Major Changes in Diagnosis and Management of Preeclampsia
Susan Snydal, CNM, MS

Preeclampsia and eclampsia continue to be major contributors to maternal mortality and morbidity. Lack of appreciation for the multi-organ involvement of preeclampsia, combined with overly rigid criteria for diagnosis, may hinder early diagnosis and appropriate management. Recently, the American College of Obstetricians and Gynecologists Task Force on Hypertension in Pregnancy evaluated the evidence and formulated new recommendations for diagnosis and management. This article reviews some of these recommended changes, including the new classification of the hypertensive diseases of pregnancy. Systolic blood pressure has been shown to be as important as diastolic blood pressure in the diagnosis of preeclampsia. Changes in proteinuria are not predictive of disease severity or maternal or fetal complications; therefore, the magnitude of proteinuria or changes in the amount should not dictate diagnosis or management. Instead, symptoms of cerebral involvement, such as headache and visual changes or signs of end-organ involvement including abnormal laboratory tests (elevated serum creatinine or liver function tests, low platelet count), are evidence of preeclampsia with severe features. Immediate induction of labor is recommended for women with gestational hypertension or preeclampsia at 37 weeks’ gestation or later. Pregnant and postpartum women need to know important warning signs and symptoms of preeclampsia. Prompt diagnosis of preeclampsia and appropriate management will improve the quality of care for women.

Keywords: eclampsia, gestational hypertension, maternal mortality, postpartum, preeclampsia, pregnancy, pregnancy-induced hypertension

INTRODUCTION

Preeclampsia is a multi-organ disease of pregnancy that affects 2% to 8% of pregnancies.1 It is a leading cause of maternal mortality, infant prematurity, and fetal growth restriction in the United States.2 Although preeclampsia is classified as a hypertensive disease of pregnancy, to view it primarily as a blood pressure problem is incorrect. It can have serious effects on the liver, kidneys, brain, and lungs. Maternal mortality reviews from both the United Kingdom and California have demonstrated how serious this condition can be.3,4

Preeclampsia is a challenging disease to identify. It manifests itself in the second or third trimester or even postpartum. The disease process is often invisible; the woman may initially look and feel well. Many women have no symptoms, whereas others have symptoms that may deceive the woman and her clinician into thinking that she has some other, more benign condition.

Preeclampsia is a progressive disease. About 25% to 50% of women with gestational hypertension progress to preeclampsia.5 Preeclampsia, in turn, can develop severe features. One study demonstrated that 44% of women with gestational hypertension or preeclampsia without severe features who were managed expectantly experienced serious adverse effects such as severe hypertension; hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome; pulmonary edema; or postpartum hemorrhage.6 Unfortunately, it is impossible to predict how rapidly preeclampsia will progress. Sometimes it is a relatively benign, slow-moving disease; at other times it evolves very rapidly.

Recently, the American College of Obstetricians and Gynecologists Task Force on Hypertension in Pregnancy (the task force) evaluated the current research on preeclampsia.7 They noted that there are few clinical issues for which there is strong evidence for specific management strategies. The task force used the Grading of Recommendations Assessment, Development, and Evaluation Working Group framework8–11 to assess the evidence and make recommendations. The resulting recommendations were graded as either strong or qualified. A strong recommendation is one that is well-supported by the evidence and would be appropriate for almost all patients. A qualified recommendation is one for which the evidence of benefit is more uncertain. Although appropriate for most patients, it might not be optimal for some patients whose values and attitudes toward uncertainty differ from those of the task force.

This article reviews the nature of preeclampsia as well as some of the changes recommended by the task force that contrast with typical current management. Current classifications of pregnancy-related hypertensive disorders are listed in Table 1. Discussion of the management of chronic hypertension, superimposed preeclampsia, and HELLP syndrome is beyond the scope of this article.

DEVELOPMENT OF PREECLAMPSIA

The cause of preeclampsia remains unknown. The initial problems in a pregnancy complicated by preeclampsia begin early, when the blastocyst is implanting in the uterine wall. Defects in the invasion of the decidua by the trophoblasts, the cells on the leading edge of the blastocyst, lead to impaired remodeling of the spiral arteries of the decidua and

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myometrium during the first and second trimesters. Normally, trophoblasts initiate a process that changes the spiral arteries from narrow, high-velocity vessels with a muscular coat into wide, relatively slow-moving channels lacking muscle fibers that might constrict them. A leading theory of the cause of this defect is an exaggerated maternal immune response to the trophoblasts, which may be related to maternal genetic factors. Failed remodeling may result in an abnormally small placenta or in blood vessels that still retain some of their muscle fibers. When these contract, blood flow to the placenta becomes intermittent. This is the first stage of preeclampsia, which occurs prior to the development of any clinical signs or symptoms.

The second stage of preeclampsia occurs during the second half of pregnancy. As the growing fetus puts additional demands on the placenta, it struggles with its inadequate or intermittently inadequate blood flow. The resulting hypoxia and oxidative stress lead the trophoblasts to release excessive amounts of microparticles and antiangiogenic factors such as soluble endoglin and the soluble form of the vascular endothelial growth-factor receptor. These substances in turn trigger the release of inflammatory cytokines. Altogether, this leads to the generalized inflammation and inappropriate, exaggerated activation of the endothelium that produce the clinical signs and symptoms of preeclampsia. The endothelium lines the entire circulatory system, and its dysfunction leads to increased vascular reactivity and other abnormalities. The more extreme the placental problems, the earlier the clinical preeclampsia tends to emerge, the more severe the disease tends to be, and the more likely it is to involve intrauterine growth restriction. However, preeclampsia with severe features also occurs at term and postpartum. It is now thought that maternal genetic, immunologic, and constitutional factors probably interact to produce preeclampsia.

**HOW PREECLAMPSIA AFFECTS DIFFERENT BODY SYSTEMS**

**Effects on the Cardiovascular System**

The excessive inflammation and endothelial dysfunction of preeclampsia cause vascular hyperreactivity, which results in the hypertension that is characteristic of this disease. A second effect of endothelial malfunction is inappropriate leukocyte, complement, and clotting activation, which can lead to thrombocytopenia (low platelets) and generalized fluid leakage into the interstitial tissue. Failure of normal vasodilation in pregnancy and hemoconcentration cause the hematocrit to rise significantly. Edema may be present throughout the body, causing sudden weight gain.

**Effects on the Kidneys**

Animal studies suggest that the excessive placental production of a protein (soluble-fms-like tyrosine kinase-1, or sFlt-1) causes the characteristic swelling and hypertrophy of the endothelial cells lining the glomerulus, which results in a reduced glomerular filtration rate and proteinuria. In pregnant women, reduced filtration and proteinuria are often seen in preeclampsia and can progress to renal failure. The most important symptom heralding severe renal problems is oliguria, usually defined as urine output of less than 25 to 30 mL per hour over 2 consecutive hours.

**Effects on the Liver**

Preeclampsia with severe features may damage the lining of small blood vessels in the liver, leading to hemolysis and fibrin deposits that can create areas of necrosis and infarction in the liver. Epigastric, shoulder, or right upper quadrant pain or tenderness when the liver is palpated may signal liver involvement. The pain is thought to arise from the fibrin blockage of blood flow through the hepatic sinusoids. Liver damage may lead to an increased incidence of postpartum hemorrhage or may progress to disseminated intravascular coagulation, resulting in uncontrollable bleeding. A hematoma may develop beneath Glisson's capsule in the liver. If the capsule ruptures, shock usually results in a surgical emergency, with a maternal mortality rate of greater than 50%.

**Effects on the Central Nervous System**

Eclampsia, or grand mal seizure, is an extremely serious progression of preeclampsia. In preeclampsia, the endothelium
<table>
<thead>
<tr>
<th>Condition</th>
<th>Criteria</th>
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<tbody>
<tr>
<td><strong>Chronic hypertension</strong></td>
<td>Systolic BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90 mmHg</td>
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<tr>
<td></td>
<td>BP measured twice, at least 4 h apart</td>
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<tr>
<td></td>
<td>Present before 20 weeks' gestation</td>
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<tr>
<td></td>
<td>Laboratory tests are not relevant to diagnosis.</td>
</tr>
<tr>
<td><strong>Gestational hypertension</strong></td>
<td>Systolic BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90 mmHg</td>
</tr>
<tr>
<td></td>
<td>BP measured twice, at least 4 h apart</td>
</tr>
<tr>
<td></td>
<td>Present $\geq$ 20 weeks' gestation</td>
</tr>
<tr>
<td><strong>No proteinuria</strong></td>
<td>Serum creatinine, AST, ALT, and platelets are normal.</td>
</tr>
<tr>
<td></td>
<td>No pulmonary edema</td>
</tr>
<tr>
<td></td>
<td>No new-onset headache or visual changes</td>
</tr>
<tr>
<td><strong>Preeclampsia</strong></td>
<td>Systolic BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90 mmHg</td>
</tr>
<tr>
<td></td>
<td>BP measured twice, at least 4 h apart</td>
</tr>
<tr>
<td></td>
<td>Present $\geq$ 20 weeks' gestation</td>
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<tr>
<td></td>
<td>Proteinuria (one of the following):</td>
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<tr>
<td></td>
<td>Protein $\geq$ 300 mg per 24-h urine collection</td>
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<tr>
<td></td>
<td>Protein/creatinine ratio $\geq$ 0.3</td>
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<tr>
<td></td>
<td>Protein $\geq$ 30 mg/dL or 1+ on urine dipstick</td>
</tr>
<tr>
<td><strong>Preeclampsia with severe features</strong></td>
<td>Same as preeclampsia, except one of the following must be present (proteinuria is not required):</td>
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<tr>
<td></td>
<td>Systolic BP $\geq$ 160 mmHg, measured twice at least 15 min apart</td>
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<tr>
<td></td>
<td>Diastolic BP $\geq$ 110 mmHg, measured twice at least 15 min apart</td>
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<tr>
<td></td>
<td>Thrombocytopenia: platelet count $&lt; 100,000$/microliter</td>
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<td></td>
<td>Impaired liver function: AST or ALT $&gt; 70$ units/L or twice the normal concentration</td>
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<tr>
<td></td>
<td>Renal insufficiency: serum creatinine $&gt; 1.1$ mg/dL or doubled from baseline values</td>
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<tr>
<td></td>
<td>Pulmonary edema</td>
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<tr>
<td></td>
<td>Symptoms indicating possible cerebral or neurologic involvement: headache or visual changes (e.g., flashing, blurring, visual loss, blindness)</td>
</tr>
<tr>
<td><strong>Eclampsia</strong></td>
<td>Seizure</td>
</tr>
<tr>
<td></td>
<td>Systolic BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90 mmHg</td>
</tr>
<tr>
<td></td>
<td>Present $\geq$ 20 weeks' gestation</td>
</tr>
</tbody>
</table>

**Abbreviations:** ALT, alanine transaminase; AST, aspartate aminotransferase; BP, blood pressure; h, hour; min, minute.

*Preeclampsia may be superimposed on chronic hypertension; discussion of this condition is beyond the scope of this article.*

*Using dipsticks for diagnosis is discouraged unless other approaches are not readily available.*

*Source: American College of Obstetricians and Gynecologists.*

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lining the cerebral blood vessels malfunctions, allowing fluid to leak into the brain tissue, which causes cerebral edema. The blood vessels sometimes overreact, and the resulting vasospasm may result in areas of ischemia. Many of these cerebral malfunctions can be described as posterior reversible leucoencephalopathy, which is now hypothesized to be the primary injury in eclampsia. Cerebral autoregulation is the process of maintaining an even cerebral blood flow in the face of fluctuations in blood pressure. A recent study demonstrated that cerebral autoregulation is impaired in women with preeclampsia and does not directly correlate with blood pressure. Women with preeclampsia who have only mildly elevated blood pressures may have autoregulatory breakdown leading to eclampsia. Symptoms frequently precede eclampsia; the most common is headache, occurring in 60% to 87% of women with eclampsia. Other women experience nausea, vomiting, or visual changes such as blurred vision or even blindness. Still others have confusion, agitation, or difficulty speaking. The most serious neurologic complication is stroke, which is the major cause of death in women who have preeclampsia with severe features or eclampsia.

**Effects on the Cardiopulmonary System**

The endothelial dysfunction of preeclampsia can cause leakage of fluid out of blood vessels into the alveoli, resulting in pulmonary edema, which occurs most frequently postpartum. The main symptom is shortness of breath, especially when lying flat. Pulse oximetry will show decreased oxygen saturation. Pulmonary edema may advance to pregnancy-related acute respiratory distress syndrome, which has a high mortality rate. Rarely, preeclampsia with severe...
features may cause congestive heart failure or cardiopulmonary arrest.\(^\text{15}\)

**Effects on Placental Function**

Significant defects in the trophoblast invasion of the decidua may lead to direct effects on the fetus, such as intrauterine growth restriction, reduced amniotic fluid volume, absent or reversed end diastolic flow on Doppler study, a nonreactive nonstress test, or category II fetal heart-rate patterns.\(^\text{7}\) There is also an increased risk of placental abruption.\(^\text{22}\)

**DIAGNOSIS OF PREECLAMPSIA**

The task force recommends a new classification system for hypertensive diseases of pregnancy (Table 1). An algorithm to aid diagnosis can be found in Supporting Appendix S1.

**Change in Terminology**

The progressive nature of preeclampsia means that a label of mild preeclampsia applies only to the moment of diagnosis. The task force recommends removing this modifier and simply diagnosing preeclampsia.\(^\text{7}\) They stress that all women with preeclampsia should be frequently reassessed for signs or symptoms of preeclampsia with severe features.

**Blood Pressure Considerations**

**New Emphasis on Systolic Blood Pressure**

Recent research has highlighted the importance of elevated systolic blood pressure. For example, Martin and colleagues noted that, in women with preeclampsia with severe features and eclampsia who died from stroke, only 12.5% had severely elevated diastolic blood pressures (≥ 110 mmHg) just prior to the fatal stroke, but 96% had very high systolic blood pressures (≥ 160 mmHg).\(^\text{23}\) Likewise, the most recent inquiry into maternal deaths in the United Kingdom (2006-2008) determined that the majority of deaths from preeclampsia and eclampsia were due to intracranial hemorrhage and that severely high systolic blood pressures were usually present for several hours before stroke, whereas diastolic blood pressures were often not particularly high.\(^\text{4}\) Therefore, the task force emphasizes treating extremely high systolic blood pressures, as well as high diastolic blood pressures, as a hypertensive emergency (quality of evidence: moderate; strength of recommendation: strong).\(^\text{7,24}\)

**Blood Pressure Measurement**

Blood pressure elevations must be persistent to diagnose preeclampsia; therefore, a high blood pressure should be reevaluated within 4 hours to assess persistence before a diagnosis is made. This is a change from the previous 6-hour interval. However, if the initial blood pressure is extremely high, the blood pressure should be rechecked in 15 minutes. If still severely raised, preeclampsia with severe features is diagnosed, and antihypertensive treatment should begin immediately. The California Maternal Quality Care Collaborative recommends that severely high blood pressures be treated within 30 to 60 minutes.\(^\text{25}\) Note that either a high systolic blood pressure or a high diastolic blood pressure is sufficient for the diagnosis of preeclampsia. Both do not have to be high. Updated recommendations for accurately taking blood pressure can be found in Supporting Appendix S2.

**Proteinuria**

Recent studies have demonstrated that the magnitude or changes in the amount of proteinuria do not accurately reflect the severity of preeclampsia, nor do they accurately predict maternal or fetal complications.\(^\text{26–28}\) The task force eliminated heavy proteinuria (≥ 5 g/24 h) as a criterion for diagnosing preeclampsia with severe features.\(^\text{7}\) Testing for protein should be done because it is a disease feature, but the amount of protein no longer guides management or diagnoses the severe features. Testing may be discontinued once significant proteinuria has been demonstrated.

The primary strength of collecting a 24-hour urine for protein is that it is not influenced by hour-to-hour variations in the amount of protein excreted. However, questions have been raised about the test’s accuracy in light of frequently poor collection techniques.\(^\text{29,30}\) Its major drawback is that it can significantly delay a diagnosis of preeclampsia. An alternative is a spot protein/creatinine ratio. Results of this test are available comparatively rapidly, although there is some controversy about the cutoff point for abnormality and concern about whether the ratio varies throughout the day.\(^\text{31}\) The task force recommends that a protein/creatinine ratio of at least 0.3 is preferable as a cutoff point because it most closely matches a 24-hour urine protein collection of 300 mg.\(^\text{7}\)

A recent review of dipstick urine tests compared to the 24-hour urine protein test showed an average sensitivity of only 55% and a specificity of 84%.\(^\text{32}\) Because of its inaccuracy, the task force discourages using dipstick urine testing for the diagnosis of preeclampsia unless other methods are not readily available.\(^\text{7}\)

**New Emphasis on Signs and Symptoms**

The new classification system highlights the importance of symptoms. A recent systematic review showed that headache, visual disturbances, and epigastric pain moderately predicted serious maternal complications; however, the absence of symptoms was not as accurate in excluding complications.\(^\text{33}\) Likewise, abnormal liver or kidney tests or low platelets signal serious complications. The task force classifies women with new-onset hypertension plus headache, visual changes, or abnormal laboratory tests as having preeclampsia with severe features. Proteinuria is not necessary for the diagnosis.\(^\text{7}\)

**PREDICTION AND PREVENTION OF PREECLAMPSIA**

**Prediction**

Despite great research interest in developing tests of biomarkers or using uterine artery Doppler velocimetry to predict preeclampsia, the task force was unable to locate any evidence that accurate prediction improves maternal or fetal outcomes.\(^\text{7}\) Recent studies using risk factors to predict
Preeclampsia have been only modestly successful, showing detection rates at best of 37%, with false positive rates of 5% to 10%.34,35

Prevention
No intervention to date has been widely successful in preventing preeclampsia. A Cochrane review of 59 trials of low-dose aspirin therapy, thought promising because of aspirin’s ability to block the production of thromboxanes and reduce inflammation, showed a significant risk reduction only in women who are at high risk.36 The task force suggests that high-risk women be limited to those with a history of early-onset preeclampsia or preterm birth (<34 weeks’ gestation) due to preeclampsia or preeclampsia in more than one prior pregnancy. These women should be given daily low-dose (60–80 mg) aspirin beginning in the late first trimester to reduce risk (quality of evidence: moderate; strength of recommendation: qualified).7

According to the task force, there is no evidence that the following interventions prevent preeclampsia:7 supplementation with vitamin C or vitamin E (quality of evidence: high; strength of recommendation: strong); calcium supplementation in populations with adequate dietary calcium intake (eg, the United States); restricting dietary salt (quality of evidence: low; strength of recommendation: qualified); or bedrest (quality of evidence: low; strength of recommendation: qualified). Some authorities have made different recommendations, which can be found in Table 2.37–40

Timely Detection of Preeclampsia
Women often do not know the symptoms of preeclampsia and even if they do, they may not understand the importance of reporting them promptly. The 2011 California Pregnancy Associated Mortality Review found that 56% of the women who died from severe preeclampsia failed to understand the importance of a key symptom, and 63% delayed or did not seek care, factors that probably or definitely contributed to their deaths.3 Another study confirmed that women generally have a poor understanding of preeclampsia.41 A randomized controlled trial compared a new, one-page, graphic-rich educational tool written at a fifth-grade reading level to an educational pamphlet produced by the American College of Obstetricians and Gynecologists and to no education about preeclampsia. Women recalled significantly more clinically important information about preeclampsia with the new tool.42 This handout is in Supporting Appendix S3. The task force recommends that health care providers convey crucial information about preeclampsia to all women who are pregnant and postpartum using proven health communication practices (quality of evidence: low; strength of recommendation: qualified).7

Management of Preeclampsia
Currently, the only definitive treatment for preeclampsia is birth. Treatments such as administering magnesium sulfate and antihypertensive medication for severely high blood pressure reduce the risk of serious complications, but the underlying processes of inflammation and endothelial activation continue to progress.

Magnesium Sulfate
Magnesium sulfate is used to prevent and treat eclamptic seizures. The task force recommends treatment with magnesium sulfate for women with preeclampsia with severe features and for women with eclampsia (quality of evidence: high; strength of recommendation: strong).7

The task force recommends that magnesium sulfate not be given universally to preeclamptic women without severe features (quality of evidence: low; strength of recommendation: qualified).7 There are only 2 double-blind placebo-controlled trials that administered magnesium sulfate to women with preeclampsia without severe features. No women developed eclampsia in either group; however, only 181 women were assigned to the placebo groups. The task force estimates that 10,000 women would need to be enrolled in both the placebo and magnesium sulfate groups to detect a 50% reduction in seizures.

Magnesium sulfate may result in arterial vasodilatation and thus lower blood pressure, but it is not a reliable antihypertensive medication.43 Women with severely high blood pressure need antihypertensive medication in addition to magnesium sulfate.

Antihypertensive Medication
The task force recommends labetalol (Trandate) and hydralazine (Apresoline) for first-line therapy for severely high blood pressure with preeclampsia.7 Labetalol is contraindicated when women have used cocaine or methamphetamine or have asthma or heart failure. The target blood pressure is 140 to 160 mmHg systolic and 90 to 100 mmHg diastolic. It is important not to lower the blood pressure further because this may compromise placental perfusion and thus have adverse effects on the fetus.25 An excellent resource person in this situation is the anesthesia provider, who has extensive experience in titrating medications to lower and stabilize blood pressure.

Changes in Proteinuria
The task force found that the development of severe proteinuria was not associated with worse outcomes in women with preeclampsia. Proteinuria can have multiple causes. For example, labor, infection, fever, increased blood pressure, emotional states that increase catecholamine levels, or steroids given for fetal lung maturity may cause an increase in proteinuria in the absence of any progression in the kidney lesion.29 Thus, the task force recommends that decisions about birth should not be made on the basis of the amount of proteinuria or change in the amount of proteinuria (quality of evidence: moderate; strength of recommendation: strong).7

Anesthesia Considerations
Because of the generalized edema of preeclampsia, a careful airway examination by the anesthesia provider is essential,
### Table 2. Alternative Recommendations to the Task Force on Hypertension in Pregnancy

<table>
<thead>
<tr>
<th>Issue or situation</th>
<th>Recommendation from the Task Force on Hypertension in Pregnancy</th>
<th>Controversy</th>
<th>Alternative Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal symptoms other than headache and visual changes are mentioned but not included in any recommendations by the task force.</td>
<td>None.</td>
<td>Several studies show that nonspecific symptoms have some value in indicating the presence of preeclampsia or of disease progression. For example, one study found that dyspnea and chest pain were important predictors of life-threatening complications within 48 h for women hospitalized for preeclampsia. A meta-analysis showed that epigastric pain moderately predicted maternal complications. Another study showed that a significant number of women who presented to the hospital with eclamptic seizure had preceding epigastric pain, nausea, or vomiting.</td>
<td>Based on these reports, it seems reasonable to recommend that after 20 weeks’ gestation, maternal symptoms of epigastric pain, upper abdominal pain, shoulder pain, nausea, vomiting, malaise, shortness of breath, difficulty breathing, and chest pain should be investigated as possible symptoms of preeclampsia or, if preeclampsia has already been diagnosed, progression of the disease.</td>
</tr>
<tr>
<td>Calcium supplementation to prevent preeclampsia for women with low calcium in the diet.</td>
<td>Does not recommend calcium supplementation to prevent preeclampsia for women in the United States, even if the woman has low dietary intake of calcium (&lt; 600-900 mg daily).</td>
<td>In a large US study, calcium supplementation did not reduce the incidence of preeclampsia. However, studies done in populations outside the United States with low baseline calcium intake show significant reduction in the diagnosis of preeclampsia. One expert, Dr. Peter von Dadelszen, does not support supplementation because he is concerned that calcium in these women may function as an antihypertensive agent, masking the development of preeclampsia. His research group has an RCT in progress to clarify this issue.</td>
<td>There are population groups within the United States that have low calcium intake. Based on the positive reports for calcium supplementation of these groups outside the United States, it seems reasonable to recommend that dietary calcium be increased for these groups and for individual women with low calcium intake, if possible. If dietary calcium cannot be increased to adequate levels, it seems reasonable to offer women the option of calcium supplementation for prevention of preeclampsia after discussion of the uncertainties of using it.</td>
</tr>
<tr>
<td>Women with gestational hypertension or preeclampsia at ≥ 37 weeks’ gestation should have their labors induced.</td>
<td>Induce labor</td>
<td>The task force recommendation was based on a single RCT. It is rare to change clinical practice on the basis of one study. It would be reasonable to await confirmation of these findings by one or more additional trials. This is possibly the reason for the task force’s “qualified” recommendation.</td>
<td>Based on the quality of this one study, it seems reasonable to recommend the induction of labor for most women. However, considering the relatively slim evidence base, it also seems reasonable to offer the option of expectant management to a woman who strongly does not want to have her labor induced.</td>
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<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Management of women with gestational hypertension whose diastolic BP is 90-94 mmHg at ≥ 37 weeks’ gestation</td>
<td>Induce labor</td>
<td>Gestational hypertension was defined as diastolic BP ≥ 95 mmHg in the trial upon which the task force based its recommendation. Thus, there are no data upon which to base management for women whose diastolic BP is 90-94 mmHg.</td>
<td>Because there is a gap in knowledge about optimal management of women with gestational hypertension whose diastolic BP is 90-94 mmHg at ≥ 37 weeks’ gestation, it seems reasonable to offer these women the option of expectant management or induction of labor after discussion of the uncertainties involved.</td>
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</table>

Abbreviations: BP, blood pressure; h, hour; RCT, randomized controlled trial.

and one should be prepared for a difficult airway. In addition, because rapid sequence induction and intubation usually causes a significant rise in blood pressure, every precaution should be taken to minimize such increases. Overall, women with preeclampsia who receive general anesthesia have a 7-fold greater risk of maternal mortality compared to those receiving regional anesthesia. For this reason, the task force recommends using regional anesthesia whenever possible (quality of evidence: moderate; strength of recommendation: strong).

Management of Preeclampsia at 34 to 36 Weeks’ Gestation

When a woman is diagnosed with preeclampsia with severe features at 34 to 36 weeks’ gestation, the task force recommends that she give birth as soon as she is stabilized (quality of evidence: moderate; strength of recommendation: strong). However, for women with preeclampsia without severe features, there are no evidence-based data on management. Therefore the task force’s recommendation for expectant management is based on expert opinion and summarized in Table 3 (quality of evidence: low; strength of recommendation: qualified).

Management of Preeclampsia from Viability to 33 6/7 Weeks’ Gestation

Preeclampsia that develops early in gestation tends to progress more rapidly and be more severe than does preeclampsia in the later third trimester. However, birth at an early gestational age obviously puts the fetus at high risk. The task force lists these considerations as paramount: Women should be hospitalized at facilities with adequate resources for maternal and neonatal intensive care. If need be, the woman should be transferred to such a facility if she is stable enough (quality of evidence: moderate; strength of recommendation: strong). In addition, the woman should be given corticosteroids for fetal lung maturity, and birth should be delayed for 48 hours if maternal and fetal conditions remain stable (quality of evidence: high; strength of recommendation: strong).

There is moderate evidence that the expectant management of women who have preeclampsia with severe features and who are stable but less than 34 0/7 weeks’ gestation may be beneficial for the fetus, but this is usually possible only for a short time before worsening disease dictates that birth should occur. Women with preeclampsia without severe features may be managed the same as women at 34 to 36 weeks’ gestation (see Table 3).
Table 3. Management of Gestational Hypertension and Preeclampsia Without Severe Features Prior to 37 Weeks’ Gestation

<table>
<thead>
<tr>
<th>Gestational Hypertension at &lt; 37 Wk Gestation</th>
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<tbody>
<tr>
<td>Daily kick count</td>
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<tr>
<td>Daily monitoring for preeclampsia symptoms by the woman</td>
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<tr>
<td>Weekly clinical (in-person) assessment including blood pressure, maternal symptoms, and urine protein</td>
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<tr>
<td>An additional blood pressure check at another time in the week (may be done at home)</td>
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<tr>
<td>Weekly laboratory evaluation of platelets, AST, ALT, and serum creatinine (this is the minimum evaluation; additional tests may be ordered)</td>
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<tr>
<td>Weekly amniotic fluid volume assessment and NST</td>
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<tr>
<td>Ultrasound examination to assess fetal growth every 3 wk</td>
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<td>Women should be counseled to eat a regular diet without salt restriction.</td>
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<tr>
<td>Strict bedrest should not be prescribed, although increased rest and decreased physical activity, manual labor, or office work may be indicated for individual women.</td>
</tr>
<tr>
<td>If preeclampsia without severe features develops, manage as below.</td>
</tr>
<tr>
<td>If preeclampsia with severe features, IUGR, or oligohydramnios develop, admit for inpatient care.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preeclampsia Without Severe Features at &lt; 37 Wk Gestation: Manage as Above Except for These Changes</th>
</tr>
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<tbody>
<tr>
<td>Twice weekly clinical (in person) assessment, including blood pressure and maternal symptoms</td>
</tr>
<tr>
<td>Omit urine protein testing after diagnosis.</td>
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<tr>
<td>Twice weekly NSTs</td>
</tr>
<tr>
<td>If preeclampsia with severe features, IUGR, or oligohydramnios develop, admit for inpatient care.</td>
</tr>
</tbody>
</table>

Abbreviations: ALT, alanine transaminase; AST, aspartate aminotransferase; IUGR, intrauterine growth restriction; NST, nonstress test; wk, week.
Source: American College of Obstetricians and Gynecologists.7

Management of Eclampsia
The woman who develops seizures should be initially stabilized (see Supporting Appendix S4); birth should be expedited by induction or cesarean.

Management of Postpartum Preeclampsia
The blood pressure in women with preeclampsia usually decreases for the first 48 hours after birth but may then increase 3 to 6 days postpartum.59 Good-quality data are lacking regarding the level of blood pressure to treat, what the target blood pressures should be, and when to stop medication. The task force relied on expert opinion to make its recommendations that women with persistent postpartum blood pressures of 150 mmHg systolic or 100 mmHg diastolic or higher be given antihypertensive medication.7 The task force also recommends that all women who have had gestational hypertension or preeclampsia should have their blood pressures monitored during the postpartum period for 72 hours in the hospital or with equivalent intensity on an outpatient basis. They should be reassessed in the office 7 to 10 days after birth (quality of evidence: moderate; strength of recommendation: qualified).7

Some women develop preeclampsia for the first time postpartum. Women who develop preeclampsia in the postpartum period should be managed essentially the same as women with antepartum preeclampsia. It is important to note that, in a recent series of 152 women with delayed postpartum preeclampsia and eclampsia, 63% did not have hypertension in their most recent pregnancy, labor, or birth.50 The disease appeared at a mean of 8 days postpartum. Two-thirds (69%) of these women, and 100% of those who had eclampsia, presented with headache. The task force recommends that the symptoms of preeclampsia should be reviewed with all women postpartum (quality of evidence: low; strength of recommendation: qualified).7 Women should also be told that, if they go to an emergency department, they should inform the staff of a recent birth so that they can be evaluated by a maternity care provider.51 Clinicians in emergency departments often overlook the possibility of preeclampsia.

AFTER EFFECTS OF PREECLAMPSIA
The psychological impact of preeclampsia has rarely been studied, yet it may result in profound effects. A Dutch study showed that nearly one-fifth of women with a history of preeclampsia were referred for psychological treatment, usually for dysfunctional coping or posttraumatic stress disorder.52 Women with a history of preeclampsia should be assessed for symptoms of psychological distress and referred for treatment, if indicated.

Women with a history of preeclampsia have an increased risk of having cardiovascular disease later in life. Women who had recurrent preeclampsia, gave birth before 37 weeks’ gestation, or had a pregnancy with fetal growth restriction are at much greater risk that is approximately equal to the adverse cardiovascular effects of obesity or smoking. The task force suggests that lifestyle modification be encouraged in these women, including maintenance of a healthy weight, adequate aerobic physical exercise, optimal diet, and avoiding tobacco.7
CLINICAL PRACTICE REGARDING PREECLAMPSIA

Delays in Diagnosis

The 2011 California Pregnancy Associated Mortality Review found that delay in diagnosis was a factor that probably or definitely contributed to the deaths of 92% of the women who died of preeclampsia. In many cases, clinicians thought that the woman did not have preeclampsia but some other condition, although signs and symptoms clearly pointed toward preeclampsia. This type of error is called a fixation error. Another mistake is called the de minimus (minimizing) error. This occurs when signs of trouble are noticed but explained away. For example, high blood pressures might be ignored because the woman is in pain, had her blood pressure taken during a contraction, or has no risk factors for preeclampsia.

One strategy to prevent these errors is to simply recognize how commonly they occur with preeclampsia. It is critical to remember is that after 20 weeks’ gestation, new-onset hypertension is almost always the beginning of preeclampsia. If there is any doubt, consultation with the most clinically skilled colleague available is warranted.

Changing Clinical Practice

Clinical practice related to preeclampsia needs to change. The 2011 California Pregnancy Associated Mortality Review found that better care would have had a good to strong chance of altering the outcome in 50% of the women who died from preeclampsia, and the use of ineffective treatment probably or definitely contributed to 79% of these deaths. However, translating knowledge into new patterns of clinical practice is not simple. Passive distribution of preeclampsia guidelines has failed to change perinatal practice. However, active implementation in British Columbia by involving local opinion leaders and holding interactive educational sessions was followed by a significant decline in adverse maternal and perinatal outcomes. The California Maternal Quality Care Collaborative Preeclampsia Toolkit includes many resources to improve the quality of the health care team’s response.

CONCLUSION

Preeclampsia is an unpredictable disease that continues to have devastating consequences. To mitigate harm, clinicians must use current evidence to guide assessment and management, consider preeclampsia for cases of new-onset hypertension in pregnancy, resist minimizing signs and symptoms of preeclampsia, and improve the functioning of our interprofessional health care teams.

AUTHOR

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CONFLICT OF INTEREST

The author has no conflict of interest to disclose.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher’s Web site:

Appendix S1. Algorithm for diagnosis of preeclampsia for women with gestations of > 20 weeks or postpartum

Appendix S2. Steps for Obtaining Accurate Blood-Pressure Measurements

Appendix S3. Preeclampsia Patient Education Handout

Appendix S4. Algorithm for initial steps in stabilization of women with preeclampsia with severe features

REFERENCES


Appendix S1: Algorithm for diagnosis of preeclampsia for women with gestations of > 20 weeks or postpartum

START

New onset BP ≥ 160 systolic and/or ≥ 110 diastolic

YES

YES

NO

NO

New onset BP ≥ 140 systolic and/or ≥ 90 diastolic

YES

Arrange to recheck BP in 4 hours. Meanwhile, perform these actions:
1. Ask about maternal symptoms of preeclampsia
2. If short of breath, obtain pulse oximetry
3. Order blood work:
   - CBC with differential, AST, ALT, creatinine
4. Order/test urine for protein
   a. Protein/creatinine ratio
   b. Do dipstick for protein if results of P/C ratio unlikely to be available within 4 hours

NO

4 hours later, BP is still ≥ 140 systolic and/or ≥ 90 diastolic

YES

If any ONE of the following, choose pathway for “YES”:
- Headache or visual changes
- Labs indicate any of the following:
  o Thrombocytopenia (platelets < 100,000/microliter)
  o Renal insufficiency (creatinine > 1.1 mg/dL)
- Impaired liver function (AST & ALT > 70 IU/L)
- Pulmonary edema

NO

Proteinuria
- Protein/creatinine ratio ≥ 0.3 OR
- Urine dipstick 30mg/dL or 1+ or greater

YES

NO

YES

NO

Diagnose preeclampsia with severe features
- Transfer urgently to Labor and Delivery/Postpartum (if not there)
- Consult with/ transfer care to obstetrician
- Manage initial care per Appendix S4.

Diagnose preeclampsia
- Consult with/ transfer care to obstetrician
- If undelivered and ≥ 37 weeks, induce labor.
- If < 37 weeks, manage care per Table 3.

Diagnose gestational hypertension
- Consult with/ transfer care to obstetrician
- If undelivered and ≥ 37 weeks, induce labor.
- If < 37 weeks, manage care per Table 3.

Manage as normal for pregnancy/postpartum except reassess BP more frequently

Manage as normal for pregnancy/postpartum
## Appendix S2: Steps for Obtaining Accurate Blood Pressure Measurements

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Prepare equipment</strong></td>
<td>- Mercury sphygmomanometer is gold standard, can use validated equivalent automated equipment&lt;br&gt;- Check cuff for any defaults&lt;br&gt;- Obtain correct size cuff: width of bladder 40% of circumference and encircle 80% of arm (See Figure 1)</td>
</tr>
<tr>
<td>2. <strong>Prepare the patient:</strong></td>
<td>- Use a sitting or semi-reclining position with back supported and arm at heart level&lt;br&gt;- Patient to sit quietly for 5 minutes prior to measurement&lt;br&gt;- Bare upper arm of any restrictive clothing&lt;br&gt;- Patients feet should be flat, not dangling from examination table or bed, and her legs uncrossed&lt;br&gt;- Assess any recent (within previous 30 minutes) consumption of caffeine or nicotine. If blood pressures are at the level that requires treatment, consumption of nicotine or caffeine should not lead to delays in instituting appropriate anti-hypertensive therapies</td>
</tr>
<tr>
<td>3. <strong>Take measurement</strong></td>
<td>- Support patients arm at heart level, seated in semi-fowlers position&lt;br&gt;- For auscultatory measurement: use first audible sound (Kortokoff I) as systolic pressure and use disappearance of sound (Kortokoff V) as diastolic pressure&lt;br&gt;- Read to the nearest 2 mm Hg&lt;br&gt;- Instruct the patient not to talk&lt;br&gt;- At least one additional reading should be taken within 15 minutes&lt;br&gt;- Use the highest reading&lt;br&gt;- If greater than or equal to 140/90, repeat within 15 minutes and if still elevated, further evaluation for preeclampsia is warranted. <strong>Do not reposition patient to either side to obtain a lower BP. This will give you a false reading.</strong></td>
</tr>
<tr>
<td>4. <strong>Record Measurement</strong></td>
<td>Document BP, patient position, and arm in which taken</td>
</tr>
</tbody>
</table>


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Appendix S4: Algorithm for initial steps in stabilization of women with preeclampsia with severe features

**Preeclampsia with severe features diagnosed**

- Urgently transfer to Labor or Delivery/Postpartum and admit (if not already there).
- Brief team members. Team to be led by obstetrician when he/she is able to be present at the bedside.
- Simultaneously perform initial actions to stabilize patient outlined below.

Administer anti-hypertensive medication, if BPs are ≥160 systolic or ≥110 diastolic. Follow EITHER of the following 2 pathways:

**Labetalol 20 mg IV over 2 min.**
- Repeat BP in 10 min. If high, give labetalol 40 mg IV.
- Repeat BP in 10 min. If high, give labetalol 80 mg IV.
- Repeat BP in 10 min. If high, give hydralazine 10 mg IV.
- Repeat BP 20 min. If high, consult anesthesia.

**Hydralazine 5-10 mg IV over 2 min.**
- Repeat BP in 20 min. If high, give hydralazine 10 mg IV.
- Repeat BP 20 min. If high, give labetalol 20 mg IV.
- Repeat BP 10 min. If high, give labetalol 40 mg IV and consult anesthesia.

Administer magnesium sulfate loading dose of 4-6 G IV over 15-20 minutes.

Administer magnesium sulfate maintenance dose of 1-2 G IV per hour.

- Order blood work (if not obtained within last few hours): CBC with differential, AST, ALT, creatinine (may order more, this is the minimum).
- Order urine test: protein/creatinine ratio or urine dipstick for protein (if not previously done with positive result).
- Start continuous FHR monitoring, if undelivered
- Institute pulse oximetry.
- Notify & brief anesthesia provider, if not already done.
- Notify & brief pediatric provider if undelivered.
Abbreviations: BP: blood pressure; mg: milligram; IV: intravenous; min: minute; G: gram; CBC: complete blood count; AST: aspartate aminotransferase; ALT: alanine transaminase.

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Preeclampsia

What Is It?
Preeclampsia is a serious disease related to high blood pressure. It can happen to any pregnant woman during the second half of her pregnancy, or up to 6 weeks after delivery.

Risks to You
- Seizures
- Stroke
- Organ damage
- Death

Risks to Your Baby
- Premature birth
- Death

Signs of Preeclampsia
- Stomach pain
- Headaches
- Feeling nauseous; throwing up
- Seeing spots
- Swelling in your hands and face
- Gaining more than 5 pounds (2.3 kg) in a week

What Should You Do?
Call your doctor or midwife right away. Finding preeclampsia early is important for you and your baby.

For more information go to www.preeclampsia.org

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