Gestational Hypertension, Preeclampsia, and Peripartum Cardiomyopathy: A Clinical Review

An evidence-based guide to major pregnancy-specific cardiovascular diseases.

**ABSTRACT:** Gestational hypertension, preeclampsia, and peripartum cardiomyopathy are among the most common and often severe pregnancy-specific cardiovascular diseases (CVDs) and causes of complications in pregnancy. This clinical review provides nurses with an overview of pregnancy-specific CVDs, outlines their pathophysiology, and discusses risk factors and assessment. It describes management interventions according to timing: the antepartum, intrapartum, and postpartum phases are each addressed.

**Keywords:** cardiovascular disease, gestational hypertension, HELLP syndrome, hypertension, peripartum cardiomyopathy, preeclampsia, pregnancy, pregnancy complications, prenatal care

Cardiovascular diseases (CVDs) constitute a leading cause of maternal and fetal mortality in pregnant women. A large subset of these diseases is nonspecific to pregnancy (for example, ischemic and congenital heart disease, cardiac valvulopathies, and chronic hypertension), and proper management should ideally start before conception. A smaller subset is composed of pregnancy-specific CVDs that appear only during the peripartum period. Gestational hypertension, preeclampsia, and peripartum cardiomyopathy are among the most common of these, as well as causes of complications during pregnancy. To limit possible adverse maternal and fetal outcomes, timely recognition and management are essential.

In a 2018 joint statement, the World Health Organization and several other organizations asserted that all women should have access during pregnancy to a competent health care professional able to identify and manage related complications. Yet recent population studies found that inadequate peripartum follow-up—such as failure to evaluate new symptoms, reevaluate existing symptoms, or respond to changes without delay—was responsible for between one-quarter and two-thirds of deaths associated with pregnancy-specific CVDs. Nurses clearly have a vital role to play in efforts aimed at the prevention, assessment, and management of pregnancy-specific CVDs.

Previous reviews targeting pregnancy-specific CVDs have been conducted mainly in the medical field, focusing on underlying risk factors and pharmacotherapy. One recent review published in this journal focused on the nursing approach to managing preeclampsia. But to our knowledge, no review has specifically examined the role of nurses regarding pregnancy-specific CVDs in relation to maternal and fetal health.

We decided to conduct a clinical review of the literature to learn more. To that end, we searched CINAHL, PubMed, and Google Scholar, using the terms gestational hypertension, preeclampsia, and...
PREVALENCE AND PATHOPHYSIOLOGY OF COMMON PREGNANCY-SPECIFIC CVD

Gestational hypertension is one of the most common problems in pregnant women, with prevalence ranging from 1.8% to 4.4% worldwide.1 Gestational hypertension is diagnosed after 20 weeks of gestation in women with an average blood pressure of 140/90 mmHg or higher, without any of the supplementary features of preeclampsia (described below).19 For diagnostic purposes, blood pressure should be measured in a clinical setting twice with at least four hours between measurements, using the arm with the highest values.19, 20 Although most women with gestational hypertension will not suffer any complications,6 the condition has been associated with higher risk of developing diabetes and kidney disease in later life.21 Gestational hypertension severity is a predictor of worse outcomes. A blood pressure higher than 160/110 mmHg is considered a criterion of increased severity.6

PERIPARTUM CARDIOMYOPATHY, to find systematic reviews and primary research articles pertinent to our aim. We also searched for the latest clinical practice guidelines from the major national obstetric and cardiovascular societies.

This review provides an overview of three pregnancy-specific CVDs—gestational hypertension, preeclampsia, and peripartum cardiomyopathy—and synthesizes the relevant information regarding the role of nurses in their prevention, assessment, and management.

NORMAL CARDIOVASCULAR CHANGES DURING PREGNANCY

An understanding of the normal physiological changes that occur in the maternal cardiovascular system during pregnancy allows for better comprehension of the pathophysiological changes that occur with pregnancy-specific CVDs. This will also help nurses to distinguish between normal changes and those that may indicate a pregnancy-specific CVD. Cardiovascular changes during pregnancy serve to ensure proper fetal blood flow. During a pregnancy, the heart will gradually be geometrically and mechanically remodeled to accommodate an increase in circulatory volume load.14 Such remodeling includes, for example, an increase in the volume and mass of the atria and ventricles. As maternal body surface area increases, cardiac output will increase significantly throughout the pregnancy.14 One study found that in singleton pregnancies, cardiac outputs increased by as much as 45% above nonpregnant levels.15 The same study also found that in twin pregnancies, the average cardiac output was 15% higher than it was in singleton pregnancies.

Although such changes are normal, tolerance for physical exertion is generally lower in pregnant than in nonpregnant women, and pregnant women may experience shortness of breath and fatigue while performing even light physical activities.16 At rest, maternal heart rate and blood pressure should remain in the normal range: heart rate less than 100 beats per minute, blood pressure less than 140/90 mmHg. It’s worth noting that blood pressure often tends to drop slightly during pregnancy, most notably during the first trimester.14, 17 In adult women, the left ventricular ejection fraction (the percentage of blood exiting the left ventricle with each contraction) ranges from 54% to 74%, and should not go below the lower value even in pregnancy.18 From the first to the third trimester, activation of the renin–angiotensin–aldosterone system causes increased retention of salt and water, which leads to a rise in blood volume, venous return, and cardiac preload.21 Thus edema is relatively common in pregnant women.
Preeclampsia and HELLP syndrome. Preeclampsia is another common problem, occurring in 5% to 8% of pregnant women overall and in 17% to 46% of those with gestational hypertension. Preeclampsia can be diagnosed after 20 weeks of gestation when there is new-onset hypertension with either proteinuria or indications of target organ dysfunction, including pulmonary edema; cerebrovascular disturbances (including visual disturbances like flashing lights, blurred vision); or signs of kidney failure (such as low urine output, electrolyte imbalance). Proteinuria is diagnosed when the protein-to-creatinine ratio of two urine samples taken at least six hours apart exceeds 0.3 mg/dL or when the protein concentration of a 24-hour urine excretion sample equals or exceeds 300 mg. If not managed, preeclampsia can progress to eclampsia, as defined by the onset of seizures. Eclampsia is by exclusion: a left ventricle ejection fraction of less than 45% has to be present on echocardiography, with this finding unexplained by another underlying heart disease. Proteinuria is diagnosed when the protein-to-creatinine ratio of two urine samples taken at least six hours apart exceeds 0.3 mg/dL or when the protein concentration of a 24-hour urine excretion sample equals or exceeds 300 mg. If not managed, preeclampsia can progress to eclampsia, as defined by the onset of seizures. Eclampsia can be lethal; mortality rates are estimated at up to 1.8% in developed countries and up to 15% in developing countries. Although the cause of preeclampsia remains unclear, most theories cite a combination of immunologic factors and oxidative stress, leading to placental dysfunction. The latter leads to the release of certain antiangiogenic factors into the maternal blood flow, which cause endothelial damage and abnormal vascular remodeling.

For pregnant women, preeclampsia significantly increases the risk of cardiopulmonary failure and cerebrovascular accident later in life. It’s also associated with a cluster of symptoms known as HELLP syndrome (characterized by hemolysis, elevated liver enzymes, and low platelet count). One review found that in 70% to 80% of cases of preeclampsia, HELLP syndrome was also present.

Outcomes are worse in cases of early-onset or severe preeclampsia. For example, a Norwegian study found that risk of stillbirth overall was about 0.5% among women with preeclampsia but was substantially higher among women with early-onset preeclampsia.

Peripartum cardiomyopathy has been diagnosed in up to 37% of women with gestational hypertension or preeclampsia. But the links between these disorders have yet to be clarified. Peripartum cardiomyopathy was once thought to be a silent underlying dilated cardiomyopathy (a condition in which the left ventricle is stretched), but it’s now recognized as a distinct idiopathic cardiomyopathy that can manifest between the last month of pregnancy through the fifth month postpartum. Diagnosis is by exclusion: a left ventricle ejection fraction of less than 45% has to be present on echocardiography, with this finding unexplained by another underlying heart disease.

Multiple factors appear to be associated with peripartum cardiomyopathy, and its evolution varies among individuals. The presence of certain genetic variants, excessive oxidative stress, fetal microchimerism (migration of a few fetal cells to the mother’s myocardium, prompting an autoimmune response), and the abnormal metabolism of prolactin (a hormone involved in breast milk production) are all suggested factors in its development. Many women with peripartum cardiomyopathy regain cardiac function: one study found that at one year after delivery, 60% showed full recovery and 31% showed partial recovery. Maternal and fetal outcomes are generally positive during future pregnancies. That said, about one-third of women who have had peripartum cardiomyopathy experience relapse in subsequent pregnancies. At two years postpartum, maternal mortality ranges from 0% to 9%, with higher rates seen in women of African descent. Outcomes are generally better when the level of maternal heart failure at time of diagnosis is classified as class I or II (little or no impact on physical activity) rather than class III or IV (marked or severe impact) per the New York Heart Association (NYHA) Functional Classification system. For details about this system, visit www.heart.org/en/health-topics/heart-failure/what-is-heart-failure/classes-of-heart-failure.
be confused with signs and symptoms of normal pregnancy. Noticing the onset of new signs and symptoms or the progression of existing ones are both vital to timely recognition of pregnancy-specific CVDs. For a synopsis of key diagnostic criteria for the pregnancy-specific CVDs discussed in this article, see Table 1.4, 19, 20, 27, 31, 52

**Gestational Hypertension**. Elevated blood pressure will often be the only visible sign at clinical assessment, with no further symptoms.53 Women with severe hypertension—160/110 mmHg or greater—should be admitted to a hospital for further assessment and proper management until blood pressure falls below that threshold.6

**Preeclampsia and HELLP syndrome**. Pregnant women with elevated blood pressure should also be assessed for preeclampsia, which has a different course and prognosis, and to determine whether hypertension is severe, which affects management and outcomes.7 As noted earlier, the presence of proteinuria or systemic organ dysfunction (or both) are defining features of preeclampsia. Women with elevated blood pressure should be evaluated for signs and symptoms of nervous system disorders such as hyperreflexia, clonus, tremor, headaches, paresthesia, and visual disturbances, as well as cardiovascular symptoms of heart failure consistent with volume overload and systemic hypoperfusion.59 Volume overload in the lungs can result in dyspnea during ordinary daily activities, orthopnea, persistent nocturnal dry cough, and paroxysmal nocturnal dyspnea.8 Volume overload may also lead to peripheral edema.32 Enlargement of

**Table 1. Key Diagnostic Criteria for Pregnancy-Specific Cardiovascular Diseases**

| Gestational Hypertension19, 20 | Preeclampsia19, 20, 27 | HELLP Syndrome4, 27, 52 | Peripartum Cardiomyopathy21 |
|--------------------------------|------------------------|-------------------------|-----------------------------|
| SBP ≥ 140 mmHg or DBP ≥ 90 mmHg, as measured at two points in time at least four hours apart | SBP ≥ 140 mmHg or DBP ≥ 90 mmHg, as measured at two points in time at least four hours apart | Hemolysis (serum haptoglobin ≤ 25 mg/dL) AND | LVEF < 45%, not explained by another cardiac disease |
| AND | Protein-to-creatinine ratio of two urine samples exceeds 0.3 mg/dL AND/OR | Elevated liver enzymes (serum LDH > 600 IU/L OR total bilirubin > 1.2 mg/dL) AND | |
| AND/OR | Protein concentration of a 24-hour urine excretion sample ≥ 300 mg | Low platelet count (< 100,000 cells/µL) | |

DBP = diastolic blood pressure; HELLP = hemolysis, elevated liver enzymes, low platelet count; LDH = lactate dehydrogenase; LVEF = left ventricular ejection fraction; SBP = systolic blood pressure.

DBP = diastolic blood pressure; HELLP = hemolysis, elevated liver enzymes, low platelet count; LDH = lactate dehydrogenase; LVEF = left ventricular ejection fraction; SBP = systolic blood pressure.
the atria and ventricles may lead to development of ectopic foci and thus cardiac arrhythmia. At clinical assessment, cardiac auscultation may reveal new-onset murmurs, indicating a mitral or tricuspid regurgitation, and elevated jugular venous pressure. Depending on the degree to which peripartum cardiomyopathy has progressed, different symptoms of heart failure at varying levels of severity may be present. The patient may either have a normal heart rate or be tachycardic, and arterial hypertension or hypotension may also be found. One review found that, at the time of diagnosis, about 75% of pregnant women with peripartum cardiomyopathy had heart failure symptoms corresponding to class III or IV of the NYHA Functional Classification system. That is, symptoms such as dyspnea, fatigue, and palpitations either markedly impeded daily activities (class III) or severely impeded daily activities, with discomfort even at rest (class IV).

**Fetal assessment.** If the initial maternal assessment for pregnancy-specific CVDs is negative, but there are ongoing medical concerns about fetal health, fetal monitoring is recommended. Performing a fetal ultrasound can permit identification of an abnormal fetal heart rate (less than 120 or more than 160 beats per minute), oligohydramnios (insufficient amniotic fluid), and intrauterine growth restriction (delayed fetal growth). If evidence of fetal stress is found, antenatal testing is suggested using umbilical artery Doppler velocimetry. Pregnancy-specific CVDs have been linked to placental abnormalities (such as inflammation, infarct, thrombosis), which can increase placental vascular resistance and impair blood perfusion. The absence or reversal of end-diastolic flow in the umbilical arteries can be a further indication of fetal stress.

**MANAGEMENT**

Primary care providers should discuss with their pregnant patients the risks and benefits of pharmacotherapy for pregnancy-specific CVDs, as well as the potential impact of untreated illness, to determine the safest and most appropriate approach. In collaboration with other interdisciplinary team members, nurses should educate their pregnant patients on any medications that are then prescribed. Moreover, aerobic exercise is “absolutely contraindicated” in pregnant women with pregnancy-induced hypertension, preeclampsia, HELLP, and hemodynamically significant heart disease, and nurses should counsel patients accordingly. The timing and mode of delivery should be based on the severity of hypertension and the stability of the maternal–fetal condition. As in any pregnancy, decisions about delivery should be made collaboratively by the pregnant woman, her family members, and the health care team.

Here we address clinical management for each pregnancy-specific CVD, with consideration for when to initiate: during the antepartum, the intrapartum, or, if applicable, the postpartum phase. For medications frequently used in managing pregnancy-specific CVDs and their specific use during pregnancy and breastfeeding, see Table 2.

| Drug Class | Use During Pregnancy | Use When Breastfeeding |
|------------|----------------------|------------------------|
| Angiotensin-converting enzyme (ACE) inhibitors (such as benazepril, fosinopril) | Not recommended. | Generally acceptable for use. But certain ACE inhibitors (such as captopril, enalapril) are preferred. |
| Angiotensin receptor blockers (such as losartan, valsartan) | Not recommended. | Not recommended, as profound hypotension in the infant may result. |
| β-blockers (such as labetalol, metoprolol) | Generally acceptable for use. | Generally acceptable for use. |
| Calcium channel blockers (such as amlodipine, nifedipine) | Generally acceptable for use. | Generally acceptable for use. |
| Centrally acting antiadrenergics (such as clonidine, methyl dopa) | Generally acceptable for use. | Methyl dopa is generally acceptable for use. Clonidine is not recommended, as there are potential adverse effects for the infant. |
| Diuretics (such as furosemide, hydrochlorothiazide) | Use cautiously to avoid compromising fetal perfusion. | Generally acceptable for use. May decrease milk production. |
Gestational hypertension. Antepartum phase. First-line pharmacotherapy typically involves the administration of methyldopa, a centrally acting anti- 
adrenergic, or labetalol (Trandate), a dual α-blocker and 
nonselective β-blocker. Both lower blood pressure 
mainly through vasodilation. Although antih 
ypertensive medication can be initiated if the 
blood pressure is over 150/100 mmHg, for pregnant 
women this isn’t usually recommended unless the 
blood pressure is consistently over 160/110 mmHg. Prolonged or severe hypertension can lead to central 
nervous system injury.

Once pharmacotherapy begins, maternal blood 
pressure must be closely monitored to evaluate treatment 
effectiveness and to avoid hypoperfusion; a 
diastolic blood pressure of 85 mmHg should be the 
target. Nurses can suggest home self-monitoring 
with an automated blood pressure device and 
explain its use. For best results, patients should 
refrain from exercising at least 30 minutes before 
taking a reading and should sit up straight with legs 
uncrossed and feet flat; the upper arm should be 
unclothed and held at heart level. Blood pressure 
should be measured at the same time daily. The correct 
cuff size matters—it should be 1.5 times the arm 
circumference—and nurses or pharmacists can help 
women to determine the right size. Partial bed rest 
may be recommended for women with mild hyper 
tension (between 140/90 and 159/109 mmHg). Strict 
bed rest is not advised because of the increased risk 
of thromboembolism.

Intrapartum phase. During this phase, positioning 
the woman in a left lateral or sitting position may 
help lower cardiovascular stress by avoiding aorta 
caval compression and reduced venous return. 
Vaginal birth is preferred when the woman is stable 
and there are no obstetric indications for a cesarean 
section. Advantages of vaginal birth include less 
blood loss, better hemodynamic stability, lack of 
surgery-related stress and anxiety, and fewer pul 
monary complications.

Postpartum phase. During this phase, it’s recom 
manded that maternal blood pressure be assessed 
at least once at three to 10 days postpartum. As for 
breastfeeding and drugs commonly used to treat 
either gestational hypertension or preeclampsia, 
there are usually no contraindications. As with 
any new parents, nurses should provide standard 
information and recommendations regarding the 
benefits of breastfeeding, proper positioning and 
latching of the infant on the nipple, and common 
problems and ways to address them.

Preeclampsia and HELLP syndrome. Management 
of preeclampsia and HELLP syndrome includes 
all the recommendations described above for gesta 
tional hypertension, as well as these below.

Antepartum phase. During this phase, manage 
ment is focused on preventing the onset of seizures. 
In some cases, magnesium sulfate might be admin 
istered intravenously or intramuscularly to help 
prevent seizures. After such administration, it’s 
important to monitor for signs of magnesium toxic 
ity, which include bradycardia, bradypnea, oliguria, 
and altered states of consciousness (such as confu 
sion, anxiety).

Intrapartum phase. In women with mild pre 
eclampsia without signs of clinical instability or indi 
cators for preterm delivery, full-term delivery may 
be considered. In women with severe preeclampsia 
or with signs of maternal or fetal instability, delivery 
is recommended as soon as the maternal condition 
is stabilized.

Peripartum cardiomyopathy. Antepartum phase. 
To our knowledge, there have been no clinical trials 
specifically evaluating the management of heart fail 
ure in peripartum cardiomyopathy. Thus, during the 
antepartum phase, standard management of heart 
failure is warranted. This can include the cautious 
administration of diuretics, β-blockers, hydralazine, 
nitrates, and heparin. Managing volume status is 
esential. As such, salt and fluid intake restriction 
are necessary to prevent volume overload. Light 
physical activity may still be encouraged in women 
with peripartum cardiomyopathy.

Women with a severely impaired ejection frac 
tion (below 25%) despite treatment or who are in 
cardiogenic shock and receiving IV positive inotropes 
(such as dobutamine) may require mechanical sup 
port. Left ventricular assist devices (a surgically 
implemented pump that assists the heart in pumping 
blood) are one such type of support. In women 
with peripartum cardiomyopathy, these devices are 
often installed to support those who are waiting for a 
heart transplant.

Intrapartum phase. Early delivery is not indicated 
as long as the maternal–fetal condition is stable. 
In cases of maternal instability requiring the use of 
inotropes or mechanical support, fetal delivery by 
planned cesarean section may reduce the hemody 
namic stress. In cases of less severe maternal insta 
bility, regional anesthesia and assisted vaginal 
delivery are preferred. Pain control during delivery 
is essential. Regional anesthesia (such as epidural 
analgesia or continuous spinal anesthesia) can 
improve cardiac loading and stabilize cardiac out 
put by reducing preload and afterload. Anesthesia 
also reduces anxiety and lowers sympathetic ner 
vous system stress, which further benefits cardiovas 
cular function.

Administration of IV fluids in this population 
requires close monitoring to avoid overhydration and 
rapid preloading. With epidural anesthesia, 
some women may require IV fluids before the anes 
thesia is delivered. Although 500 mL of crystalloid 
fluids is a typical dose, the potential benefits of this 
practice must be weighed against the risks of volume 

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overload, hypoperfusion, and pulmonary edema. A vasopressor can also be added as needed. Postpartum phase. There is a lack of consensus as to whether women with peripartum cardiomyopathy can safely breastfeed. Some experts have advised against it, theorizing that prolactin production could potentially exacerbate the condition. But recent literature reviews report that, unless there are pharmacologic contraindications, women with peripartum cardiomyopathy who are clinically stable should not be discouraged from breastfeeding.

With regard to future pregnancies, the left ventricular ejection fraction should be checked before attempting to conceive. Experts agree that women with an incompletely recovered ejection fraction should refrain from becoming pregnant again. In such cases, nurses should offer counseling on contraceptive methods to reduce the odds of unplanned pregnancy. Progesterone-only forms of contraceptive methods to reduce the odds of unplanned pregnancy.32 Pregnancy-specific CVDs can contribute to intratrunal or neonatal mortality, especially in low- and middle-income countries. Pregnancy-specific CVDs also increase the risks of undesirable outcomes such as preterm birth, low birth weight, and low Apgar scores. The severity of the maternal condition does not directly predict fetal and neonatal outcomes. Lower gestational age and abnormal results from more than one type of fetal monitoring may be better indicators of fetal morbidity and mortality risks. The delivery care plan should be made in collaboration with the parents and should address topics such as fetal prematurity, neonatal intensive care, and maternal postpartum posttraumatic stress disorder. All deliveries before 34 weeks of gestation should occur only in a clinical setting with the necessary maternal and neonatal intensive care resources. Parents of infants born prematurely or with complications are likely to experience emotional shock, self-blame, sadness, and fear. For such parents, being able to participate in the care of and to interact with their baby; focusing on positive aspects and improvements; receiving information about their child’s health and specific needs, as well as available resources; and receiving emotional support from nurses and other health care professionals are all vital to helping them cope.

For 12 additional continuing nursing education activities on pregnancy-related topics, go to www.nursingcenter.com/ce.

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