

The background features a dark blue field with several overlapping, semi-transparent gears in various shades of blue. On the left side, there is a vertical strip with a colorful, abstract, and textured appearance, possibly representing a microscopic view or a biological process. The main title is enclosed in a red rectangular border.

Hypertension in Pregnancy

A white rectangular box with a thin black border containing the author's name.

Dotun
Ogunyemi, MD

1997 JNC CLASSIFICATION

	SBP	DBP
Optimal	<120	<80
Normal	<130	<85
High-normal	130-139	85-89
Stage 1	140-159	90-99
Stage 2	160-179	100-109
Stage 3	\geq 180	\geq 110

1997 JNC HTN RISK FACTORS

- ✱ **Smoking**
- ✱ **Abnormal lipids**
- ✱ **Diabetes**
- ✱ **Age > 60 years**

- ✱ **Male**
- ✱ **Menopause**
- ✱ **Family history of CVD (women <65, men <55)**

END ORGAN DAMAGE

- ★ Heart

- ★ Left ventricular hypertrophy
- ★ Coronary artery disease
- ★ Congestive heart failure

- ★ Cerebrovascular accident/TIA

- ★ Nephropathy
- ★ Peripheral artery disease
- ★ Retinopathy

JNC VI Risk Stratification

BP Stage	No risk factor	One risk factor	DM or EOD
High normal	Lifestyle	Lifestyle	Rx
Stage 1	Lifestyle 12 months	Lifestyle 6 months	Rx
Stage 2 or 3	Rx	Rx	Rx

Impact of high normal blood pressure on cardiovascular risk

- ✦ In 6859 subjects followed for 10 years over 4 decades, subjects with high normal blood pressure (**130-139/85-89**) had a higher incidence of **CV death, MI, CVA and CHF**.
- ✦ Women : **2.5** higher risk ratio
- ✦ Men: **1.6** higher risk ratio

Vasan et al. NEJM 2001;\;345:1291-1297

Lifestyles: Dietary approaches to Step HTN) DASH

- ★ DASH diet (**High fruit/ vegetable with low total/saturated fat**) in RCT trials was shown to reduce blood pressure
- ★ Combination of DASH diet with low sodium diet had more effect than either alone
- ★ The effect was most significant among African-Americans (SBP 12.6 mm Hg vs. 9.5) and women (10.5 vs. 6.8 mm Hg)
- ★ Message: **Reduce salt** from all sources.

Sacks FM; NEJM 2001;344:3-10

Lifestyle: weight & Exercise

- ✦ Sustained weight loss of **10 lbs** produced reduction of DBP of **5** mmHg and SBP of **7** mm Hg
- ✦ Meta-analysis of 54 RCT on effect of **exercise** on HTN showed a decrease of **3.84** on SBP and **2.58** for DBP.
- ✦ Little benefit from **>2.5** hours/week exercise

Whelton et al. Ann Int Med 2002;

ALLHAT (Antihypertensive & lipid-lowering treatment to prevent heart attack trial)

- ✦ **33357 subjects BP >140/90, 180/110 with at least one risk factor:**
- ✦ **(MI, CVA, LVH, type 2 DM, smoker, HDL<35, PVD)**
- ✦ **Chlorthalidone, Amlodipine, Lisinopril,**
- ✦ **Atenelol, Clonidine, Reserpine**
- ✦ **Hydralazine**
- ✦ **Followed for 4.9 years**
- ✦ **JAMA 2002;288:2981-2997**

ALLHAT results (Thiazide better than ACEI or CCB)

- ★ **Thiazide diuretics** were more **effective** in preventing CHF and ischemic heart disease than Lisinopril and amlodipine
- ★ Hypokalemia and BS >126 mg/dl were more common with thiazide diuretics but were easily controlled
- ★ Most patients required **2 drugs**

LIFE study: ARB are second line treatment

☀ In a report of 9193 & another with 1326 subjects randomized to Losartan and Atenolol showed that **Lorsartan** reduced:

- ☀ CV mortality 25-46%
- ☀ CVA 25-40%
- ☀ New DM 25-28%
- ☀ Total mortality 11-28%
- ☀ Lorsartan was also more effective therapy

JAMA 2002;288:1491-1498, Lancet 2002;359:1004-1010

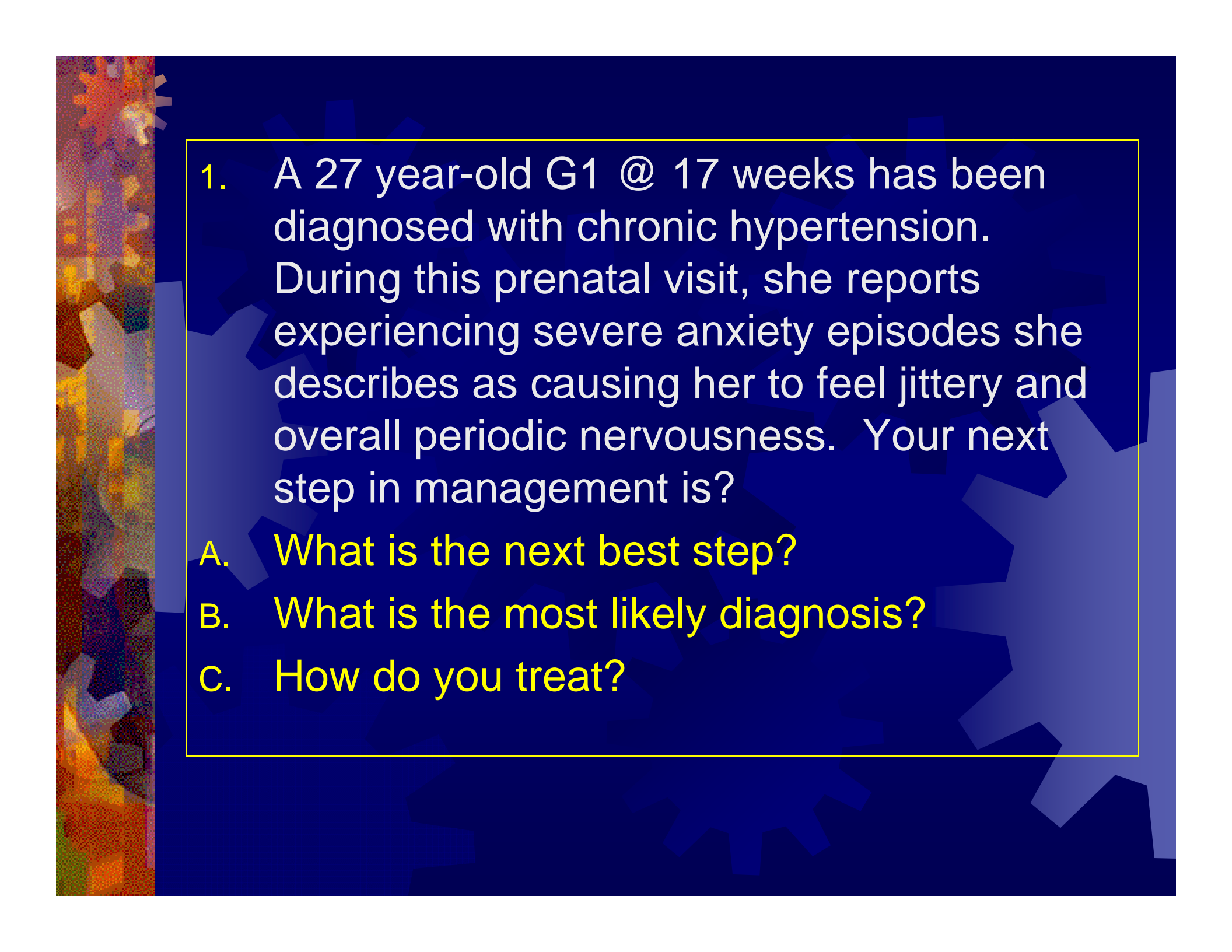
Tighter control for Diabetes reduces death and CVD

- ★ 1148 diabetics randomized to tight control (mean BP=144/82) and less tight control (mean BP= 154/85) showed:
- ★ 32% reduction in diabetes related deaths, 44% reduction in strokes, 37% in microvascular disease
- ★ Optimum BP control require multiple medications

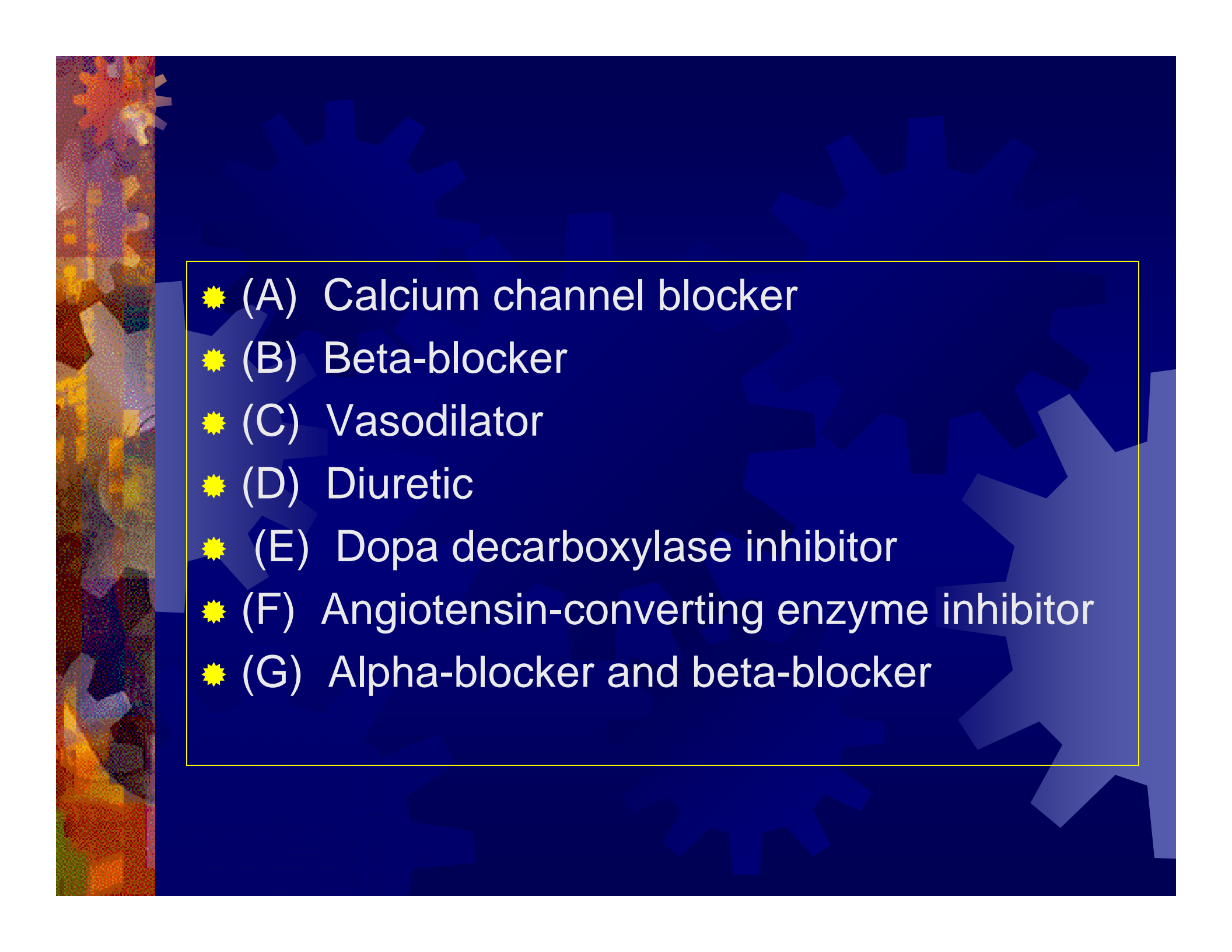
★ BMJ 1998;317:703-713

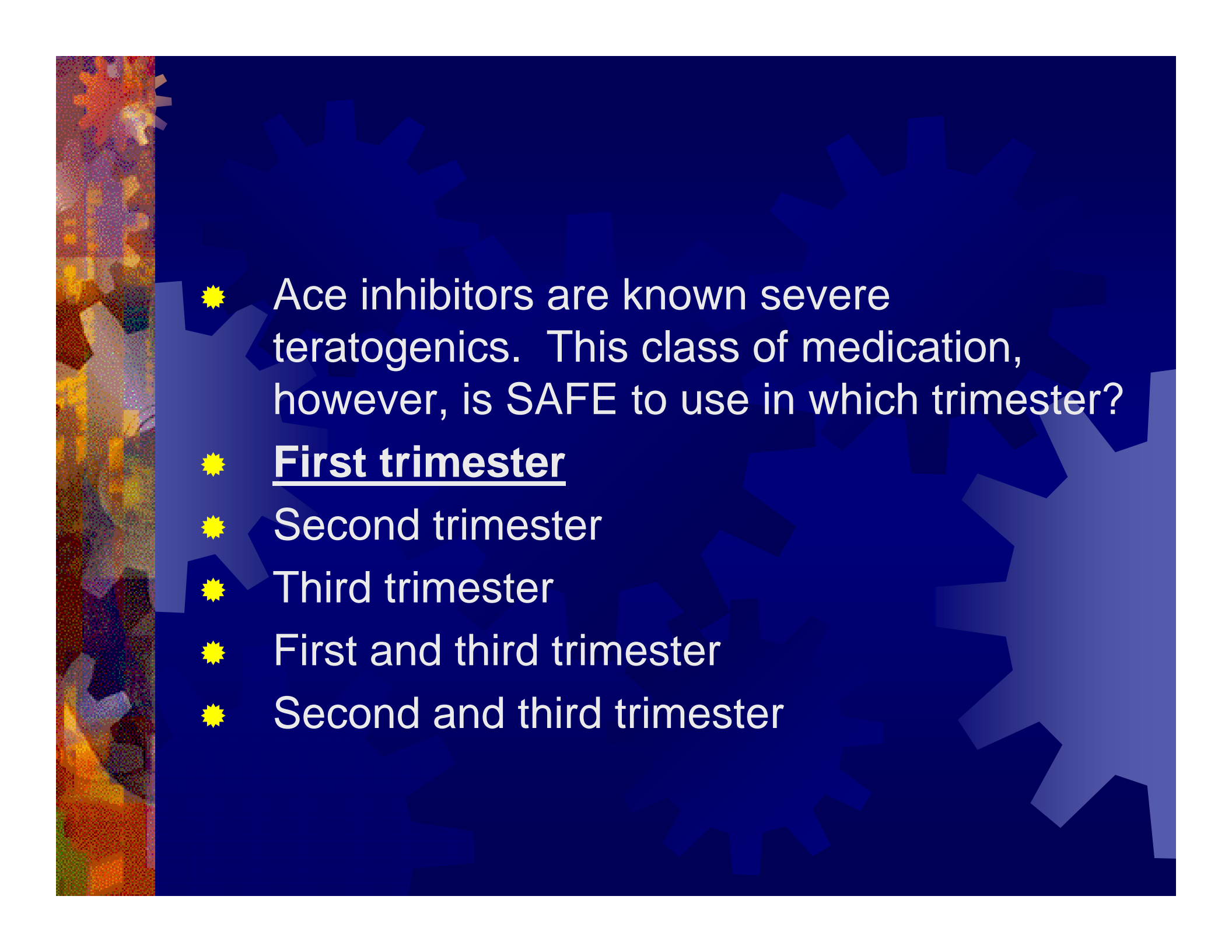
Classification

- ✱ **Chronic hypertension**
- ✱ **Gestational Hypertension**
- ✱ **Preeclampsia**
- ✱ **Superimposed preeclampsia**

- 
- The background is a dark blue field with several light blue gears of various sizes scattered across it. On the left side, there is a vertical strip with a colorful, abstract, and somewhat pixelated pattern in shades of orange, yellow, and brown.
1. A 27 year-old G1 @ 17 weeks has been diagnosed with chronic hypertension. During this prenatal visit, she reports experiencing severe anxiety episodes she describes as causing her to feel jittery and overall periodic nervousness. Your next step in management is?
 - A. What is the next best step?
 - B. What is the most likely diagnosis?
 - C. How do you treat?

- ★ **32 year old at 32 weeks GA has somnolence , is pale & yellow. hemoglobin is 4 g/dl, unconjugated bilirubin is 2 mg/dl and direct Coombs' test is positive.**
- ★ **Newborn has renal dysgenesis, pulmonary hypoplasia and limb abnormalities**
- ★ **28 year old at 30 weeks GA has headaches & dizziness on standing up. Pulse is 120 beats per minute & she is flushed.**
- ★ **35 year old at 16 weeks GA has right upper abdominal pain with nausea & vomiting. Uric acid is 8mg/dl; amylase is 1800 mg/dl.**
- ★ **30 year old at 34 weeks GA has facial rash, muscle and joint pains. ANA are positive.**
- ★ **Newborn is SGA; has jitteriness, apnea & seizures. Serum glucose is 10mg/dl**

- 
- ☀ (A) Calcium channel blocker
 - ☀ (B) Beta-blocker
 - ☀ (C) Vasodilator
 - ☀ (D) Diuretic
 - ☀ (E) Dopa decarboxylase inhibitor
 - ☀ (F) Angiotensin-converting enzyme inhibitor
 - ☀ (G) Alpha-blocker and beta-blocker



☀ Ace inhibitors are known severe teratogenics. This class of medication, however, is SAFE to use in which trimester?

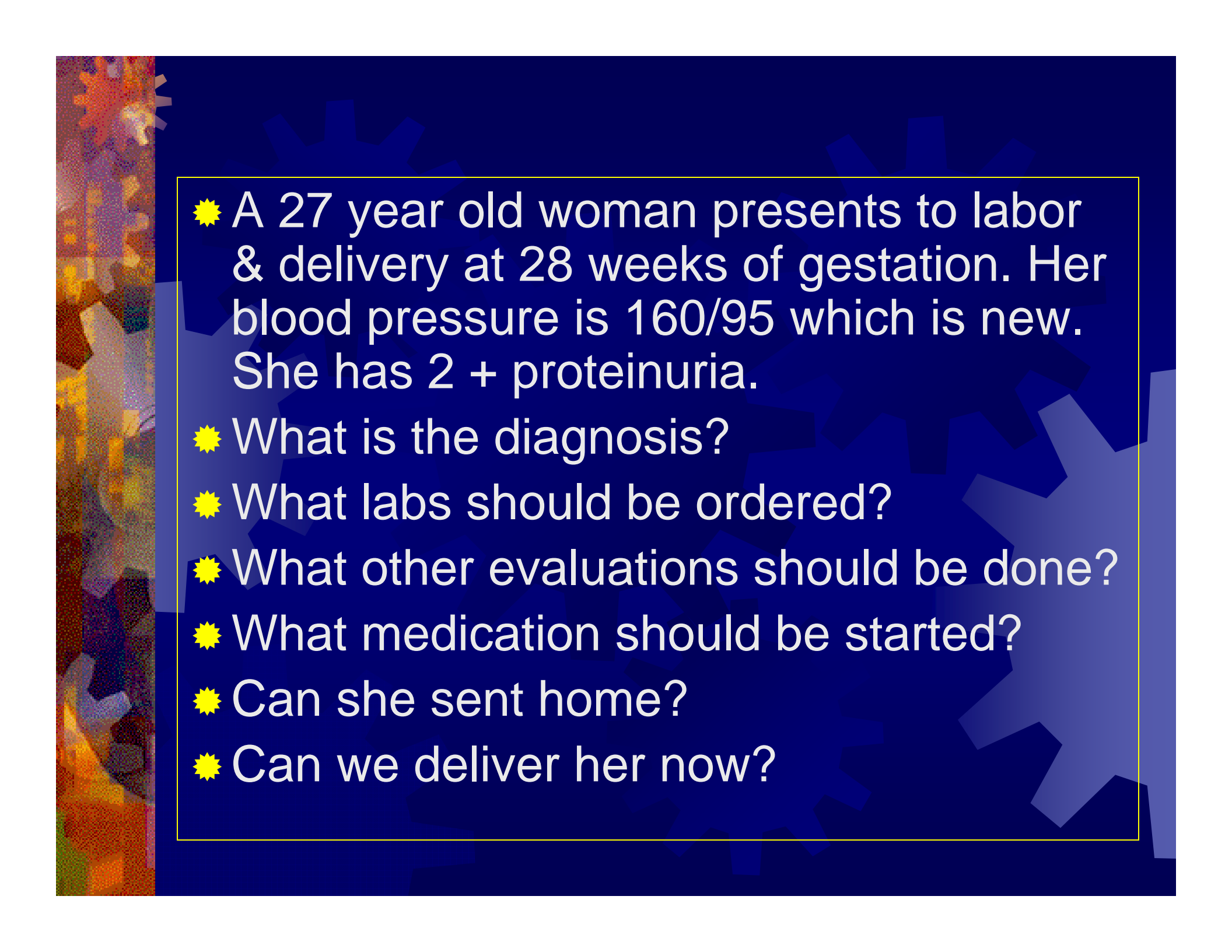
☀ First trimester


☀ Second trimester

☀ Third trimester

☀ First and third trimester

☀ Second and third trimester

- 
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- ★ A 27 year old woman presents to labor & delivery at 28 weeks of gestation. Her blood pressure is 160/95 which is new. She has 2 + proteinuria.
 - ★ What is the diagnosis?
 - ★ What labs should be ordered?
 - ★ What other evaluations should be done?
 - ★ What medication should be started?
 - ★ Can she sent home?
 - ★ Can we deliver her now?

- 
- ★ A 27 year old woman is 28 weeks pregnant. She was diagnosed with lupus 7 years ago and is on plaquenil.
 - ★ She now has 3+proteinuria and her blood pressure is 210/120?
 - ★ What is the diagnosis?
 - ★ What tests do you order?
 - ★ How do you treat?

Chronic Hypertension

- ✱ **BP > 140/90 mm Hg diagnosed before pregnancy or before 20 weeks gestation**
- ✱ **Hypertension diagnosed after 20 weeks gestation and persistent after 12 weeks postpartum**

Chronic Hypertension

- ✦ 5% of pregnancies
- ✦ later reproductive years
- ✦ African American women
- ✦ 95% to 98% have essential hypertension
- ✦ 2% to 5% secondary hypertension
- ✦ (renal disease, renovascular disease, aldosteronism, Cushing syndrome, connective tissue disorders, pheochromocytoma)

Chronic Hypertension

- ✦ Because of physiologic lowering of blood pressure in pregnancy.
- ✦ Up to 1/3 with chronic HTN are normotensive in the first 1/2 of pregnancy.
- ✦ Antihypertensive medications can be discontinued and restarted when BP elevations reoccur, commonly after 28 weeks of gestation.
- ✦ If presenting late may confuse with preeclampsia.

Chronic Hypertension

- ✦ **Severe HTN has adverse effects**
- ✦ **10% to 25% of women with chronic hypertension develop superimposed preeclampsia-eclampsia**
- ✦ **Abruptio placentae**
- ✦ **Restriction of fetal growth**
- ✦ **Fetal compromise, fetal death, or preterm delivery**

Chronic Hypertension

- ✱ In mild to moderate HTN, discontinuation of antihypertensive therapy in pregnancy likely does little to impact long-term cardiovascular risk.
- ✱ Treatment does not seem to decrease the risk of superimposed preeclampsia.
- ✱ Therapy to decrease SBP to < 160 mm Hg and DBP < 105 mm Hg.

Chronic Hypertension

- ✦ **Renal function studies, uric acid**
- ✦ **Liver enzymes,**
- ✦ **Complete blood count +platelet count,**
- ✦ **24-hour urine collection for protein excretion and creatinine clearance.**
- ✦ **Chest x-ray,EKG, Echocardiogram,**
- ✦ **In atypical cases, causes of secondary hypertension should be investigated**

Chronic Hypertension

- ✦ **Aldomet, lebetalol, hydrallazine**
- ✦ **More frequent prenatal visits,**
- ✦ **bed rest**
- ✦ **Home blood pressure monitoring**
- ✦ **Ultrasound to assess fetal growth**
- ✦ **Fetal biophysical profile**
- ✦ **Doppler velocimetry of umbilical arteries**

Treatment of severe hypertension

Drug	Dose	Onset of action	Duration of action	Side effects
Hydrallazine	5-10 mg IV q 20 min	10-20 min	3-6 hr	Tachycardia, headaches
Lebetalol	20-80 mg Iv q 10 min	5-10 min	3-6 hr	Heart block, vomiting
Nifedipine	10 mg PO q 30 min	10-15 min	4-5 hr	Tachycardia, headaches
Clonidine	10 mg PO q 30 min	30 min	6-8 hr	bradycardia, hypo tension, rebound hypertension
Na nitroprusside	0.25-10 ug/kg/min IV	0 min	1-2 min	N, V, cyanide intoxication

Gestational Hypertension

- ✦ BP \geq 140/90 mm Hg for first during pregnancy after 20 weeks
- ✦ No proteinuria
- ✦ BP return to normal $<$ 12 weeks postpartum
- ✦ Final diagnosis made postpartum
- ✦ No other signs of preeclampsia

Superimposed Preeclampsia

- ★ **New onset proteinuria ≥ 300 mg/24 hours in hypertensive women but no proteinuria before 20 weeks gestation**
- ★ **Sudden increase in proteinuria or BP or platelet count $< 100,000/\text{mm}^3$ in women with hypertension and proteinuria before 20 weeks gestation**

Preeclampsia

★ Diagnosis

- ★ Hypertension
- ★ *Edema*
- ★ proteinuria

★ Emergencies

- ★ Severe preeclampsia
- ★ HELLP syndrome
- ★ Eclampsia

Eclampsia

- ★ **The occurrence of convulsions in a woman with preeclampsia without other neurological diagnosis . Occurrence is a sign of inadequate prenatal care.**
- ★ **Etiology**
- ★ **Cerebral hemorrhage**
- ★ **cerebral edema •cerebral vasospam**

Eclampsia

- ★ 25 cases of eclampsia were compared to 33 cases of preeclampsia and 50 pregnant controls
- ★ 64% of eclamptics had either maternal death, pulmonary edema, hemodialysis, DIC or neurological and visual disorders versus 24% of preeclamptics versus 0% of controls
- ★ Both preeclampsia and eclampsia were associated with preterm births and sequelae.

Is Eclampsia Preventable? A Case Control Review of Consecutive Cases from an Urban Underserved Region, Ogunyemi et al, SMJ 2004

Eclampsia

- ★ **56%** would have been preventable by patient education and compliance
- ★ **16%** would have been preventable healthcare provider response
- ★ **28%** were not preventable, since eclampsia developed without signs and symptoms of preeclampsia

Is Eclampsia Preventable? A Case Control Review of Consecutive Cases from an Urban Underserved Region, Ogunyemi et al, SMJ 2004

Preeclampsia

- ★ About 6% of pregnancies
- ★ BP \geq mm Hg after 20 weeks gestation
- ★ Proteinuria \geq 300 mg/24 hours
- ★ Or \geq 1+ dipstick

Severe Preeclampsia

- ✦ **BP \geq 160/110**
- ✦ **Proteinuria 3+**
- ✦ **Visual disturbance**
- ✦ **Headaches**
- ✦ **Epigastric pain**
- ✦ **Convulsions**
- ✦ **Pulmonary edema**
- ✦ **Abruption**
- ✦ **Oliguria**
- ✦ **CVA**
- ✦ **Elevated Creatinine**
- ✦ **Thrombocytopenia**
- ✦ **Retinal changes**
- ✦ **Liver enzymes elevation**
- ✦ **Oligohydramnios**
- ✦ **Fetal distress**
- ✦ **IUGR**
- ✦ **DIC**

Mechanism

- ✱ **Vasospasm**
- ✱ **Glomerular capillary endotheliosis**
- ✱ **Acute atherosclerosis in uteroplacental arteries**
- ✱ **Lack of invasion of spiral arteries by trophoblasts**
- ✱ **Increased vascular sensitivity to pressor agents**

Pathology

- ✦ **Prostacyclin thromboxane ratio**
- ✦ **Nitric oxide**
- ✦ **Endothelin**
- ✦ **Vascular endothelial growth factor**
- ✦ **S-FLT receptors**
- ✦ **Placental growth factor**
- ✦ **Endothelial cell activation**
- ✦ **Genetic predisposition**

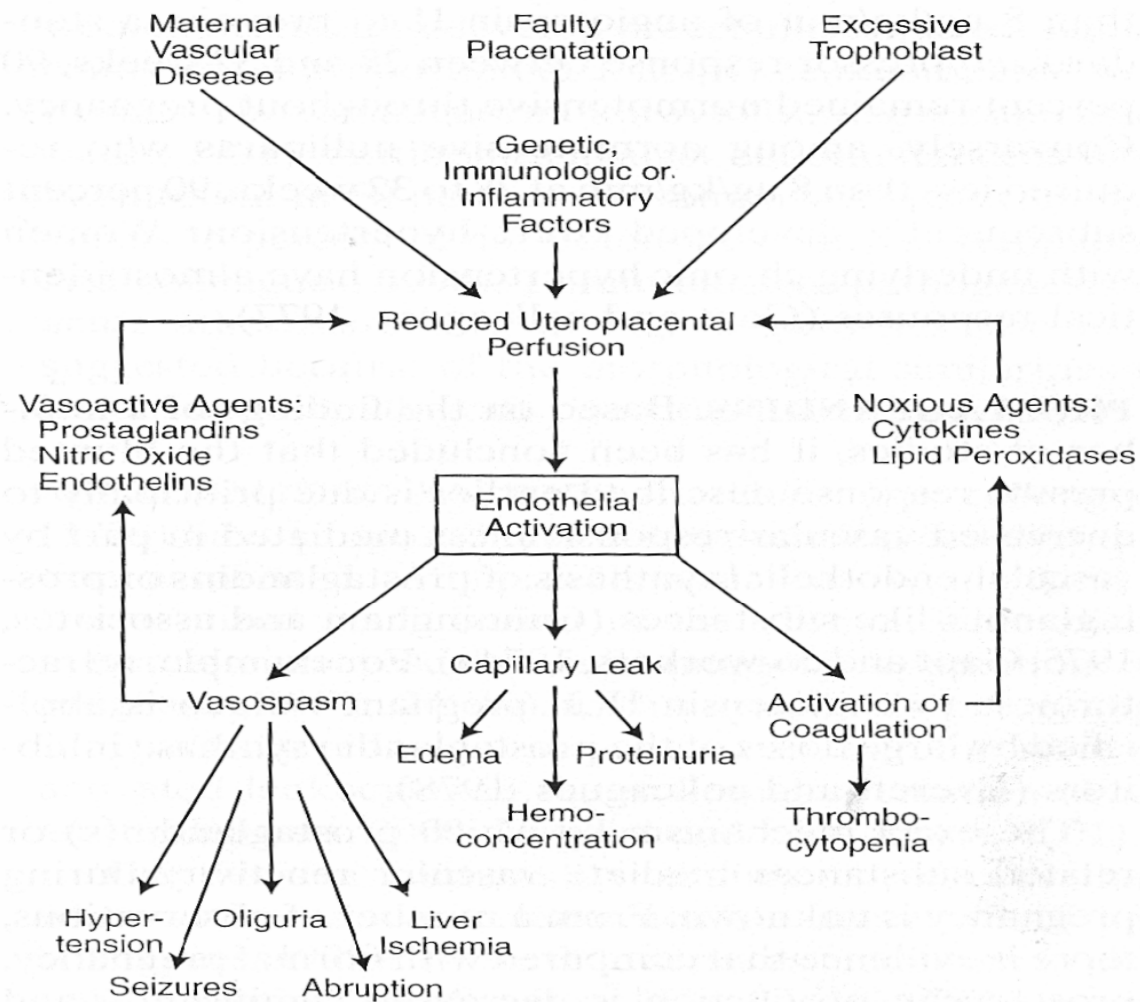


FIGURE 24-10. Pathophysiological considerations in the development of hypertensive disorders due to pregnancy. (Adapted from Friedman and Lindheimer, 1999.)

Risk Factors

- ✦ Nulliparity
- ✦ Lower socioeconomic class
- ✦ Young age
- ✦ Older age
- ✦ Diabetes
- ✦ Hypertension

- ✦ Obesity
- ✦ Multiple pregnancy
- ✦ Hydatidiform mole
- ✦ Polyhydramnios
- ✦ Hydrops
- ✦ Thrombophilia
- ✦ Familial

Preeclampsia Assessment

★ Assess Maternal Condition

- ★ **Complete Blood Count**
- ★ **Liver Function Test**
- ★ **Uric acid**
- ★ **Urinalysis**
- ★ **Coagulation profile**
- ★ **Electrolytes**

Preeclampsia Assessment

- ★ *Assess fetal condition*
- ★ Review fetal growth records
- ★ Ultrasound
- ★ Fetal monitoring

Preeclampsia treatment

- ★ **Definitive treatment is delivery**
- ★ **Mild preeclampsia**
- ★ **Expectant management if preterm**
- ★ **Induction and delivery at term**
- ★ **Severe preeclampsia**
- ★ **Stabilize and deliver regardless of gestational age**

Preeclampsia; expectant management

- ☀ **Maternal evaluation**
- ☀ BP at least every 4 hours
- ☀ Facial or abdominal edema
- ☀ Daily weighing
- ☀ Daily eclamptic symptoms
- ☀ Urine protein daily
- ☀ CBC, LFT, uric acid 1-7 times weekly
- ☀ **Fetal evaluation**
- ☀ Daily fetal movements
- ☀ Serial fetal heart rate monitoring
- ☀ Serial Biophysical profiles
- ☀ Ultrasound for fetal growth every 2-4 weeks

Preeclampsia; expectant management

- ✱ **BP medications used for SBP >160 or SDP >110 to prevent stroke and HTN maternal complications.**
- ✱ **Goal of therapy is to maintain SBP at 140-150 mm Hg and DBP at 90-100 mm Hg.**
- ✱ **Diuretic should be used with pulmonary edema.**
- ✱ **If BP is lowered excessively this may exacerbate maternal cerebral ischemia, decrease renal function and jeopardize fetal wellbeing by decreasing placental blood flow.**

Aggressive vs. expectant mx of severe preeclampsia between 28-32 weeks. A randomized control trial. Sibai et al.

- ✦ **95 patients between 28-32 weeks with severe preeclampsia (BP 160/110 mm Hg and proteinuria) were randomized. 49 expectantly and 46 with delivery in 48 hours after steroid therapy.**
- ✦ **In the expectant group there was significant increase in:**
 - ✦ **Prolongation of pregnancy(15.4 days)**
 - ✦ **Lower NICU days 20 vs. 36.6 days**
 - ✦ **Reduced RDS 22.4% vs. 50%**
 - ✦ **Birthweight 1622 vs 1233 g**
 - ✦ **Increased SGA 30% vs. 11%**
- ✦ **Am J Obstet Gynecol 1994;171:181-822**

Maternal guidelines for severe preclampsia remote from term

Expeditious delivery within 72 hours	Consider expectant management
Uncontrolled severe hypertension	Controlled hypertension using maximum dose of 2 meds
Eclampsia	Any urinary protein
Platelet count <100,000	Oliguria which resolves
AST/ALT >2 X upper limit of normal with epigastric pain or RUQ tenderness	AST/ALT >2 X upper limit of normal without epigastric pain or RUQ tenderness
Pulmonary edema	
Compromised renal function	Creatinine level \leq1mg/dl
Persistent severe headaches/visual changes	

Fetal guidelines for severe preeclampsia remote from term

Expeditious delivery within 72 hours	Consider expectant management
Repetitive late decelerations	Reassuring fetal heart rate
Repetitive severe variable decelerations	
BPP \leq 4 on 2 occasions 4 hours apart	BPP \geq 6
Amniotic fluid index \leq 5 cm	AFI $>$ 5 cm
IUGR	Appropriate fetal growth
Abnormal Doppler flow	

Preeclampsia treatment

- ★ Control or prevent seizures

- ★ Magnesium sulfate

- ★ Control blood pressure

- ★ Hydralazine
- ★ Labetalol
- ★ Nifedipine

Magnesium sulfate

- ✦ **Blocks neuromuscular and cardiac conducting systems**
- ✦ **Decreases smooth muscle contractility**
- ✦ **Depresses CNS irritability**
- ✦ **Relaxes vasculature**
- ✦ **IV 4-6g loading dose with 1-4g/h**
- ✦ **10 gm IM with 5 gm Q 4h IM**
- ✦ **Phenytoin is less effective, indicated in renal failure, myasthenia gravis**

Magnesium levels

Effect	Serum Level mEq/liter
Anticonvulsant prophylaxis	4-6
EKG changes	5-10
Loss of deep tendon reflexes	10
Respiratory paralysis	15
General anesthesia	15
Cardiac arrest	>25

Magpie Trial

- ★ Randomized trial with 4999 women given Magnesium sulfate versus 4993 controls showed:
- ★ risk of eclampsia was:
0.8 vs. 1.9% OR=0.58, CI, 0.29-0.6
- ★ Risk of maternal mortality was
0.2% vs. 0.4% OR =0.55 CI, 0.26-1.14
- ★ Risk of abruption was
2% vs. 3.3%, OR=0.67, CI 0.45-0.89
- ★ No difference in neonatal morbidity

HELLP syndrome

- ★ Low platelet:
 - ★ adherence to damaged vascular endothelium
 - ★ increased platelet aggregation & consumption
- ★ hepatic necrosis ---->hematoma---
> rupture
- ★ Microangiopathic hemolysis

HELLP syndrome

★ Hemolysis

- abnormal smear
- bilirubin ≥ 1.2 mg/dl
- LDH >600 U/L

★ Elevated liver enzymes

- sgot > 70 U/L

★ Low platelets

- Class 1 = 50,000
- Class 2 = 50,000-100,000
- Class 3 = 100,000-150,000

HELLP/Preeclampsia treatment

- ✱ **Judicious hemotherapy & hydration**
- ✱ **FFP, platelets, cryoprecipitate**
- ✱ **RBC,**
- ✱ **Watch IV fluids, CVP, Swan-Ganz**
- ✱ **Exchange plasmapheresis**
- ✱ **Dialysis**
- ✱ **steroid rx: dexamethasone 10mg
q12hr**

Imitators	HEELP	TTP	HUS	AFL	ITP
hypertension	++	+/-	+/-	+/-	normal
Proteinuria	++	+/-	+/-	+/-	normal
Thrombocytopenia	+++	+++	+++	+/-	+++
Ammonia	normal	normal	normal	+	normal
Glucose	normal	normal	normal	decreased	normal
Liver enzymes	++	+/-	+/-	++	normal
Neurological d.	+	+++	normal	normal	normal
Anemia	+	++	++	+/-	normal
Fever	normal	+	normal	normal	normal
Clotting factors	normal	normal	normal	decreased	normal
Creatinine	+	++	++	++	normal

PREVENTION

- ☀ Health Care Provider
- ☀ Early prenatal care
- ☀ Watch blood pressure
- ☀ Watch urine protein results
- ☀ Follow weight gain
- ☀ Review family history
- ☀ **ASSESS AS HIGH RISK**
- ☀ See patient frequently
- ☀ Admit immediately for symptoms or signs
- ☀ Community follow-up

PREVENTION

- ★ Patient Education

- ★ **To come to hospital at once for:**

- ★ **Headaches**

- ★ **Visual disturbance**

- ★ **Epigastric pain**

- ★ **Nausea and vomiting**



The End