The hypertensive disorders of pregnancy and prevention of future cardiovascular disease

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Disclaimers

- I serve as an expert witness
- I serve as Director at Large of the LGBT Caucus of the AAPA
- I have no other conflicts of interest to disclose
- I certify that this material is based on current standards of care

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Objectives

- By the conclusion of this session, attendees will be able to:
  - Describe the eight hypertensive disorders of pregnancy
  - Discuss the management of a patient with pre-eclampsia with severe features
  - List disorders for which patients with a history of a hypertensive disorder of pregnancy are at risk
  - Identify screening techniques to identify early evidence of cardiovascular disease in patients with a history of a hypertensive disorder of pregnancy

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Case

- A 38 yo gravida 1, para 0 with no past medical history at 37 weeks gestational age presents complaining of a severe headache for 8 hours as well as decreased fetal movement for the past four hours. The patient also notes severely painful contractions and dark red vaginal bleeding with clots for the past two hours. She denies: blurred vision, scotomata or epigastric or RUQ pain.
- Her physician asked her to go straight to Labor and Delivery.

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Introduction, epidemiology, and sequelae

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Hypertensive disorders of pregnancy: why they matter[1]

Tucker BAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- Among the most common medical complications of pregnancy
- Affects up to 10% of all pregnancies
- Responsible for up to 16% of all maternal deaths
- Incidence has increased over 25% in the past 20 years

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Why hypertensive disorders of pregnancy matter[2]

"Centers for Disease Control and Prevention. Pregnancy mortality surveillance system. Reviewed March 23, 2023. https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm Accessed July 2, 2023.

Maternal mortality rates have increased in the U.S. over the past four years → 17.4/100,000 live births in 2018 to 23.8/100,000 in 2020

Hypertensive disorders ranks **sixth** among direct causes of maternal deaths → Most common cause of maternal death is cardiovascular disease

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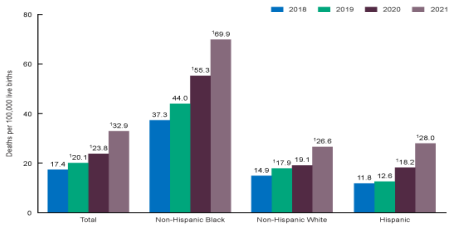
U.S. maternal mortality rates by race and Hispanic origin, 2018-2021[3]

[3]Hoyert DL. Maternal mortality rates in the United States, 2021. NCHS Health E-Stats. 2023. Last reviewed March 21, 2023. https://www.cdc.gov/nchs/data/hestat/maternal-mortality/2021/maternal-mortality-rates-2021.htm?~~~sscr=In%202021%2C%201%2C265%20Hispanic%20died,20.1%20in%202019%20(Table). Accessed July 2, 2023.



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Long-term maternal sequelae of hypertensive disorders of pregnancy[4]

[4]Choudakis E, Oikonomou N, Fousas S, Habalis G, Karatzis AA. Pre-eclampsia emerging as a risk factor of cardiovascular disease in women. *High Blood Press Cardiovasc Prev.* 2021;28(2):103-114.

- Patients with a history of pre-eclampsia have twice the risk of cardiovascular disease in later years than patients who were normotensive
- Patients with a history of pre-eclampsia who delivered at <34 weeks gestational age have an eight to ninefold risk of cardiovascular disease
  - Not due to the pre-eclampsia, but rather due to common risk factors between cardiovascular disease and pre-eclampsia
    - These patients may benefit from yearly H&P, lipids, glucose and BMI

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Fetal sequelae of hypertensive disorders

- Prematurity
- Intrauterine growth restriction (IUGR)
  - Fetal weight at or <10%ile (by estimated fetal weight) at current gestational age based on ultrasonographic measurement of:
    - Head circumference
    - Biparietal diameter
    - Abdominal circumference
    - Femur length

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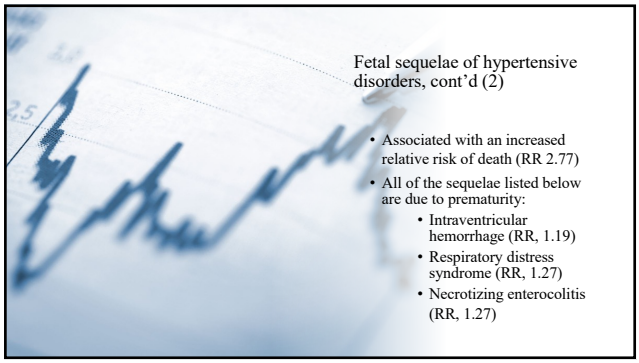

Fetal sequelae of hypertensive disorders, cont'd (2)

- Associated with an increased relative risk of death (RR 2.77)
- All of the sequelae listed below are due to prematurity:
  - Intraventricular hemorrhage (RR, 1.19)
  - Respiratory distress syndrome (RR, 1.27)
  - Necrotizing enterocolitis (RR, 1.27)

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The hypertensive disorders of pregnancy

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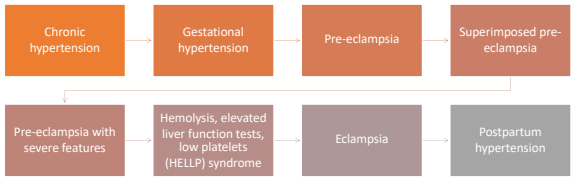
The hypertensive disorders of pregnancy



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Chronic hypertension

- Affects about 3-5% of all pregnancies
- Presents prior to conception up to 20 weeks gestational age
- Blood pressure of >140/90 mm Hg on 2 separate occasions at least 4 hours apart
- Associated with
  - Increased risk of pre-eclampsia in this pregnancy (superimposed pre-eclampsia)
  - Cesarean section
  - Preterm delivery
  - Low birth weight
  - Neonatal ICU admission

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Gestational hypertension

- Affects 1-4% of all pregnancies
- Occurs **after** 20 weeks gestational age
- Blood pressure of >140/90 mm Hg on 2 separate occasions at least 4 hours apart
- Requires close monitoring of blood pressure

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Pre-eclampsia and related disorders

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Pre-eclampsia[1]

[1]Sahai E.A.J. "Hypertensive disorders of pregnancy." In: Watkins E. ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- Occurs at or after 20 weeks GA
- Blood pressure of 140/90 mm Hg or higher on 2 separate occasions at least 4 hours apart after 20 weeks gestation in patients who were previously normotensive, **with at least one of the following:**
  - New onset proteinuria
  - Thrombocytopenia
  - Elevated transaminases
  - Renal insufficiency
  - Pulmonary edema
  - Cerebral symptoms

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Risk factors for pre-eclampsia[5]

[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222. Gestational hypertension and pre-eclampsia. Washington, D.C.: ACOG, 2020. Reaffirmed 2023.

- Chronic hypertension
- Diabetes mellitus (pregestational or gestational)
- History of thrombophilia
- Multifetal gestation
- Nulliparity
- Prior history of pre-eclampsia

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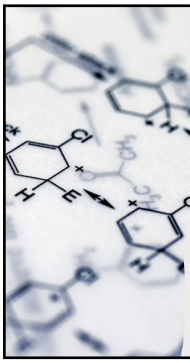

Risk factors for pre-eclampsia, cont'd (2)[5]

[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222. Gestational hypertension and pre-eclampsia. Washington, D.C.: ACOG, 2020.

- Advanced maternal age (>35 yo)
- History of antiphospholipid antibody syndrome
- History of conception via in vitro fertilization
- History of obstructive sleep apnea
- Prepregnancy obesity
- Renal disease
- Systemic lupus erythematosus

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Pathophysiology of pre-eclampsia[6]

[6]Burton GJ, Redman CW, Roberts JM, Moffett A. Pre-eclampsia: pathophysiology and clinical implications. *BMJ* 2019;366:l2381.

- We may subdivide this disorder in those that present before 34 weeks EGA and those that occur after 34 weeks EGA
- **Early-onset pre-eclampsia** tends to be associated with placental abnormality
  - Cytotrophoblasts normally migrate into the spiral arteries; this increases blood flow, but in these patients the cytotrophoblasts invade the spiral arteries, narrowing them and leading to placental ischemia, hypoxia, and pre-eclampsia
- There is also an association between placenta accreta spectrum and retained placenta with pre-eclampsia

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Pathophysiology of pre-eclampsia, cont'd (2)[6]

[6]Burton GJ, Redman CW, Roberts JM, Moffett A. Pre-eclampsia: pathophysiology and clinical implications. *BMJ* 2019;366:l2381.

- **Late-onset pre-eclampsia** tends to be associated with obesity and primiparity
- Other factors include:
  - In vitro fertilization
  - Donor oocyte
  - Autologous frozen embryo transfers
  - Maternal immune response to paternally derived antigens

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Laboratory results that define pre-eclampsia[1]

[1]Salner EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- Proteinuria
  - May be defined as any of the following:
    - 300 mg proteinuria or higher in 24 hour urine collection
    - Protein/creatinine ratio of 0.3 or higher
    - Creatinine >1 mg/dL
    - Urine dipstick of 1+ protein or higher
      - Use this method only if no other method is available
- Thrombocytopenia
  - Platelet count <100,000/mcl
- Transaminase abnormalities
  - Elevated (at least double the upper limit of normal) transaminases with or without RUQ or epigastric pain

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Signs and symptoms of pre-eclampsia[1]

[1]Salner EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- Central nervous system
  - Headache
  - Blurred vision
  - Scotomata
- Pulmonary edema

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Pre-eclampsia with severe features[1]

[1]Salzer EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- Systolic BP of ≥160 mm Hg **and/or** diastolic BP of ≥110 mm Hg on 2 separate occasions 4 hours apart while at rest **with at least one of the following:**
  - New onset proteinuria
  - Thrombocytopenia
  - Elevated transaminases
  - Persistent severe RUQ or epigastric tenderness
  - Renal insufficiency
  - Pulmonary edema
  - Cerebral symptoms
    - Persistent headache or visual changes

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Hemolysis, elevated liver function tests, and low platelets (HELLP) syndrome[1]

[1]Salzer EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

Affects <1% of all pregnancies

Associated with pre-eclampsia, but up to 20% of all patients do not have a history of HTN or of pre-eclampsia at diagnosis

However, 20% of patients with pre-eclampsia will develop HELLP

All patients with HELLP should be presumed to have pre-eclampsia

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Symptoms and signs of HELLP syndrome[1]

[1]Salzer EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- Epigastric or RUQ pain
- Headache
- Visual changes
- Nausea and vomiting
- **However, the syndrome is defined by presence of thrombocytopenia, hemolysis, and elevated transaminases**

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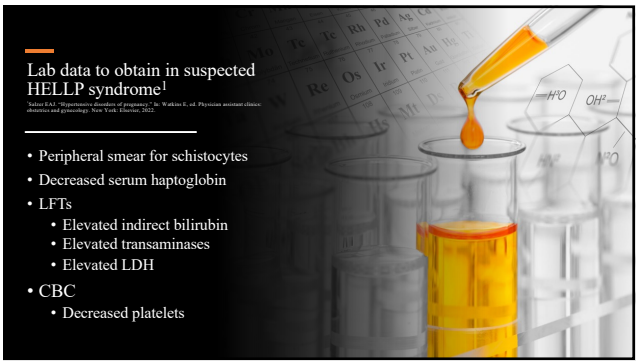
Lab data to obtain in suspected HELLP syndrome[1]

[1]Salzer EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- Peripheral smear for schistocytes
- Decreased serum haptoglobin
- LFTs
  - Elevated indirect bilirubin
  - Elevated transaminases
  - Elevated LDH
- CBC
  - Decreased platelets



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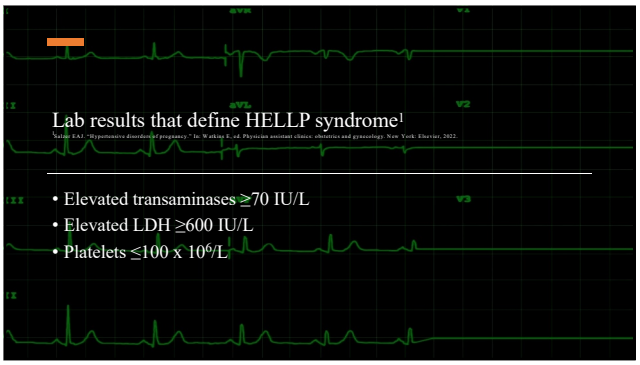
Lab results that define HELLP syndrome[1]
[1]Salzer EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.
• Elevated transaminases ≥70 IU/L
• Elevated LDH ≥600 IU/L
• Platelets ≤100 x 10⁶/L

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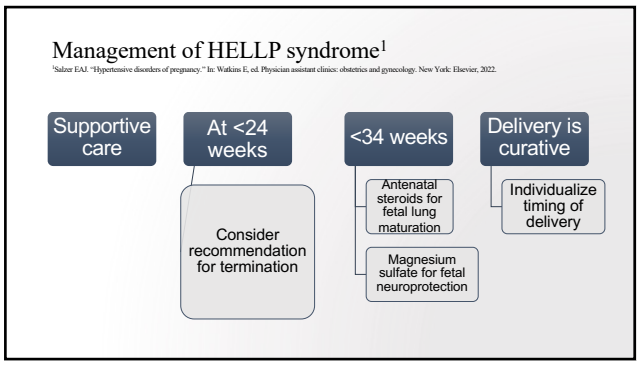
Management of HELLP syndrome[1]
[1]Salzer EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.
Supportive care
At <24 weeks
Consider recommendation for termination
<34 weeks
Antenatal steroids for fetal lung maturation
Magnesium sulfate for fetal neuroprotection
Delivery is curative
Individualize timing of delivery

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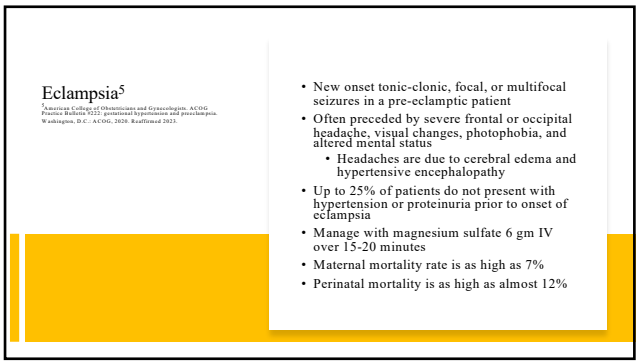
Eclampsia[5]
[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin 9222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG, 2020. Reaffirmed 2023.
• New onset tonic-clonic, focal, or multifocal seizures in a pre-eclamptic patient
• Often preceded by severe frontal or occipital headache, visual changes, photophobia, and altered mental status
• Headaches are due to cerebral edema and hypertensive encephalopathy
• Up to 25% of patients do not present with hypertension or proteinuria prior to onset of eclampsia
• Manage with magnesium sulfate 6 gm IV over 15-20 minutes
• Maternal mortality rate is as high as 7%
• Perinatal mortality is as high as almost 12%

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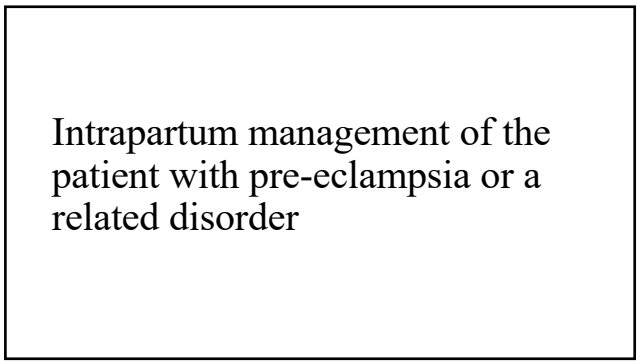
Intrapartum management of the patient with pre-eclampsia or a related disorder

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"The only two questions to answer in obstetrics are when to deliver, and how to deliver."

-Irwin Merkatz, M.D.

Chairman emeritus, Department of Obstetrics and Gynecology

Albert Einstein College of Medicine and Montefiore Medical Center

Bronx, NY

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The treatment of pre-eclampsia and related disorders is

DELIVERY

But other things may have to be done to manage the disease before delivery!

- Manage hypertension
- Possible induction of labor
- Prophylaxis to reduce risk of eclampsia

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Evaluation of the antepartum patient with suspected or known pre-eclampsia and related disorders[1]

[1]Salzer E.A.J. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- History
  - Inquire about
    - Headache, blurred vision, scotomata, dyspnea, epigastric or RUQ pain
    - Vaginal bleeding, painful contractions, fetal movement
- Laboratory data
  - CBC
  - Transaminases
  - BUN/creatinine
  - 24 hour urine or elevated protein/creatinine ratio
  - Coagulation profile
  - Liver function tests
  - Lactate dehydrogenase

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Evaluation of the antepartum patient with pre-eclampsia and related disorders, cont'd (2)[1]

[1]Salzer E.A.J. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.

- Fetal surveillance
  - External fetal heart monitoring
  - Ultrasound
    - Measurement of estimated fetal weight (normal: >10%ile for gestational age)
    - Amniotic fluid index (normal: 5-25 cm)
    - Biophysical profile (normal: 8-10/10)
      - Evaluates fetus via real time sonography for: fetal breathing movements, amniotic fluid index, gross fetal movements, fetal tone, and nonstress test

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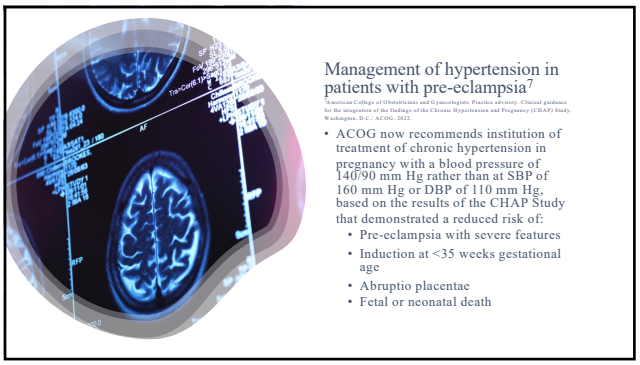

Management of hypertension in patients with pre-eclampsia[7]

[7]American College of Obstetricians and Gynecologists. Practice advisory. Clinical guidance for the integration of the findings of the Chronic Hypertension and Pregnancy (CHAP) Study. Washington, D.C.: ACOG, 2022.

- ACOG now recommends institution of treatment of chronic hypertension in pregnancy with a blood pressure of 140/90 mm Hg rather than at SBP of 160 mm Hg or DBP of 110 mm Hg, based on the results of the CHAP Study that demonstrated a reduced risk of:
  - Pre-eclampsia with severe features
  - Induction at <35 weeks gestational age
  - Abruptio placentae
  - Fetal or neonatal death

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When to deliver with pre-eclampsia and related disorders: **maternal** indications[1,5]

[1]Salice EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier; 2022.
[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG, 2020. Reaffirmed 2023.

- Any of the following:
  - Uncontrolled severe range BPs not responsive to medication
  - Persistent headache with no response to medication
  - Right upper quadrant or epigastric pain with no response to pain medication
  - Visual or motor deficit
  - Cerebrovascular accident
  - Myocardial infarction
  - Liver and/or renal disturbances
  - Pulmonary edema
  - Seizure
  - Suspected abruptio placentae

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When to deliver with pre-eclampsia and related disorders: **fetal** indications[1,5]

[1]Salice EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier; 2022.
[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG, 2020. Reaffirmed 2023.

- Any of the following:
  - Abnormal electronic fetal testing
  - Fetal death
  - Previable fetus
  - Fetus not expected to survive
  - Persistent reversed end-diastolic flow in umbilical artery

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Magnesium sulfate[5]

[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG, 2020. Reaffirmed 2023.

- Used to reduce the risk of eclampsia
- Mechanism of action: decreased cerebral edema
- Will not lower blood pressure
- Loading dose: 4 gm IV x 1 dose; then 1-2 gm IV infusion/hr
- Continue until the patient is 24 hrs postpartum
- Pre-eclampsia with severe features who are **not** treated with magnesium sulfate have a rate of seizure 400% higher than those with pre-eclampsia without severe features

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Case: initial evaluation

- BP upon presentation to Labor & Delivery: 180/118 mm Hg
- HR: 120/min
- Fetal heart rate 170/min with abnormal pattern noted
- Contractions every 1-2 minutes
- Pelvic exam: speculum exam reveals some dark red blood and clots in the vaginal vault
- Cervical exam: 1 cm dilated, 50% effaced, presenting part -4 station

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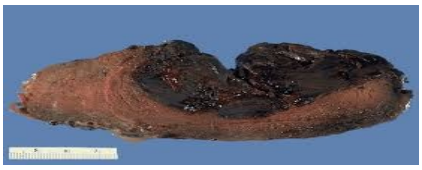
Retroplacental hematoma seen in abruptio placentae



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Management of pre-eclampsia with severe range blood pressures: manage hypertension[1,5]

[1] Sattar AAJ. "Hypertensive disorders of pregnancy." In: Watkins K, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier; 2022.
[5] American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG; 2020. Reaffirmed 2023.

- Treat for systolic BP of 160 mm Hg or higher and/or diastolic BP of 110 mm Hg or higher (severe range BPs) if persistent for 15 minutes or longer to avoid sequelae of severe hypertension
- Reassess BP every 10 minutes
- Administer labetalol 20 mg IVP, then 40 mg, then 80 mg every 10 minutes if the patient continues to have severe range pressures
  - Maximum dose: 220 mg over 24 hours
  - Never use labetalol in asthmatic patients

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Management of pre-eclampsia with severe range blood pressures: manage hypertension, cont'd (2)[1,5]

[1] Sattar AAJ. "Hypertensive disorders of pregnancy." In: Watkins K, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier; 2022.
[5] American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG; 2020. Reaffirmed 2023.

- If the patient continues to have severe range pressures after maximal doses of labetalol, administer hydralazine 10 mg IVP, then repeat as needed in 10 and 20 minutes, respectively
- If the patient continues to have severe range pressures, consult:
  - Intensivist
  - Maternal fetal medicine specialist
  - Anesthesia team

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Case: repeat BP and lab data

- Repeat BP: 173/112 mm Hg
- Lab data:
  - Protein/creatinine ratio: 0.81
  - Creatinine=1.2 mg/dL
  - AST/ALT 98/122 U/L
  - Platelets 61,000/mcl

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Management of pre-eclampsia with indication for magnesium and delivery[1,5]

[1]Salzer EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.
[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG, 2020. Reaffirmed 2023.

- Magnesium sulfate 4 gm IV bolus followed by IV infusion of 1-2 gm/hr
- Manage BP as needed
- Expeditious delivery (spontaneous NSVD, induction of labor, or Caesarean section, depending on the patient)
- Continue magnesium sulfate infusion for 24 hours postpartum
- Manage blood pressure during postpartum hospitalization (and possibly beyond) with PO nifedipine or labetalol (in non-asthmatic patients)

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Case: assessment

- Intrauterine pregnancy at 37 weeks gestational age
- Advanced maternal age
- Pre-eclampsia with severe features
- Abnormal fetal monitoring
- Suspected abruptio placentae
- Remote from delivery

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Case: plan

- Admit
- Labetalol 20 mg IVP now; repeat as needed
- Stabilize with labetalol and/or hydralazine
- Magnesium sulfate 4 gm IV loading dose followed by 1-2 gm IV infusion per hr
- Keep NPO
- To OR for stat C/S when the patient is stabilized
  - C/S indicated because the patient is remote from delivery with abnormal fetal heart rate pattern AND with suspected abruptio placentae

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Case: findings at Caesarean section

- Live male fetus
- 70% placental abruption
- Birth weight: 2500 gm (3%ile)
- Couvelaire uterus
- Estimated blood loss: 1200 cc

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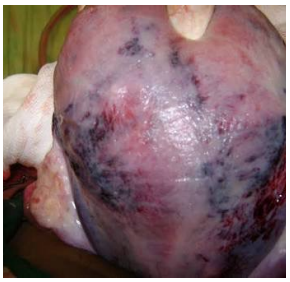
Couvelaire uterus seen in abruptio placentae



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Case: postpartum course

- Magnesium sulfate continued x 24 hours postpartum
- The patient developed oliguria (urine output: 20-30 cc/hr), followed by significant diuresis (200-250 cc/hr)
- Blood pressures ranged from 150-155/88-97 mm Hg
  - Nifedipine XL 30 mg PO daily begun with BPs of 133-138/83-87 mm Hg

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Case: postpartum course, cont'd (2)

- The patient denied headache, visual changes or epigastric or right upper quadrant pain
- Discharged home on postoperative day #4 on nifedipine XL 30 mg PO daily, oxycodone/acetaminophen, docusate
- Follow-up in office within 1 week of discharge for blood pressure and wound check

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Management of patients with hypertensive disorders of pregnancy at time of discharge from postpartum unit[1,5]

[1]Salzer EAJ. "Hypertensive disorders of pregnancy." In: Watkins E, ed. Physician assistant clinics: obstetrics and gynecology. New York: Elsevier, 2022.
[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG, 2020. Reaffirmed 2023.

- Rx for antihypertensive, if indicated
- Follow up within 1 week in obstetrician's office for blood pressure check
  - Maternal Early Warning System (MEWS) standard

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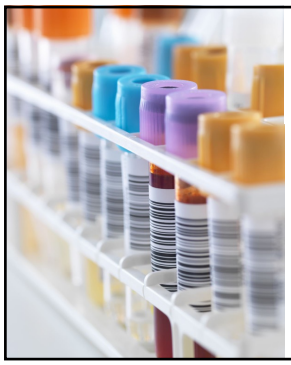

Prevention of pre-eclampsia[5]

[5]American College of Obstetricians and Gynecologists. ACOG Practice Bulletin #222: gestational hypertension and preeclampsia. Washington, D.C.: ACOG, 2020. Reaffirmed 2023.

- Aspirin 80-100 mg PO daily to begin between 12-28 weeks gestational age is indicated in patients with prior history of at least one of the following:
  - Pre-eclampsia
  - Multi-fetal gestation
  - Renal disease
  - Autoimmune disease
  - Diabetes mellitus (type 1 or type 2)
  - Chronic hypertension
  - Black patients (due to sequelae of allostatic load, not biological differences)

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Mitigating risk in the puerperium and beyond

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Risk of cardiovascular disease later in life in patients with a history of HDP[6]

[6]Stuart JJ, Tanz LJ, Cook NR, et al. Hypertensive disorders of pregnancy and maternal cardiovascular disease risk factor development: an observational cohort study. *Ann Intern Med*. 2018;169(4):224-232.

- One study of nearly 10,000 pregnancies found that patients with a history of HDP had an increased risk of:
  - Stroke
  - Coronary artery disease
  - Cardiac arrhythmias
  - Chronic kidney disease
  - Multimorbidity

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Risk of cardiovascular disease in patients with a history of HDP,[7] cont'd (2)

[7]Bellamy L, Duvekot JJ, Roeters van Lennep JE. Future risk of cardiovascular disease risk factors and events in women after a hypertensive disorder of pregnancy. *Heart* 2019;105(16):1271-1278.

A Danish study of 1.5 million pregnancies found that patients with gestational hypertension had the highest risk of chronic hypertension after pregnancy

The risk was 4-10 times that of a patient without a HDP within 1-5 years after pregnancy

Eight years postpartum, 10% of 20-29 year old women with history of HDP had chronic hypertension

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Specific risks of cardiovascular disease due to complications of pregnancy[8]

[8]Parikh NI, Gonzalez JM, Anderson CAM et al. Adverse pregnancy outcomes and cardiovascular disease risk: unique opportunities for cardiovascular disease in women: a scientific statement from the American Heart Association. Circulation 2021;143(18):e902-e916.

Pregnancy outcome	Outcome association
Hypertensive disorders of pregnancy	Increased risk of: atherosclerotic CVD; hemorrhagic stroke; heart failure
Gestational diabetes mellitus	Increased risk of atherosclerotic CVD
Preterm delivery	Increased risk of atherosclerotic CVD
Small for gestational age neonate	Increased risk of atherosclerotic CVD
Large for gestational age neonate	Increased risk of atherosclerotic CVD
Abruptio placentae	Increased risk of atherosclerotic CVD
Pregnancy loss or intrauterine fetal demise	Increased risk of atherosclerotic CVD

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Barriers to postpartum care[8]

[8]Parikh NI, Gonzalez JM, Anderson CAM et al. Adverse pregnancy outcomes and cardiovascular disease risk: unique opportunities for cardiovascular disease in women: a scientific statement from the American Heart Association. Circulation 2021;143(18):e902-e916.

About 40% of patients never go to a postpartum visit

Half of all pregnant Medicaid patients lose insurance 60 days after delivery unless they live in a state that expanded Medicaid under the Affordable Care Act

The US is one of only a few industrialized nations that do not offer paid parental leave

Approximately 25% of postpartum individuals is working again within ***ten days*** after delivery

All of these factors are more likely to affect marginalized patients or those of low economic status

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Potential interventions[8]

[8]Parikh NI, Gonzalez JM, Anderson CAM et al. Adverse pregnancy outcomes and cardiovascular disease risk: unique opportunities for cardiovascular disease in women: a scientific statement from the American Heart Association. Circulation 2021;143(18):e902-e916.

- Preconceptional (interpregnancy) care
  - During pregnancy, ensure patients have a primary care clinician to whom to transfer care in the puerperium
  - Consider multidisciplinary care teams comprised of obstetrical, cardiac, and primary care clinicians
  - For patients with HDP, consider recommending:
    - Monitoring BPs
    - Aspirin in subsequent pregnancies
  - In patients with persistent and/or uncontrolled hypertension, consider additional studies for ventricular hypertrophy, retinopathy, and renal disease
  - Consider use of statins as prophylaxis in patients with a history of gestational diabetes mellitus, pre-eclampsia, preterm birth, or birth of a small for gestational age (SGA) infant

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Potential interventions: the puerperium and beyond[8]

[8]Parikh NI, Gonzalez JM, Anderson CAM et al. Adverse pregnancy outcomes and cardiovascular disease risk: unique opportunities for cardiovascular disease in women: a scientific statement from the American Heart Association. Circulation 2021;143(18):e902-e916.

Lifestyle modifications

- Smoking cessation
- 150 minutes/week of moderate to vigorous intensity aerobic exercise
- Diet rich in fruits, vegetables, fish, legumes, and avoidance of processed and red meats

Support breastfeeding, which is associated with:

- More rapid recuperation from the physiologic changes of pregnancy
- Lower risk of atherosclerosis
- Possible reduction of the risk of hypertension

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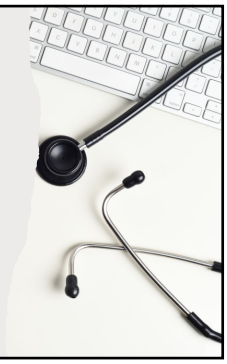
Transition of care[8,9]

[8]Parikh NI, Gonzalez JM, Anderson CAM et al. Adverse pregnancy outcomes and cardiovascular disease risk: unique opportunities for cardiovascular disease in women: a scientific statement from the American Heart Association. *Circulation* 2021;143(18):e902-e916.

[9]Tranquoy A, Coumoreis ME, Cutov JM. Hypertensive disorders of pregnancy and future maternal health: how can the evidence guide postpartum management? *Curr. Hypertens. Rep.* 2020;21(12):96.

- Use alerts in electronic medical records to alert clinicians of the history of HDP from the obstetrical documents
- Primary care clinicians need education about the importance of incorporating the obstetrical history into ongoing primary care
- Health systems need to ensure that such histories are included
  - Various computer algorithms can be used to achieve this goal



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Disparities regarding race[8]

[8]Parikh NI, Gonzalez JM, Anderson CAM et al. Adverse pregnancy outcomes and cardiovascular disease risk: unique opportunities for cardiovascular disease in women: a scientific statement from the American Heart Association. *Circulation* 2021;143(18):e902-e916.

- Black patients are at increased risk of multiple pregnancy complications when compared to White patients, including HDP, gestational diabetes, and pregnancy loss
- Black patients have a nearly 300% increased mortality rate from pre-eclampsia compared to White patients
- These may well be due to disparities in access to care
- However, most research studies about cardiovascular disease and pregnancy include populations comprised of 80-95% White patients
- The Black Women's Health Study may reveal more information about these important matters

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