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From pregnancy to renal disease:

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Understanding preeclampsia

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Abstract: Preeclampsia is a hypertensive disorder of pregnancy defined as new-onset hypertension that develops during pregnancy and resolves after delivery. Using a case history as an illustration, this article discusses hypertensive disorders of pregnancy with a focus on preeclampsia and its renal implications.

Keywords: chronic kidney disease, eclampsia, end-stage renal disease, ESRD, gestational hypertension, hypertensive disorders of pregnancy, preeclampsia

MK, AN HISPANIC FEMALE, was brought into the ED with nausea and vomiting. Lab results showed dangerously high levels of blood urea nitrogen, serum creatinine, and serum potassium, indicating renal failure. MK was admitted to the ICU with a diagnosis of hyperkalemia related to end-stage renal disease (ESRD).

MK's experience with renal disease started 5 years earlier when, at age 20, she was diagnosed with preeclamsia while pregnant with her first child. Preeclampsia is defined as new-onset hypertension in a previously normotensive woman that develops during pregnancy and resolves after delivery. It may also develop postpartum.[1,2] Complicating 5% to 8% of pregnancies globally, it is a leading cause of maternal and perinatal morbidity and mortality.[1]

Although by definition preeclampsia eventually resolves after delivery, it can sometimes lead to long-term complications such as renal dysfunction. In addition, infants born to mothers with preeclampsia are at risk for prematurity and its associated complications.[1] Using MK's case as an illustration, this article discusses hypertensive disorders of pregnancy with a focus on the assessment and care of a woman with preeclampsia and the renal implications of preeclampsia.

Fetal monitoring, labor, delivery, and neonatal care are beyond the scope of this article.

Pathophysiology

Preeclampsia is a complex illness that typically develops after 20 weeks' gestation, frequently near term. Most patients are healthy nulliparous women with no obvious risk factors (see *Risk factors for preeclampsia*).[1]

The pathophysiology of preeclampsia is poorly understood, but it centers on dysfunction of the placenta and maternal vasculature. Microscopic examination of the placenta reveals abnormalities such as infarcts, atherosis, thrombosis, and chronic inflammation.[3]

Features that may develop weeks or months before signs and symptoms appear include shallow placentation and failure to remodel the spiral arteries of the decidua and myometrium early in pregnancy. Inadequate uteroplacental blood flow places oxidative stress on the placenta. The ischemic placenta is believed to release antiangiogenic factors and placental growth factor into the maternal circulation, causing widespread maternal vascular dysfunction leading to hypertension and other signs and symptoms of preeclampsia.[2-4]

Among many possible systemic effects, preeclampsia can cause direct injury to the glomerular endothelium.[5] Uncontrolled hypertension causes intimal thickening and luminal narrowing of the large and small renal arteries and the glomerular arterioles.[6] Over time, these injured arteries cannot deliver enough oxygenated blood to the kidneys, impairing their ability to regulate BP and acid-base balance, as well as levels of fluids, hormones, and electrolytes.[5] However, with proper treatment during pregnancy and follow-up, renal impairment associated with preeclampsia can resolve.[6]

Risk factors for preeclampsia[1,2]

Although most patients with preeclampsia are healthy nulliparous women with no apparent risk factors, some possible risk factors have been identified; for example:

- nulliparity
- personal or family history of preeclampsia
- maternal age over 35
- multifetal pregnancy
- chronic hypertension
- chronic renal disease
- gestational or pregestational diabetes
- obesity
- thrombophilia
- autoimmune diseases such as systemic lupus erythematosus
- obstructive sleep apnea.

Prognosis of CKD by GFR and albuminuria categories[10]

GFR categories (mL/min/ 1.73 m²) Description and range				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30–300 mg/g 3–30 mg/mmol	>300 mg/g >30 mg/mmol
	G1	Normal or high	≥90			
	G2	Mildly decreased	60–89			
	G3a	Mildly to moderately decreased	45–59			
	G3b	Moderately to severely decreased	30–44			
	G4	Severely decreased	15–29			
	G5	Kidney failure	<15			

Green, low risk (if no other markers of kidney disease, no CKD); Yellow, moderately increased risk; Orange, high risk; Red, very high risk.

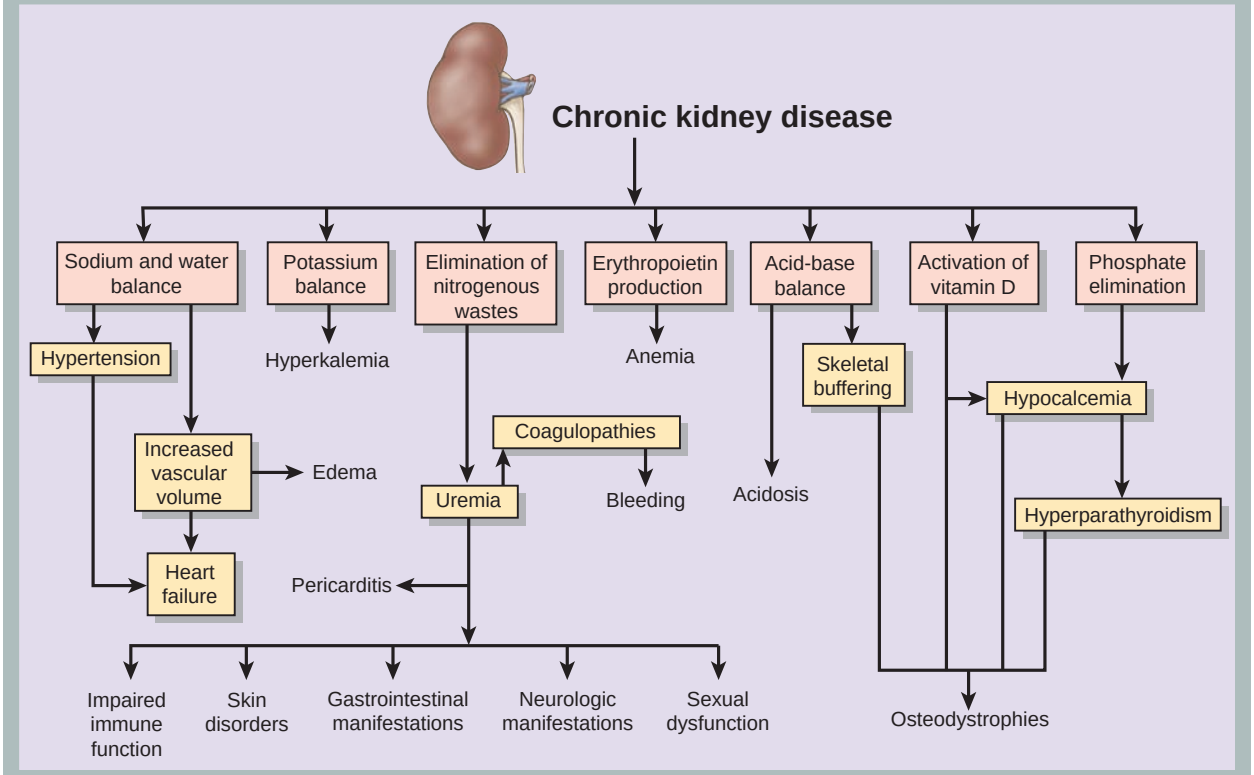
Characteristic signs and symptoms

Hypertension and proteinuria are hallmark features of preeclampsia. BP criteria for preeclampsia are a systolic BP of 140 mm Hg or more or a diastolic BP of 90 mm Hg or more on two occasions at least 4 hours apart after 20 weeks of gestation in a woman with a previously normal BP.[1]

Proteinuria in pregnancy is defined as 300 mg/dL or more in a 24-hour urine specimen or a protein-to-creatinine ratio of 0.3 or more. If results from a quantitative measurement are unavailable, a urine protein dipstick reading of 2+ or more in a random urine specimen is considered indicative of proteinuria, although this test is far less reliable.[1,2]

Some women experience hypertension and other signs and symptoms of preeclampsia without proteinuria. Patients with gestational hypertension without proteinuria are considered preeclamptic if they have any of the following severe features:[1,2]

Mechanisms of CKD



Source: Porth CM. *Essentials of Pathophysiology: Concepts of Altered Health States*. 4th ed. Philadelphia, PA: Wolters Kluwer; 2014.

- systolic BP of 160 mm Hg or more, or diastolic BP of 110 mm Hg or more on two occasions at least 4 hours apart (unless antihypertensive therapy is initiated before this time)
- thrombocytopenia (platelet count less than 100,000/microL)
- liver transaminases at least twice the upper limit of normal
- cerebral or visual symptoms (such as new-onset and persistent headaches not accounted for by alternative diagnoses and not responding to usual doses of analgesics; blurred vision, flashing lights or sparks, scotomata)
- renal insufficiency (serum creatinine >1.1 mg/dL or double the creatinine concentration in the absence of other renal disease)
- pulmonary edema.

No test or treatment is available to predict or prevent preeclampsia.[7] Clinical management of preeclampsia is symptom-based. After the fetus is delivered and the placenta is removed, preeclampsia resolves. But as in MK's case, some patients encounter long-term complications such as chronic kidney disease (CKD).[6,8]

MK's complicated pregnancy

After MK was admitted to the ICU, a nurse reviewed her medical record and obtained a focused history of her prior pregnancy. MK denied any comorbidities or significant health issues before her pregnancy, but she reported a maternal family history of hypertension and preeclampsia.

During her first prenatal visit in the eighth week of pregnancy, MK's systolic BP was 140 mm Hg. At another prenatal visit around the 20th week, her systolic BP was 160 mm Hg and a urinalysis demonstrated significant proteinuria. This was the first time MK recollected the healthcare provider expressing concern. She was prescribed methyldopa to manage her BP but, despite this antihypertensive agent, her systolic BP ranged from 150 to 250 mm Hg.

Around the 28th week of pregnancy, MK was admitted to the hospital so her BP and kidney function could be closely monitored. She delivered a healthy infant at 37 weeks of gestation.

According to the American College of Obstetricians and Gynecologists, delivery is recommended when gestational hypertension or preeclampsia with severe features is diagnosed at or beyond 34 0/7 weeks of gestation after maternal stabilization or with labor or prelabor rupture of membranes.[1,9] Early delivery resolves preeclampsia and minimizes the risk of serious complications, including fetal death and

potentially fatal maternal complications such as cerebral hemorrhage, hepatic rupture, myocardial infarction, and stroke. Delivery may be indicated at any time regardless of gestational age if signs and symptoms worsen and the patient's life is at risk.[1]

Most patients with preeclampsia can deliver vaginally. Cesarean delivery is reserved for patients with appropriate obstetric indications.[1,9]

MK reported not remembering much from that period because of the overwhelming nature of the situation, but at one point she recalled being told of a concern about her kidneys. By the time MK delivered her baby daughter, her estimated glomerular filtration rate (eGFR) was 20 mL/min (normal, ≥90 mL/min).

The healthcare provider recommended that MK continue taking methyldopa as prescribed, but she did not follow this advice or return to the provider for recommended BP monitoring and follow-up. The reason is unclear from the patient and the medical record.

Postpartum follow-up is particularly important for a woman with preeclampsia. If hypertension persists for more than 6 weeks postpartum, she may have a concurrent disorder not associated with pregnancy, such as chronic hypertension or underlying endocrine or renal disease. In that case, she should be referred to the appropriate specialist.[5]

When the authors met and cared for MK, her eGFR was 4.2 mL/min and her serum potassium level was 8.4 mEq/L (normal: 3.5 to 5 mEq/L). She was diagnosed with ESRD and emergent hemodialysis was begun (see *Prognosis of CKD by GFR and albuminuria categories).*

CKD and pregnancy

CKD is a gradual irreversible loss of kidney function over time.[10,11] The National Kidney Foundation defines CKD as abnormalities of kidney structure or function, present for 43 months, with implications for health.[12] Lab testing reveals albuminuria, urine sediment abnormalities, and electrolyte and other abnormalities due to tubular disorders (see *Mechanisms of CKD*). More than 26 million American adults have CKD, and a million more are at an increased risk for the disease. About 3% of patients with CKD develop ESRD.[11]

In MK's case, her provider believed that she developed renal disease due to preeclampsia superimposed on underlying chronic hypertension. Her personal and family history of preeclampsia placed her at a higher risk for kidney disease.

Nursing assessment

As MK's case illustrates, identifying and caring for a pregnant woman with or at risk for preeclampsia is critical to prevent long-range complications such as renal impairment. But this can be challenging due to the unavailability of cost-effective, reliable screening tests for early diagnosis and the lack of specific interventions to treat the disorder.

Ideally, women should be screened to identify preeclampsia risk factors before development of overt disease and monitored during pregnancy for hypertension and other signs and symptoms of preeclampsia. Nurses can encourage all women to maintain a healthy body weight, eat a balanced, healthy diet, and keep regular prenatal appointments with the healthcare provider to detect and monitor any troubling signs and symptoms. Reinforce teaching by providing patients with educational resources (see *Resources for patients and nurses*).

To screen a patient for preeclampsia, the nurse starts with a comprehensive health history, including a family history. If the nurse learns that the patient has a personal or family history of any risk factor for preeclampsia, such as chronic hypertension or family history of preeclampsia, this provides an opportunity for further evaluation. Inform the patient about warning signs for preeclampsia such as persistent or severe headache, upper abdominal or epigastric pain, vision abnormalities, edema of the face and hands, altered mental status, and dyspnea or retrosternal pain.[2,7] Advise her to report any of these changes as well as any sudden increase in body weight—a weight gain of 3 to 5 lb (1.4 to 2.3 kg) in 1 week could indicate fluid imbalance associated with preeclampsia. Women with preeclampsia as well as those who are at risk should be taught how to self-monitor BP using an automated electronic sphygmomanometer validated for use in pregnancy.

Pharmacologic interventions

The use of low-dose aspirin is considered to have a protective effect in high-risk women (those

Resources for patients and nurses

- **American College of Obstetricians and Gynecologists**
  https://acog.org
- **National Institutes of Health: Preeclampsia and Eclampsia Resources**
  www.nichd.nih.gov/health/topics/preeclampsia/more_information/resources
- **National Kidney Foundation**
  www.kidney.org/
- **Preeclampsia Foundation**
  www.preeclampsia.org
- **Preeclampsia Registry**
  www.preeclampsiaregistry.org
- **Pregnancy.org**
  https://pregnancy.org

with chronic hypertension, previous preterm preeclampsia, or diabetes). It should be recommended as primary prevention for at-risk women and treatment should begin in the late first trimester.[13]

In women with preeclampsia, the use of a corticosteroid such as betamethasone at less than 34 weeks appears beneficial for aiding fetal lung maturity and reducing the frequency of respiratory distress.[9,13]

In addition, medication may be prescribed to manage hypertension and prevent seizures (eclampsia). Treatment with an antihypertensive agent is initiated in patients with severe hypertension, defined as a systolic BP of ≥160 mm Hg or a diastolic BP of ≥110 mm Hg.[1] When the conditions for acute-onset severe hypertension are met, it is recommended to initiate antihypertensive therapy as soon as reasonably possible. Hydralazine or labetalol administered I.V. and oral nifedipine are most commonly prescribed. Another agent that may be prescribed is oral labetalol.[1]

Antihypertensive drugs are not generally recommended for patients with mild hypertension, but they may be prescribed for some patients with risk factors such as those with comorbidities or poor renal function.[1,9] Patient response to antihypertensive therapy should be closely monitored.

To prevent seizures, magnesium sulfate is recommended for patients with preeclampsia with severe features, as described above. The use of magnesium sulfate to prevent seizures in women with gestational hypertension or preeclampsia without severe features is controversial.[1,9]

Postpartum follow-up

After delivery, if the patient's BP is well controlled and she has no signs or symptoms of severe disease, she is followed on an outpatient basis. For the first week postpartum, BP should be assessed at least every other day. The provider will reduce and then stop the antihypertensive medication when the BP goal is reached.[3]

Women with preeclampsia as well as those who are at risk should be taught how to self-monitor BP.

For most women, the target BP is achieved in the first week postpartum.[5] However, some women may need assessment more frequently than every other day based on BP and the presence of other signs and symptoms. If hypertension persists for more than 6 weeks postpartum, the patient may have a disorder not associated with pregnancy and she should be referred to the appropriate specialist.[5]

All women with preeclampsia should be counseled about their increased risk of developing preeclampsia during subsequent pregnancies. If a woman with a history of preeclampsia becomes pregnant again, she should have early prenatal care with frequent assessments for hypertension and proteinuria. Lifestyle modifications such as weight loss, smoking cessation, low-sodium diet, and regular exercise should be emphasized.

The woman and her partner should understand that pregnancy can occur in the postpartum period. If oral contraceptives are contraindicated, the patient and her partner should use barrier contraception.[3]

Oral contraceptives that combine estrogen and progestin can be used 4 to 6 weeks postpartum if BP has normalized. Progestin-only formulations can be used regardless of BP and is a good choice for women with chronic hypertension or those who are breastfeeding.[3,9]

Inform the patient that a history of preeclampsia is a risk factor for cardiovascular disease. Routine well visits should include assessment of cardiovascular risk factors and appropriate counseling.[9]

MK's journey

The medical and nursing care for MK focused on maintaining fluid and electrolyte balance. A native arteriovenous (A-V) fistula was created as a permanent hemodialysis access. She required hemodialysis 3 days a week after her discharge from the hospital.

When the authors spoke with MK about her concerns, she addressed both physical and psychological challenges associated with ESRD, including significant lifestyle changes. She wakes at 0500 3 days a week for treatment at a dialysis center, then returns home to take her daughter to school. She worries constantly about injuring her A-V fistula while playing with her daughter and feels sad about her inability to physically lift her daughter at the park. Adhering to

the prescribed renal diet is another daily challenge.

At this stage of the illness, kidney transplantation may be the best treatment available for MK, but she is discouraged by the long odds. Because the demand exceeds supply, fewer than 4% of patients with ESRD ever receive a kidney transplant and fewer than 25% of patients on a waiting list for kidney transplantation ever receive one.[11]

Given the chronic and complex nature of ESRD and its treatment, patients are likely to experience psychosocial distress and a significant symptom burden. It is important for nurses to recognize the true impact of the disease on a patient's life and provide patient-centered care.

Keys to a good outcome

Although MK's prognosis is uncertain, most cases of renal impairment associated with preeclampsia eventually resolve after delivery in women who receive appropriate prenatal assessment and treatment. By providing follow-up and patient education, nurses hold the keys to a good outcome for mother and child. ■

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