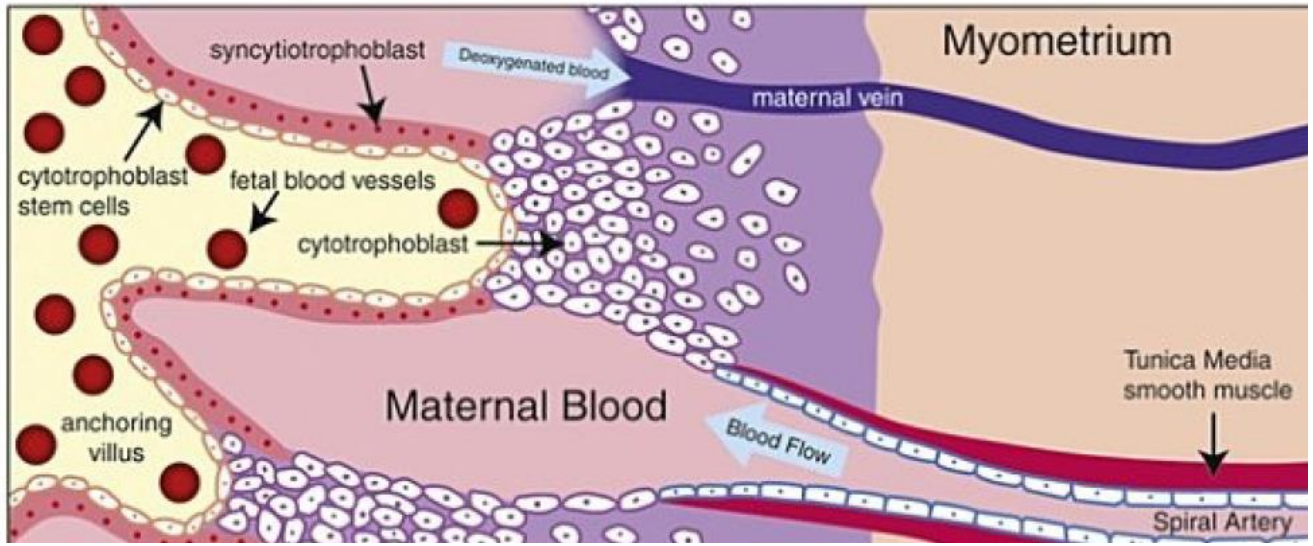
- Serum albumin concentration falls in normal pregnancy
- The serum anion gap also falls from 10.7 in the nonpregnant to 8.5 during pregnancy
- Low albumin levels in pregnancy can lead to increase free levels of drugs which are highly protein bound such as midazolam-phenytoin

Impaired tubular function

- Pregnancy is associated with decreased fractional reabsorption of amino acids and beta microglobulin and glucose thus pregnant patients may exhibit glucosuria and aminoaciduria in the absence of hyperglycemia or renal disease



Preeclampsia



Preeclampsia and HELLP Syndrome

- Preeclampsia is a systemic syndrome that is specific to pregnancy, characterized:
- by the new onset of hypertension and proteinuria after 20 weeks' gestation.
- Preeclampsia affects approximately 5% of pregnancies worldwide

preeclampsia is still a leading cause of preterm birth and consequent neonatal morbidity and mortality in the developed world.

)iagnostic Criteria for Preeclampsia

Diagnostic Criteria for Preeclampsia	
Hypertension	≥140 mm Hg systolic or ≥90 mm Hg diastolic after 20 weeks of gestation on two occasions at least 4 hours apart in a woman with a previously normal blood pressure *OR* With blood pressures ≥160 mm Hg systolic or ≥105 mm Hg diastolic, hypertension can be confirmed within a short interval (minutes) to facilitate timely antihypertensive therapy
AND	
Proteinuria	≥300 mg/24 h (or this amount extrapolated from a timed collection) *OR* Protein-to-creatinine ratio ≥ 0.3 mg protein/mg creatinine *OR* Dipstick 2+ (used only if other quantitative methods not available)

OR in the absence of proteinuria, new-onset hypertension with the new onset of any of the following:

Thrombocytopenia	≤100,000 platelets/mL
Renal insufficiency	Serum creatinine concentrations >1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease
Impaired liver	Elevated blood concentrations of liver transaminases to twice

Uric Acid

- Serum uric acid levels are correlated with the presence and severity of preeclampsia and with adverse pregnancy outcomes, even in gestational hypertension without proteinuria.
- In such patients, a serum uric acid level >5.5 mg/dL in the presence of stable renal function might suggest superimposed preeclampsia.

Comparison of Clinical and Laboratory Characteristics, Effect on Delivery, and Management of HELLP, HUS/TTP, and AFLP

	HUS/TTP	HELLP	AFLP
Clinical Characteristic:			
Hemolytic anemia	+++	++	±
Thrombocytopenia	+++	++	±
Coagulopathy	−	±	+
CNS symptoms	++	±	±
Renal failure	+++	+	++
Hypertension	±	+++	±
Proteinuria	±	++	±
Elevated AST	±	++	+++
Elevated bilirubin	++	+	+++
Anemia	++	+	±
Ammonia	Normal	Normal	High
Effect of delivery on disease	None	Recovery	Recovery
Management	Plasma exchange	Supportive care, delivery	Supportive care, delivery

Acute Kidney Injury in Pregnancy

- Acute Tubular Injury and Renal Cortical Necrosis
- Acute Kidney Injury and Thrombotic Microangiopathy
- **Severe Preeclampsia**
- Acute Fatty Liver of Pregnancy
- Obstructive Uropathy and Nephrolithiasis

Aki:

- Urinanalysis
- Protein excretion
- Urine culture
- Hemoglobin and platelet
- Bilirubin and ldh
- Ast and alt
- Kidney ultrasound

Urinary Tract Infection and Acute Pyelonephritis

- Infections of the urinary tract represent the most frequent renal problem encountered during gestation

Although the prevalence of asymptomatic bacteriuria—which ranges between 2% and 10%—is similar to that in nonpregnant populations, it needs to be managed more aggressively for several reasons.

- Urinary stasis predisposes pregnant women to ascending pyelonephritis in the setting of cystitis.
- Hence while asymptomatic bacteriuria in the nonpregnant state is usually benign, untreated asymptomatic bacteriuria in pregnancy can progress to overt cystitis or acute pyelonephritis in up to 40% of patients.

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Renal Physiology of Pregnancy

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Abstract

Pregnancy involves remarkable orchestration of physiologic changes. The kidneys are central players in the evolving hormonal milieu of pregnancy, responding and contributing to the changes in the environment for the pregnant woman and fetus. The functional impact of pregnancy on kidney physiology is widespread, involving practically all aspects of kidney function. The glomerular filtration rate increases 50% with subsequent decrease in serum creatinine, urea, and uric acid values. The threshold for thirst and antidiuretic hormone secretion are depressed, resulting in lower osmolality and serum sodium levels. Blood pressure drops approximately 10

Measurement of GFR

- 24-hour urine collection for calculation of creatinine clearance remains the preferred standard for estimating GFR in pregnant women.
- The Modification or Diet in Renal Disease (MDRD) equation underestimates GFR in pregnant women with and without preeclampsia, consistent with its known tendency to underestimate when GFR is greater than 60 mL/minute
- cystatin-C-based equations result in mean GFR greater than 120 mL/minute, but cystatin C produced higher first and second trimester GFRs followed by a fall in GFR in the third trimester despite evidence from early studies that GFR increases steadily until term.

INDICATION FOR INITIATE HEMODIALYSIS”

- GFR BELOW 20
- BUN MORE THAN 50 OR 60

WE CONSIDER ELECTIVE INITIATION OF DIALYSIS

Renal Replacement Therapy During Pregnancy

Mode of RRT

Hemodialysis (HD): Preferred for ease of vascular access; options include intermittent HD or nocturnal HD (7–8 hours/night, 5–7 nights/week). **Peritoneal Dialysis (PD):** Continuous and hemodynamically stable; challenges in late pregnancy require shorter dwell times, reduced dialysate volume(1-1.5L), and increased cycles. Comparable outcomes to HD, but transition to HD if PD targets are unmet.

Need of Intensified HD in pregnancy

Maternal Outcomes: Stabilizes BP, reduces antihypertensives, improves nutrition. **Fetal Outcomes:** Lowers polyhydramnios, IUGR risk, and fetal toxicity (BUN <35 mg/dL).**Clearance:** Maintains balance, prevents acidosis, supports fetal growth. Live **Birth Rates:** Intensive dialysis (≥36 hrs/week) boosts survival.**Volume Control:** Prevents hypoperfusion with stable intravascular volume.

Monitoring

Antenatal Visits: T1: Monthly, T2: Biweekly, T3: Weekly.
Fetal Monitoring: USG every 2–4 weeks from 24 weeks.
Monthly Blood Work: Check iron profile, calcium, phosphorus, PTH, and albumin(assess nutrition). After **20 Weeks:** Add LDH, LFTs, haptoglobin, and peripheral smear for early HELLP detection. Aspirin: Start at 10–12 weeks.
Preeclampsia Diagnosis: Creatinine clearance and proteinuria unreliable in dialysis patients (since oliguric or anuric).

Dialysis

Duration: Intensified HD >36 hours/week. **Access:** AVF, AV graft, or central vein catheters. **BFR/DFR**: Match general population; cautiously and gradually (30 min) increase BFR during sessions. **Dry Weight:** Assess weekly; increase by 300–500 g/week in 2nd and 3rd trimesters. **Dialysate:** Na 137–140 mmol/L, K 2–3 mmol/L, Ca increase to 1.5–1.75 mmol/L, HCO3 25 mmol/L. **Anticoagulation:** Heparin safe; does not cross the placenta. Dialyzer : Biocompatible non-reuse

Anemia

EPO ↑by 50–100%
Use single dose vials (in multiple dose vial - benzyl alcohol leads to fetal neurotoxicity)
IV iron preferred and avoid oral iron due to GI discomfort.

Target

Pre dialysis BUN :<35mg/dl
SBP:110-140
DBP:70-90
HB:10 - 11g/d
TSAT >20%

Nutrition

Calories: 35 kcal/kg of pre-dialysis weight + required for trimester.
Protein: 1.2–1.8 g/kg of pre-gestational weight.
Supplements: Water-soluble vitamins, folic acid ,zinc.
Potassium and phosphate supplementation as required (3K dialysate can be used).Avoid phosphate binders.

When to start

Indication similar for HD initiation in nonpregnant state
Early initiation if **BUN >50 mg/dl** to avoid fetal outcomes

Timing of delivery

Elective delivery at 37 weeks unless indicated earlier; mode of delivery depends on obstetric factors.


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