IOWA | Carver College of Medicine

Iowa Stroke Conference

Maternal Health and Stroke

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Disclosures

- I have no disclosures or conflicts of interest relevant to this presentation.

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Learning Objectives

- ***Discuss care considerations for individual populations across the stroke continuum***
- Introduce a life course approach
- Review the epidemiology and risk factors for stroke in pregnancy and postpartum
- Review physiologic changes during pregnancy
- Describe the evaluation and management of pregnant and postpartum patients by stroke subtype
- Highlight important considerations: labor and delivery, breastfeeding, depression
- Discuss impact of Adverse Pregnancy Outcomes on future risk

Gender is distinct from sex

Sex

- Set of **biological** attributes in humans and animals
- Includes physical and physiological features:
  - Chromosomes
  - Gene expression
  - Hormonal levels and functioning
  - Reproductive and sexual anatomy

Gender

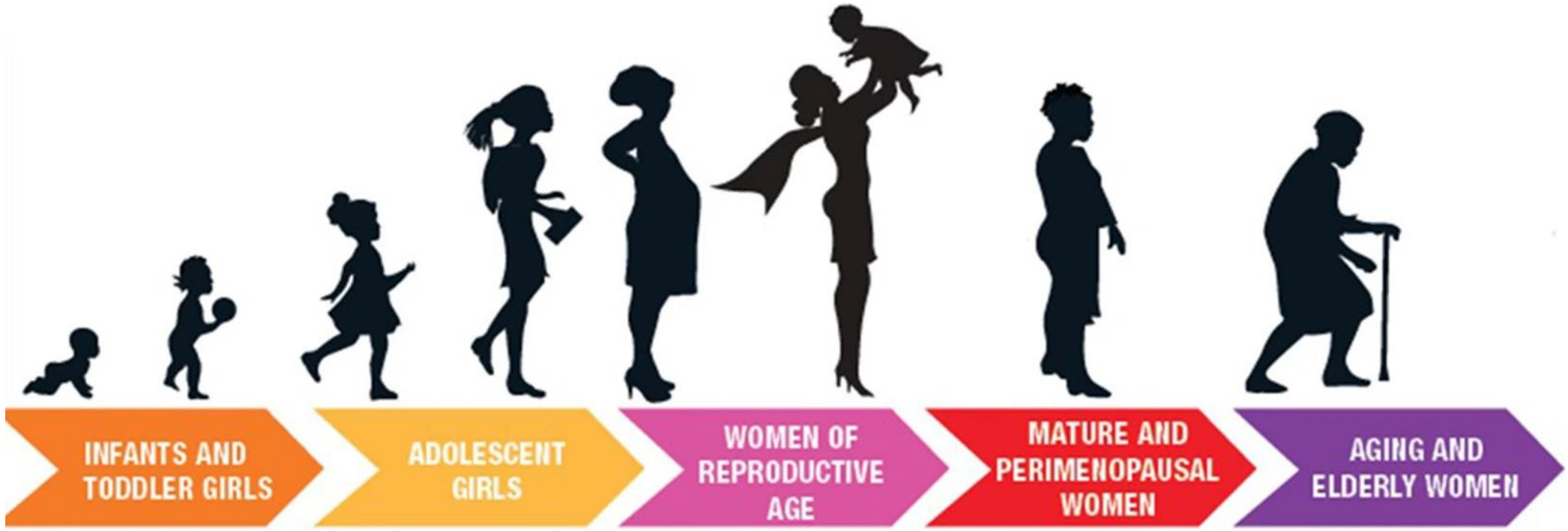
- **Psychosocial Construct**
- Includes a range of characteristics that define masculinity and femininity and is **culture-specific**
- Relates to resources and power, including health care access

- Sex vs gender often not distinguished in literature
- Women, non-binary individuals, and trans men may experience pregnancy
- Data lacking on gender nonconforming individuals

Sex/Gender Differences Affecting Stroke

- Hormonal and Reproductive Health
  - **Pregnancy and Postpartum**
  - Contraceptive Use
  - Hormonal Replacement Therapy
- Immune and Autoimmunity
- Social and Economic Factors
- Others: Migraines, Iron-deficiency Anemia

Life Course Approach to Stroke in Women



Social Determinants of Health

- Menarche
- Hypertensive disorders of pregnancy
- Atrial Fibrillation
- Contraception
- Endometriosis
- Infertility
- Menopausal Hormone Therapy
- Gender-affirming hormone treatment
- Premature Ovarian Failure
- Migraines
- APOs (e.g., preterm birth, pregnancy loss

Figure adapted from Michos, et al. Cardiovascular Health of Black Women Before, during, and After Pregnancy A Call to Action and Implications for Prevention. Current Cardiovascular Risk Reports. 2022.

Maternal Stroke

- Most common cause of serious long-term disability following pregnancy

- **Incidence:** 3x age-matched non-pregnant women
  - Approximately half of maternal stroke is hemorrhagic

- **Timing:**
  - Highest risk in late 3rd trimester, peripartum, and immediate postpartum period
  - Diagnostic Delays Common

Maternal Stroke Risk Factors

Pregnancy-related	Non-pregnancy-related
Hypertensive Disorders of Pregnancy (HDP): HELLP, preeclampsia Gestational Diabetes Assisted Reproductive Technology Cesarean delivery Peripartum Cardiomyopathy Postpartum Cerebral Angiopathy Amniotic Fluid Embolism	**Migraine (with aura)** Tobacco/drug use Cardiac Disease (including PFO) Arterial Dissection Hypercoagulable States (including APLS, SLE) Sickle Cell Disease Moyamoya vasculopathy Genetic Stroke Syndromes Infection Pregestational DM Chronic Hypertension Age Race/Ethnicity

ACOG Definitions of HDP and Preeclampsia

Gestational HTN	New-onset elevated BP after 20wk gestation
Preeclampsia	New-onset HTN at 20+ wk gestation in a woman with baseline normal BP **AND** proteinuria **OR** in absence of proteinuria, new onset of any of the following: • Thrombocytopenia • Renal dysfunction • Liver dysfunction • Pulmonary edema • New-onset unresponsive **headache or visual symptoms** (without alternate explanation)
Preeclampsia superimposed on chronic HTN	New-onset proteinuria **OR** maternal organ dysfunction in woman with chronic HTN
HELLP	LDH>600 AST and ALT> 2x upper limit of normal Platelets <100k
Eclampsia	**New-onset tonic-clonic, focal, or multifocal seizures** in the absence of other causative etiologies

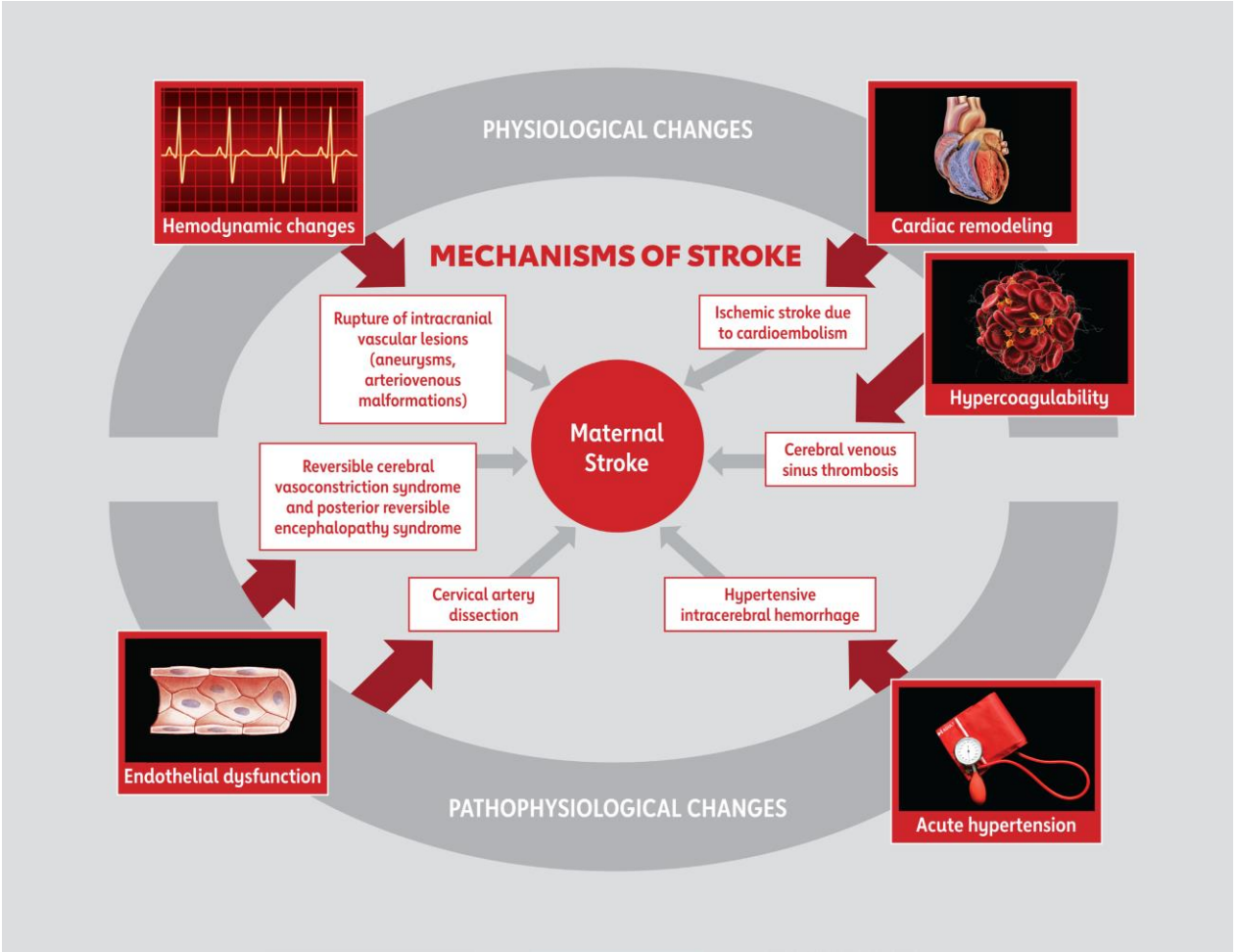
Primary Prevention of Maternal Stroke

Recommendations for Prevention of Pregnancy-Associated Stroke		
COR	**LOE**	**Recommendations**
1	**B-NR**	1. In pregnant or early postpartum (within 6 weeks of delivery), patients with severe hypertension (2 measurements of SBP ≥160 mm Hg or DBP ≥110 mm Hg, 15 minutes apart), BP-lowering treatment to a target <160/110 mm Hg as soon as possible is recommended to reduce the risk of fatal maternal ICH.[551–558]
2a	**C-LD**	2. In patients with HDP, including chronic hypertension in pregnancy, treatment with antihypertensive medication to a goal BP of <140/90 mm Hg is reasonable to reduce the risk of pregnancy-associated stroke.[559–566]

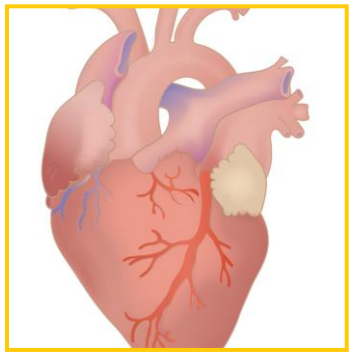
Bushnell, et al. 2024. "Guideline for the Primary Prevention of Stroke: A Guideline from the American Heart Association/American Stroke Association. *Stroke*.

Physiologic Changes During Pregnancy

- Cardiac and Hemodynamic Changes
- Hypercoagulability
- Immunologic and Inflammatory Changes
- Endothelial Dysfunction
- Cerebrovascular and BBB Changes



Maternal Ischemic Stroke Etiologies

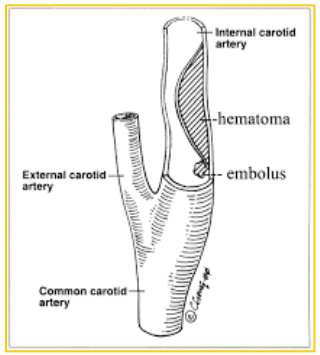


Cardioembolic

Paradoxical Emboli

Preexisting Cardiac Disease

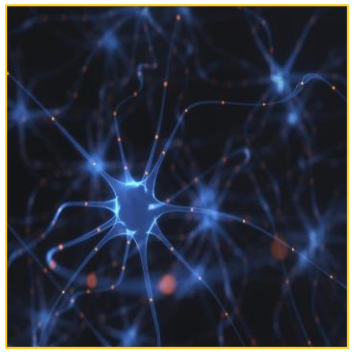
Peripartum Cardiomyopathy



Dissection

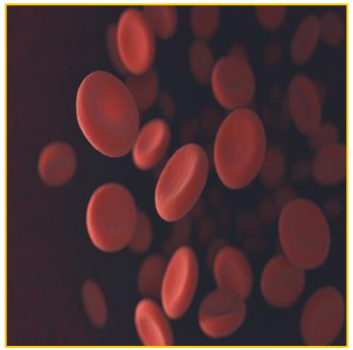
Dissection: 5x increased risk during pregnancy

Classic Large and Small Vessel Etiologies Rare



Vasospasm and RCVS

Post-partum cerebral angiopathy



Hyper-coagulability

Rare Etiologies

Pre-existing: Moyamoya, Sickle Cell, FMD, APLS, etc.

Pregnancy-related: Amniotic fluid embolism, Sheehan syndrome (pituitary infarction), etc.

Stroke Code Approach during Pregnancy

- Start with standard code stroke evaluation (LKW, NIHSS, BP, glucose, etc.)
- Check beta-HCG for all women of childbearing age
- **Call OB colleagues!**
  - May need emergent delivery, magnesium, corticosteroids, antibiotics, etc.
  - Determine gestational age
  - Fetal monitoring

Stroke Code Imaging

- CT Head, CTA, and CT perfusion acceptable to expedite treatment
- If neuro emergency, MRI ONLY if immediately available

Neuro-Imaging Considerations in Pregnancy and Lactation

Radiation

- CT/CTA: fetal radiation dose negligible
- DSA: less data

CT (Iodinated) Contrast

- May use when indicated in pregnancy (theoretical risk of neonatal hypothyroidism)
- Safe in lactation

MRI (Gadolinium) Contrast

- Not recommended in pregnancy
- Safe in lactation

Acute Maternal Stroke Treatment

- Pregnancy/postpartum state are considerations but NOT absolute contraindications to thrombolytics
- Thrombectomy should be performed in pregnant and postpartum patients when indicated
- May need magnesium
- May need emergent delivery
- Pregnant women excluded from major thrombolysis and thrombectomy trials

- **What is good for the mom is good for the baby!**

Thrombolytic Use

- tPA and TNK do **NOT** cross the placenta
- AHA/ASA recommends use of tPA in pregnant patients with disabling deficits when benefits felt to outweigh risk, but use is off-label
- Thrombolytic use in early postpartum period may have increased bleeding risk

- **Always discuss with OB!**

Endovascular Thrombectomy

- Pregnancy and postpartum state is **NOT** a reason to delay nor forgo thrombectomy

- Technical considerations:
  - Intubation difficulty, involve OB anesthesiology
  - Positioning gravid uterus
  - Minimize radiation and contrast
  - Fetal monitoring during procedure

Post-Stroke Management

- Blood Pressure Goals: optimize maternal cerebral perfusion and minimize placental abruption risk
- Etiology Evaluation: similar to stroke in the young
- Secondary Stroke Prevention:
  - Anti-platelets:
    - Aspirin frequently used after 12w gestation in OB patients
    - Other anti-platelets have less evidence
  - Anti-coagulation:
    - LMWH preferred during pregnancy
    - Safety of DOACs unknown
    - Avoid warfarin during pregnancy (may be considered with mechanical heart valve)
  - Statins: avoid in first trimester, insufficient evidence in later pregnancy

Maternal ICH Mechanisms

- **Most often related to Hypertensive Disorders of Pregnancy**
- PRES/eclampsia
- Vascular Anomalies: AVM, aneurysm, cavernous malformations, Moyamoya vasculopathy
- RCVS: often cortical SAH

Maternal ICH Management

- **Team approach:** neurology, critical care, neurosurgery, OB/MFM, and obstetric anesthesiologist, neonatology, etc.
- General Steps:
  - Endovascular and neurosurgical intervention if indicated
  - **Blood pressure management**
  - Reversal of coagulopathy
  - Management of complications: vasospasm, elevated intracranial pressure, hydrocephalus, and seizures
- Pregnancy-specific Considerations:
  - Fetal monitoring
  - May need emergent delivery via C-section
  - Consider magnesium sulfate

ICH Management: Blood Pressure

Medication	During Pregnancy	During Lactation
Labetalol	Safe	Safe
Propranolol, Metoprolol	Alternative drug preferred	Safe
Atenolol	Contraindicated	Not recommended
Long-acting nifedipine	Safe	Safe
Verapamil	Safe	Safe
Clonidine	Safe	Alternative Drug Preferred
Hydralazine	Safe	Safe
Methyldopa	Safe	Safe
ACE	Contraindicated/teratogenic	Varies by individual drug
ARB	Contraindicated/teratogenic	Alternative therapy preferred

- Nimodipine and nicardipine can be used in pregnancy and during lactation if necessary.

Cerebral Venous Sinus Thrombosis

- **Stroke subtype with greatest sex disparity**
- **Pathophysiology:** Thrombus in Cerebral Veins→ Venous Congestion→ Cerebral Edema, Venous Infarct, and/or Hemorrhage
- **Risk Factors:**
  - Dehydration, Infection, Hematologic, Malignant, Autoimmune, Thrombophilia, and other Prothrombotic Conditions
  - Sex-specific risk factors: OCP use, **Pregnancy/postpartum**, HRT
- **Diagnosis:** MRI and MRV w/o contrast in pregnancy and w/wo contrast postpartum

CVST Management

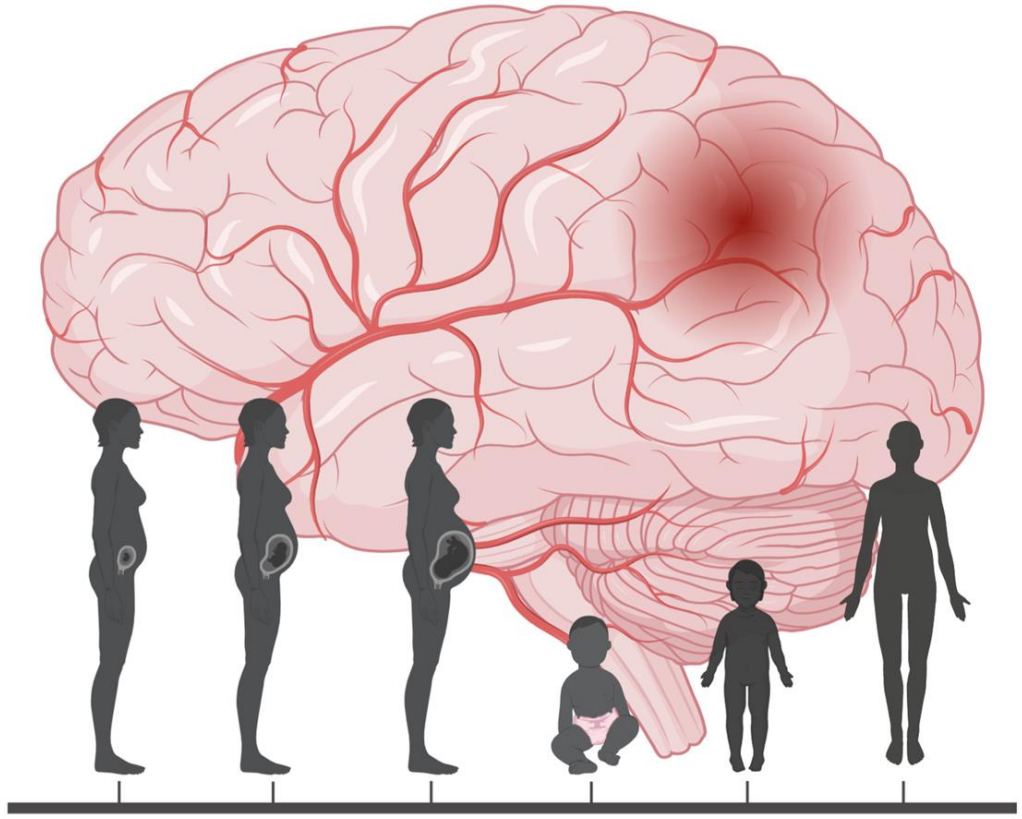
- Anti-coagulation
  - LMWH throughout pregnancy
  - Continue anti-coagulation **at least** 6w post-partum
  - Consider LMWH during future pregnancies and consult with hematology and maternal fetal medicine
  - Avoid warfarin during pregnancy but safe with breastfeeding
- Supportive measures (anti-seizure medications, headache control)
- Address any additional underlying risk factors (infection, cancer, autoimmune condition, OCP use, etc.)

Reversible Cerebral Vasoconstriction Syndrome

- AKA **postpartum cerebral angiopathy**
- Transient, multi-focal, non-vasculitic vasospasm
- **Presentation:** recurrent thunderclap headaches with or without neurological deficits
- **Common triggers:** vasoactive medications/drugs and **peri- and *postpartum state,*** particularly with preeclampsia
- May lead to ischemic stroke, ICH, and/or SAH
- **Diagnosis:** vessel imaging
- **Management:** not well-established (verapamil, magnesium)

Delivery Considerations

- Unstable stroke patients may require an emergent C-section, but not all maternal stroke patients require emergent delivery nor C-section
- Delivery planning should involve neurology and OB teams
- Consider Valsalva maneuvers and if intracranial pressure is a concern
- Consider current anti-thrombotic use and bleeding risk



Breastfeeding and Stroke

- Post-stroke Breastfeeding
  - PT, OT, rehab medicine, and lactation consultant may assist with breastfeeding adaptations
  - Pumping may be an option
  - High nutrition and hydration requirements
- No need to interrupt breastfeeding with iodinated nor gadolinium-based contrast
- Consider lactation status in medication selection
  - Drugs and Lactation Database: **LactMed @NIH**
- Among all women, breastfeeding reduces risk of future stroke

Postpartum and Post-stroke Depression

- Postpartum depression and post-stroke depression both have high incidence
- Screening for all patients
- Early involvement of psychiatry for patients with signs/symptoms of mood disorders and other mental health concerns

Future Pregnancies

Previous History	Prevention Strategy
(Pre)eclampsia	• Low-dose Aspirin starting after 12w gestation • Consider calcium supplementation
CVST	• Consider LMWH during pregnancy and puerperium
Ischemic Strokes	• Depends on mechanism. Antiplatelet or anticoagulation in most cases. Avoid teratogenic medications.
Hemorrhagic Strokes	• Optimize blood pressure control. • Consider treatment of untreated aneurysms/AVMs before future pregnancy.

Santos and de Sousa. “Cerebrovascular disease in pregnancy and postpartum. *Current Opinion in Neurology*. 2022.

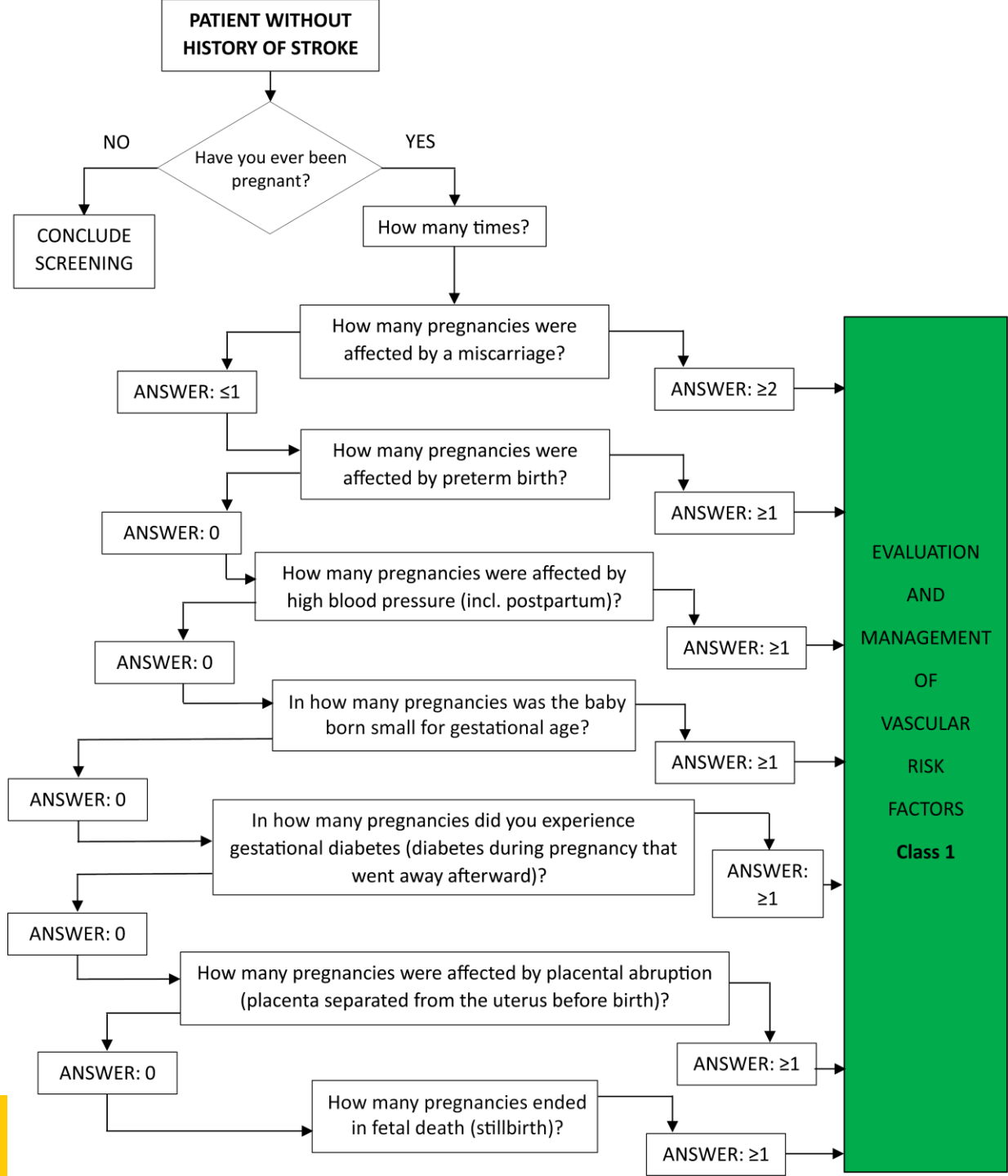
History of Adverse Pregnancy Outcomes

- HDP significantly increases risk of future stroke
- Close management of cardiovascular risk factors (HTN, tobacco use, dyslipidemia, etc.)
- Consider aspirin for primary prophylaxis with history of preeclampsia
- Obstetric history and APO are important considerations in women presenting with neurological symptoms

Screening with APOs

Recommendations for Pregnancy and Long-Term Stroke Risk

COR	LOE	Recommendations
Screening intervention		
1	C-EO	1. In adults, screening for a history of certain adverse pregnancy outcomes (APOs), including HDP, preterm birth, gestational diabetes, and placental disorders, followed by subsequent evaluation and management of vascular risk factors, is recommended to reduce the risk of stroke.
Other intervention		
1	C-LD	2. In patients with a history of HDP or other APOs, early evaluation and management of chronic hypertension are recommended to reduce the risk of stroke.[609–613]



Take Home Messages

Maternal health is crucial for fetal and infant health!

Call OB!

Screen and treat Hypertensive Disorders of Pregnancy

Special Considerations:

Neuro-Imaging

Medication Selection

Delivery Planning

Lactation

Mental Health

Iowa Stroke Conference

Thank you

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