Anesthetic Management in Complicated Obstetrics

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Outline

- Hypertensive disorders of pregnancy
- Abnormal fetal positions, shoulder dystocia, and multiple gestation
- Preterm labor and delivery
- Obstetric hemorrhage

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Hypertensive disorders of pregnancy

Incidence 10% pregnancies

classified into 4 types

1. Preeclampsia-eclampsia
2. Chronic hypertension
3. Chronic hypertension with superimposed preeclampsia
4. Gestational hypertension

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1.Preeclampsia

defined as

- Gestational hypertension

  +

- Proteinuria

developing after GA 20 weeks

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2.Chronic hypertension

defined as

- hypertension before pregnancy, if
- hypertension is present prior to GA 20 weeks, or if
- persists longer than 6 weeks after delivery

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3.Superimposed preeclampsia

defined as

- Exacerbation of hypertension

  +

- new onset of proteinuria

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4.Gestational hypertension

defined as

- elevation of blood pressure during the second half of pregnancy

  or

- in the first 24 hours postpartum,
- without proteinuria and without symptoms

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Classification of Hypertensive Disorders of Pregnancy

1. **Gestational hypertension**[a]
   - Mild
     - Systolic BP ≥140–160 mm Hg
     - Diastolic BP ≥90–110 mm Hg
   - Severe
     - Systolic BP ≥160 mm Hg
     - Diastolic BP ≥110 mm Hg
2. **Preeclampsia** (Hypertension and proteinuria, onset >20 weeks)
   - Mild preeclampsia
     - Systolic BP ≥140–160 mm Hg, OR
     - Diastolic BP ≥90–110 mm Hg
     - Mild proteinuria ≥1+ on dipstick and <5 g/24 h[b]
   - Severe preeclampsia
     - (A) Severe hypertension and severe proteinuria
       - Systolic BP ≥160 mm Hg, OR
       - Diastolic BP ≥110 mm Hg
       - Severe proteinuria ≥5 g/24 h[b]
     - (B) Mild hypertension (defined above) with severe proteinuria (defined above)
     - (C) Preeclampsia plus oliguria, cerebral/visual disturbances, pulmonary edema, right upper quadrant pain, thrombocytopenia, impaired liver function, IUGR
3. **Chronic hypertension**
4. **Chronic hypertension with superimposed preeclampsia**

Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

Criteria for Preeclampsia

Blood Pressure

- **Systolic ≥ 140 mm Hg or Diastolic ≥ 90 mm Hg** on 2 occasions at least 4 hours apart after GA 20 weeks in a patient with a previously normal arterial blood pressure
- **Systolic ≥ 160 mm Hg or Diastolic ≥ 110 mm Hg** , hypertension can be confirmed within a short interval (minutes) to facilitate timely antihypertensive therapy

AND

- **Urine protein 24-hour ≥ 300 mg** (or this amount extrapolated from a timed collection)

OR

- **Protein/creatinine ratio ≥ 0.3 mg/dL**
- Dipstick reading of 1+

OR IN THE ABSENCE OF PROTEINURIA, NEW-ONSET HYPERTENSION WITH NEW ONSET OF ANY OF THE FOLLOWING:

- **Thrombocytopenia**: platelet count < 100,000/μL
- **Renal insufficiency**: serum creatinine concentrations > 1.1 mg/dL or doubling of serum creatinine concentration in absence of other renal disease
- **Impaired liver function**: elevated liver transaminases to twice normal concentration
- **Cerebral or visual disturbances**
- **Pulmonary edema or cyanosis**

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Criteria for Preeclampsia With Severe Features

Systolic ≥ 160 mm Hg or Diastolic ≥ 110 mm Hg on two occasions at least 4 hours apart while the patient is on bed rest (unless antihypertensive therapy is initiated before this time)

Thrombocytopenia (platelet count < 100,000/μL)

Impaired liver function as indicated by
- abnormally elevated blood concentrations of liver enzymes (to twice normal concentration)
- severe persistent right upper quadrant or epigastric pain unresponsive to medication and not accounted for by alternative diagnoses
- or both

Progressive renal insufficiency (serum creatinine concentration > 1.1 mg/dL or a doubling of the serum creatinine concentration in the absence of other renal disease)

Pulmonary edema

New-onset cerebral or visual disturbances

HELLP syndrome

- Hemolysis
- Elevated Liver enzymes
- Low Platelet count

Eclampsia (presence of seizures)

- 10%-15% of eclamptics, symptoms of preeclampsia were not previously detected

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Criteria for HELLP Syndrome

Hemolysis
Elevated liver enzymes
Low platelets

- Abnormal peripheral smear
- Total bilirubin ≥1.2 mg/dL
- Reduced serum haptoglobin
- Serum AST >70 U/L
- Lactate dehydrogenase 2× upper limit of normal
- <100,000/mm^3

Hypertensive disorders of pregnancy | Abnormal fetal positions, shoulder dystocia & multiple gestation | Preterm labor and delivery | Obstetric hemorrhage

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Differential Diagnosis of HELLP Syndrome

	HELLP	TTP/HUS	AFLP
Ammonia	Normal	Normal	Elevated
Anemia	±	Severe	Normal
Antithrombin III	±	Normal	Decreased
AST	Elevated	Normal	Elevated
Bilirubin	Elevated, mostly indirect	Elevated	Elevated, mostly direct
Creatinine	±	Significantly elevated	Significantly elevated
Fibrinogen	Normal	Normal	Decreased in all cases
Glucose	Normal	Normal	Decreased
Hypertension	Present	±	±
LDH	Elevated	Significantly elevated	Elevated
Proteinuria	Present	±	±
Thrombocytopenia	Present	Severe	±

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Management of HELLP Syndrome

- maternal & fetal assessment
- control of severe hypertension
- Initiation of magnesium sulfate infusion
- correction of coagulopathy
- maternal stabilization

Immediate delivery if GA $\geq$ 34 weeks

GA < 34 weeks without proven lung maturity
→ IV corticosteroids & delivery planned in 48 hours

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Preeclampsia

Etiology

- imbalance in placental production of prostacyclin & thromboxane ⇑
- inhibition of the normal trophoblastic migration of placental arterioles during the second trimester
- ***Abnormal angiogenesis*** imbalance between proangiogenic factors (vascular endothelial growth factor [VEGF]) & antiangiogenic factors (soluble fms–like tyrosine kinase 1 [sFlt-1])
- increased sensitivity to angiotensin II → result of autoantibodies to angiotensin AT-1 receptor

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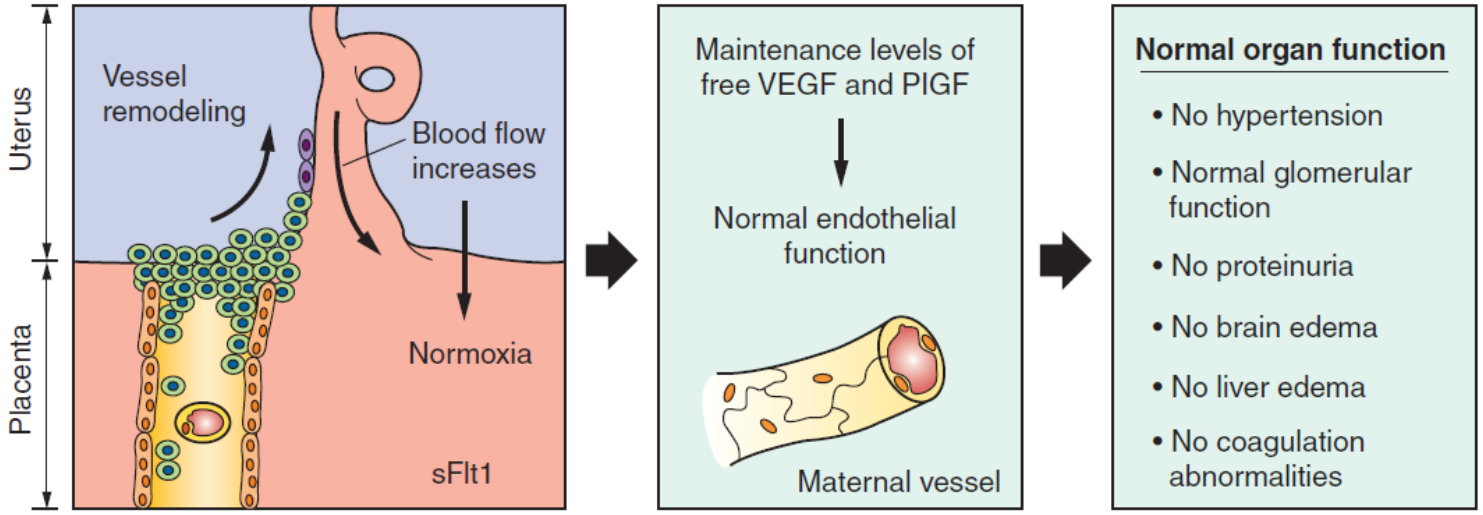
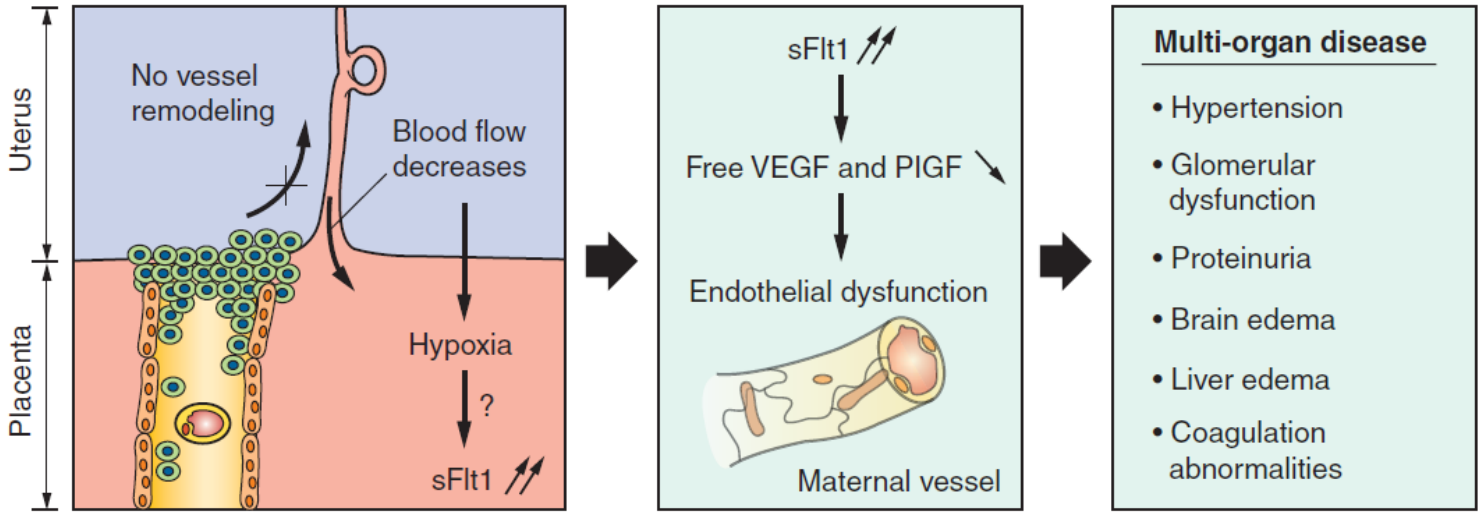


A. Normal pregnancy

Abnormal angiogenesis



B. Preeclampsia

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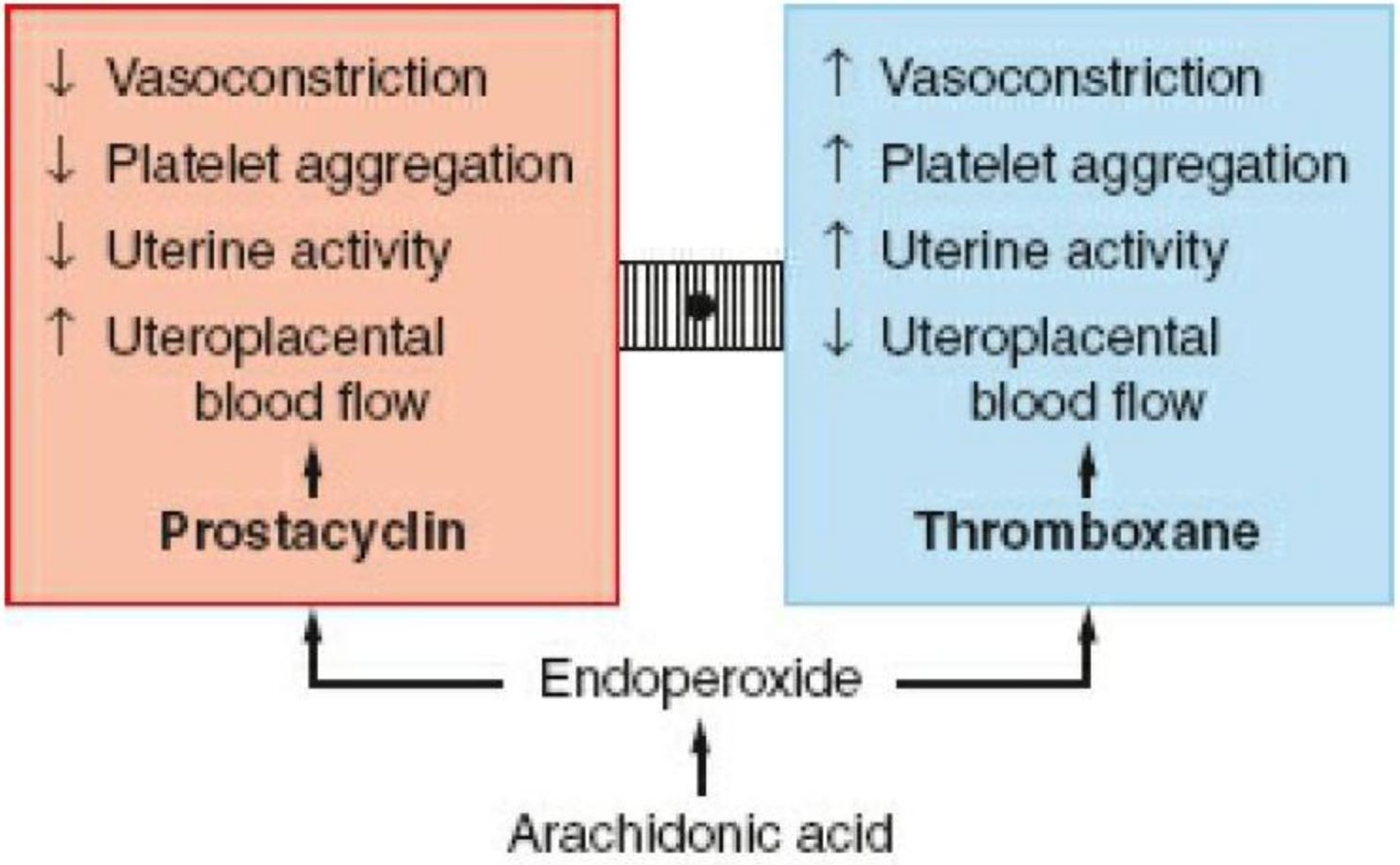
Normal pregnancy



Hypertensive disorders of pregnancy

Abnormal fetal positions, shoulder dystocia & multiple gestation

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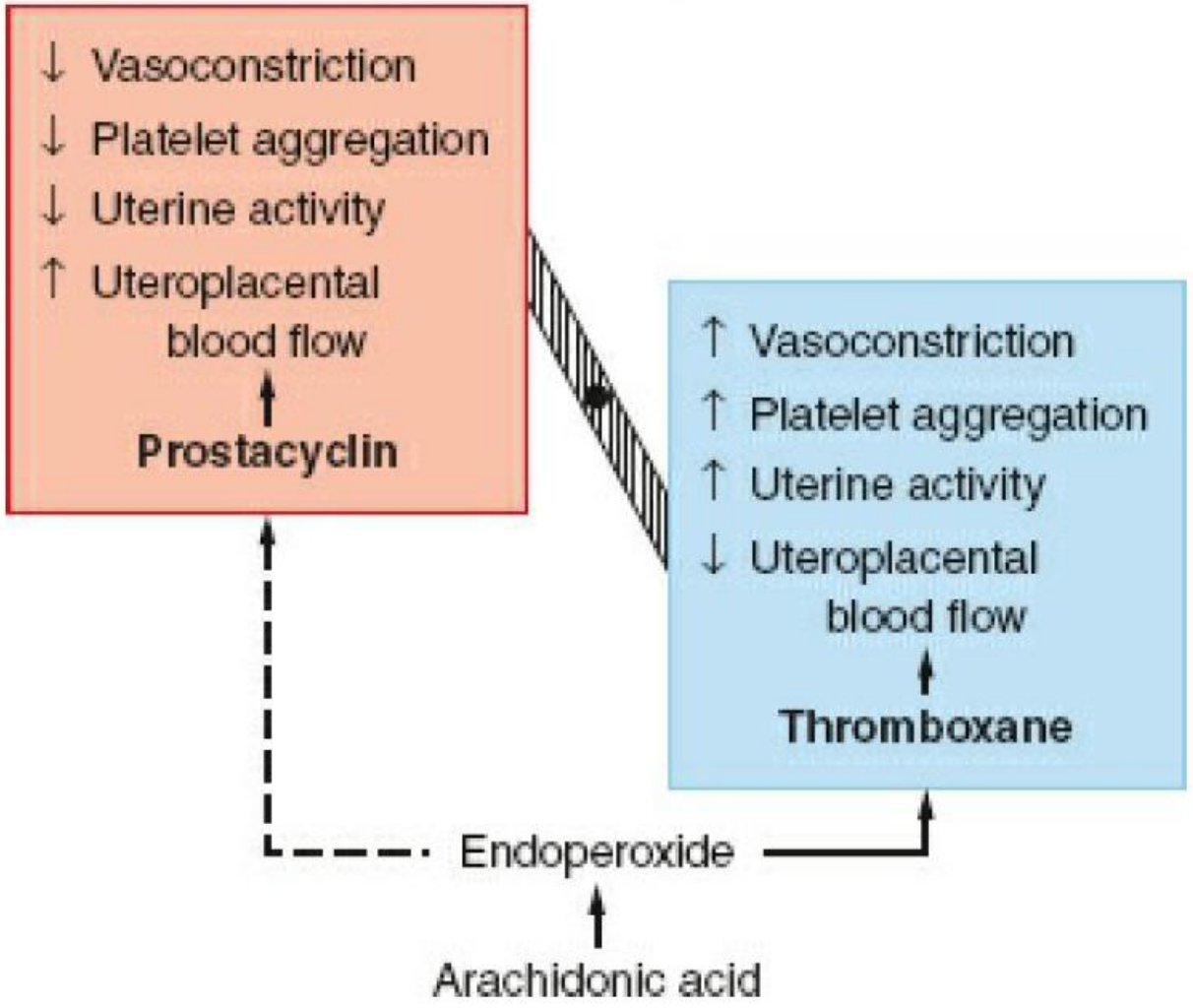
Preeclampsia



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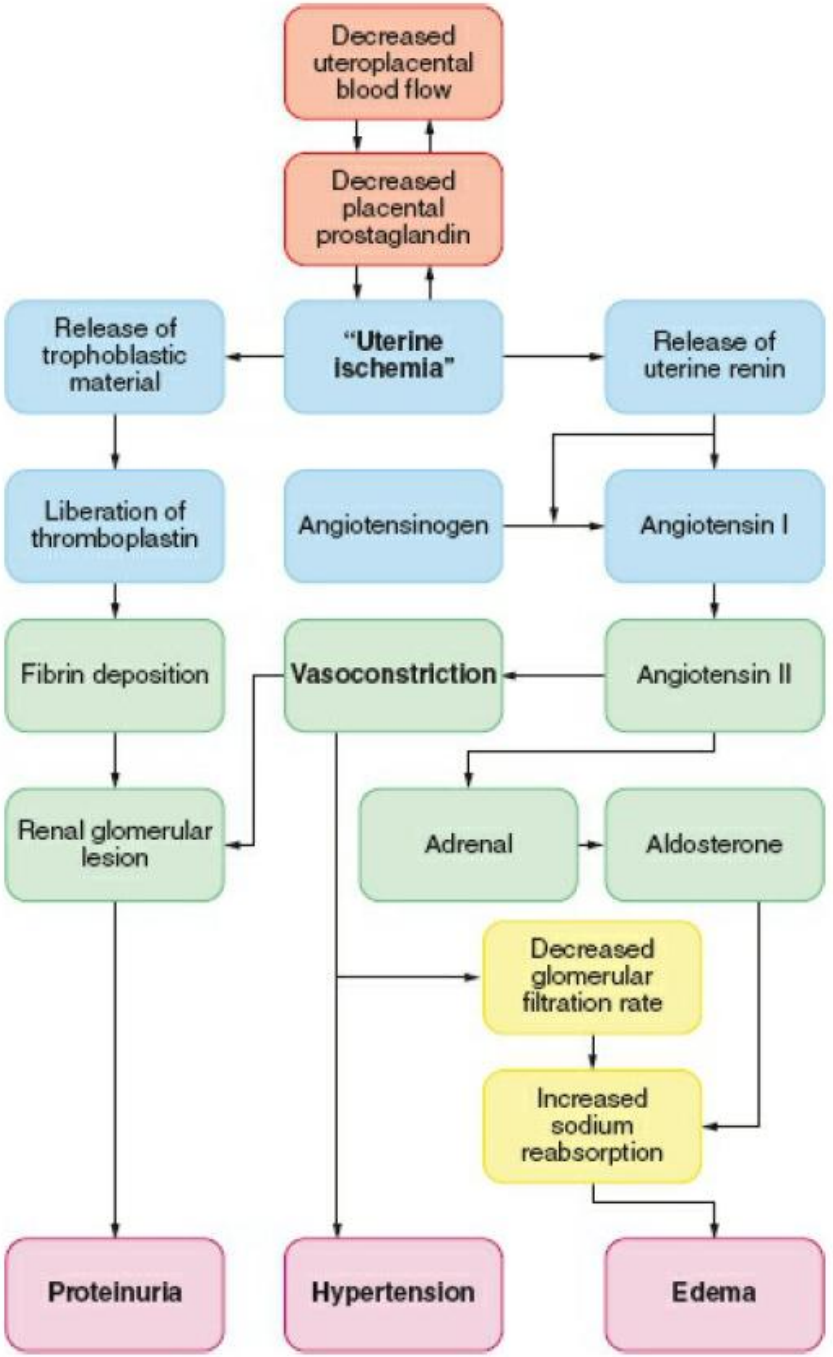
Preeclampsia



Hypertensive disorders of pregnancy

Abnormal fetal positions shoulder dystocia & multiple gestation

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EPIDEMIOLOGY AND RISK FACTORS

- incidence ~3%-10% of all pregnancies

Risk factors

- Preconceptional Factors
- Partner-related factors
- Pregnancy-related Factors

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RISK FACTORS

Risk Factors	% Risks
Preconceptional Factors	
Chronic hypertension/renal disease	15–40
Pregestational diabetes mellitus	10–35
Connective tissue diseases	10–20
Thrombophilia	10–40
Obesity/insulin resistance	10–15
Older age >40 yr	10–20
Family history of preeclampsia	10–15
Woman born as small for gestational age one- to five-fold	
Adverse outcome in a previous pregnancy two- to three-fold	
Partner-related Factors	
Limited sperm exposure	10–35
(Donor insemination, oocyte donation)	
Partner who fathered preeclamptic-two-fold pregnancy in another woman	
Pregnancy-related Factors	
Hydrops	
Multifetal gestation	
Unexplained fetal growth restriction	
Urinary tract and periodontal infection	

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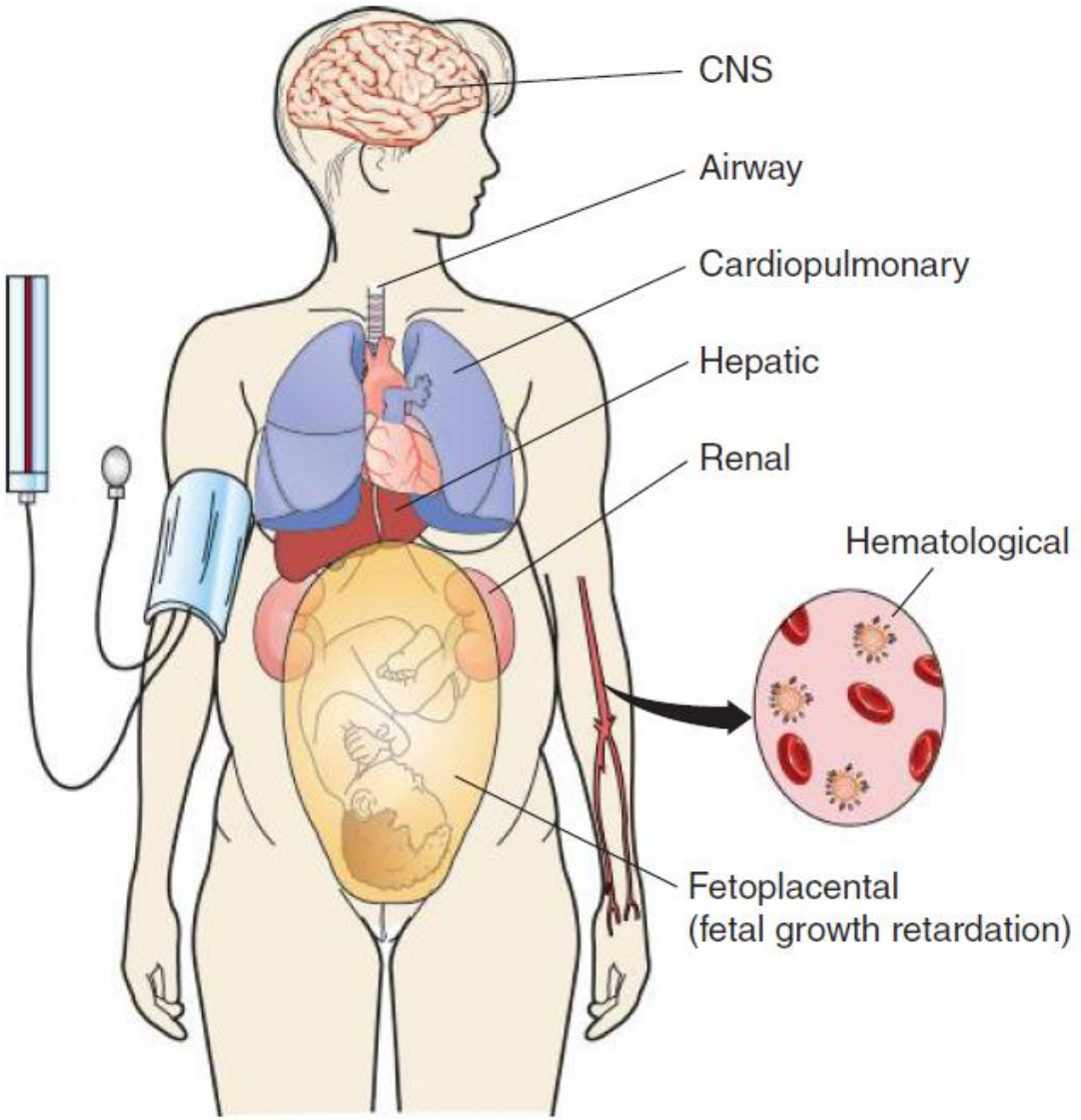
Pathophysiology of Preeclampsia



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Preeclampsia

Symptoms

- placental ischemia → chronic fetal hypoxia & malnutrition → risks of IUGR, premature birth, perinatal death

- systemic vasoconstriction
  - Intense ocular arteriolar constriction → cause blurred vision

- increased platelet aggregation -> at sites of endothelial damage → consumptive coagulopathy & thrombocytopenia

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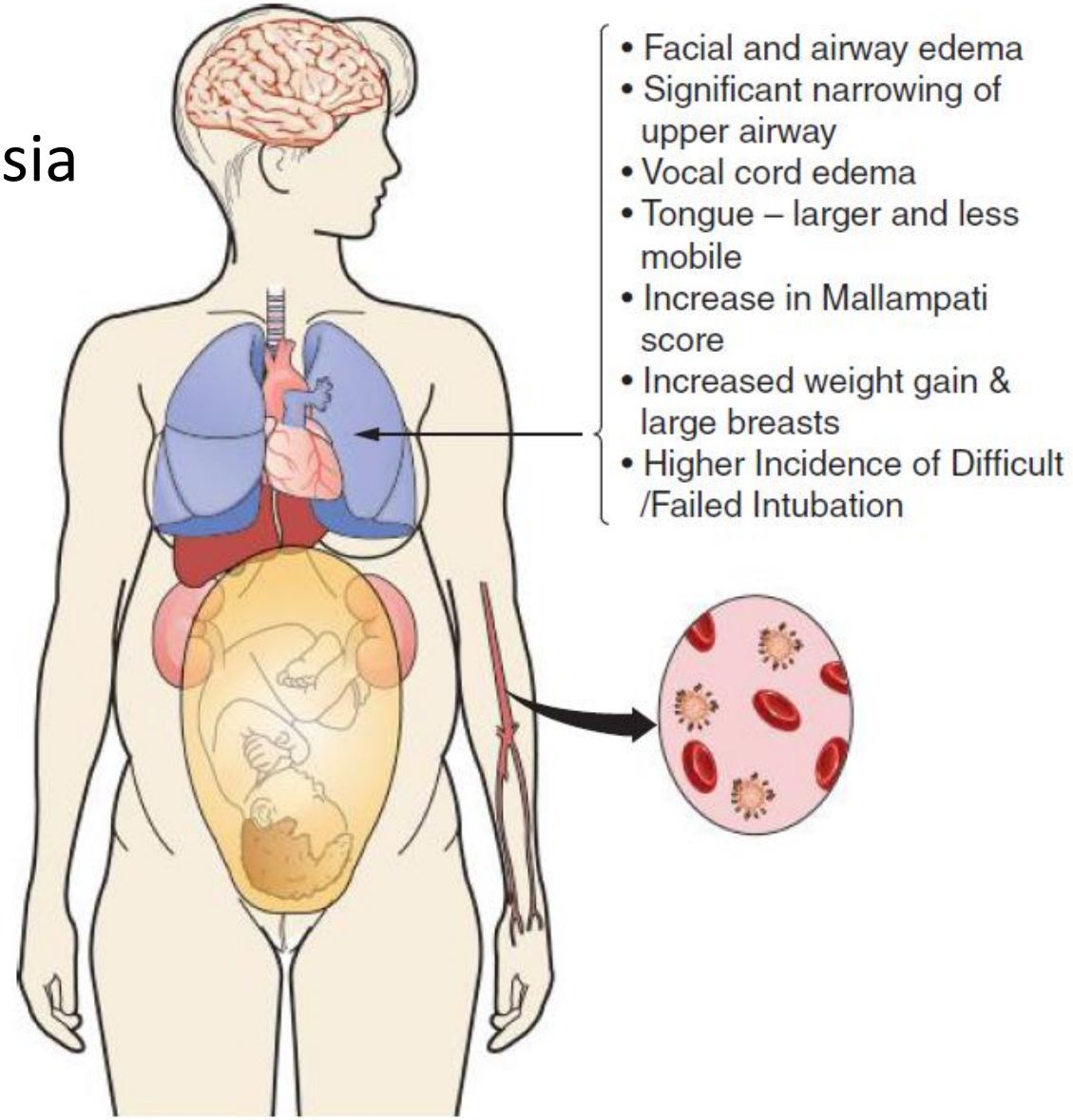
Airway changes in severe preeclampsia



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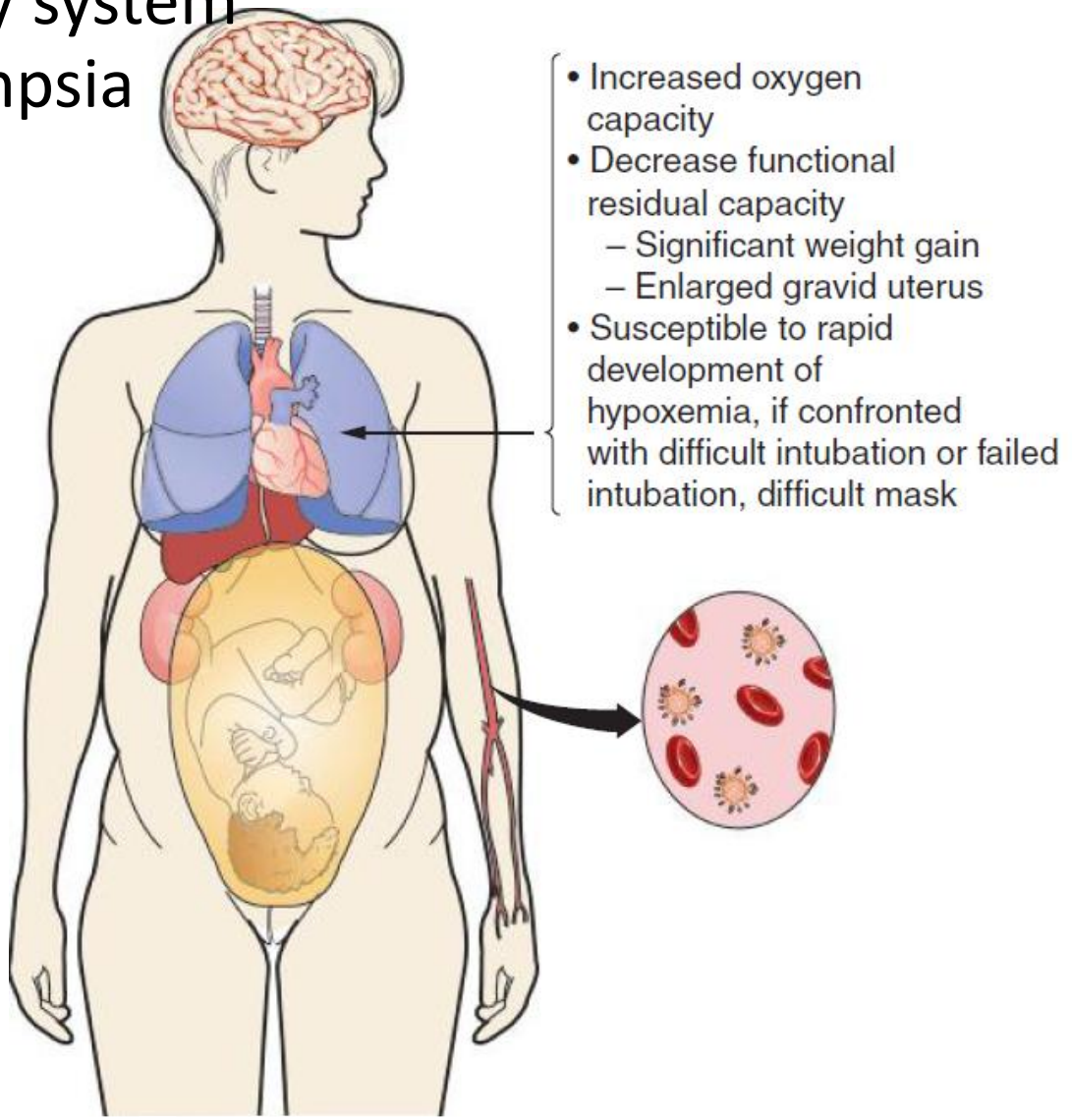
Changes in respiratory system in severe preeclampsia



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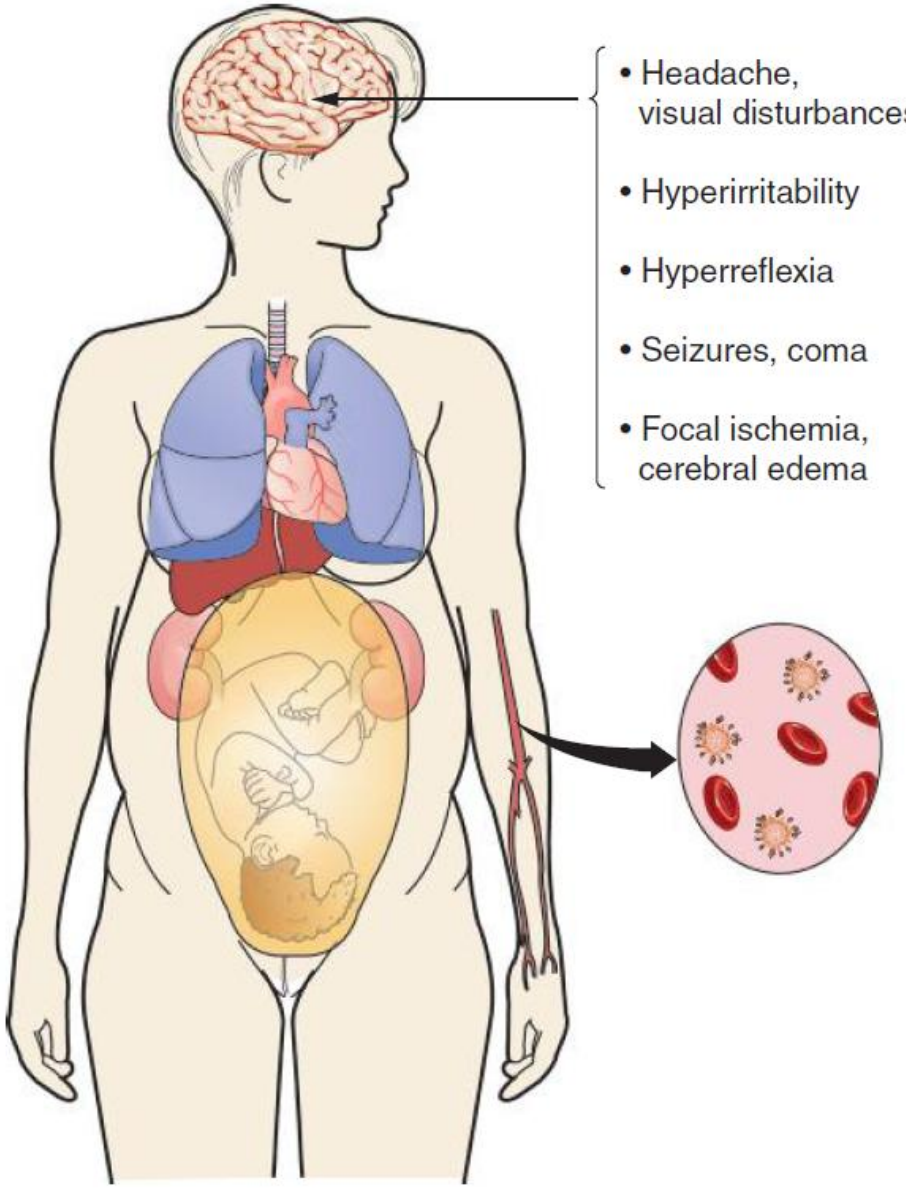
CNS changes in preeclampsia



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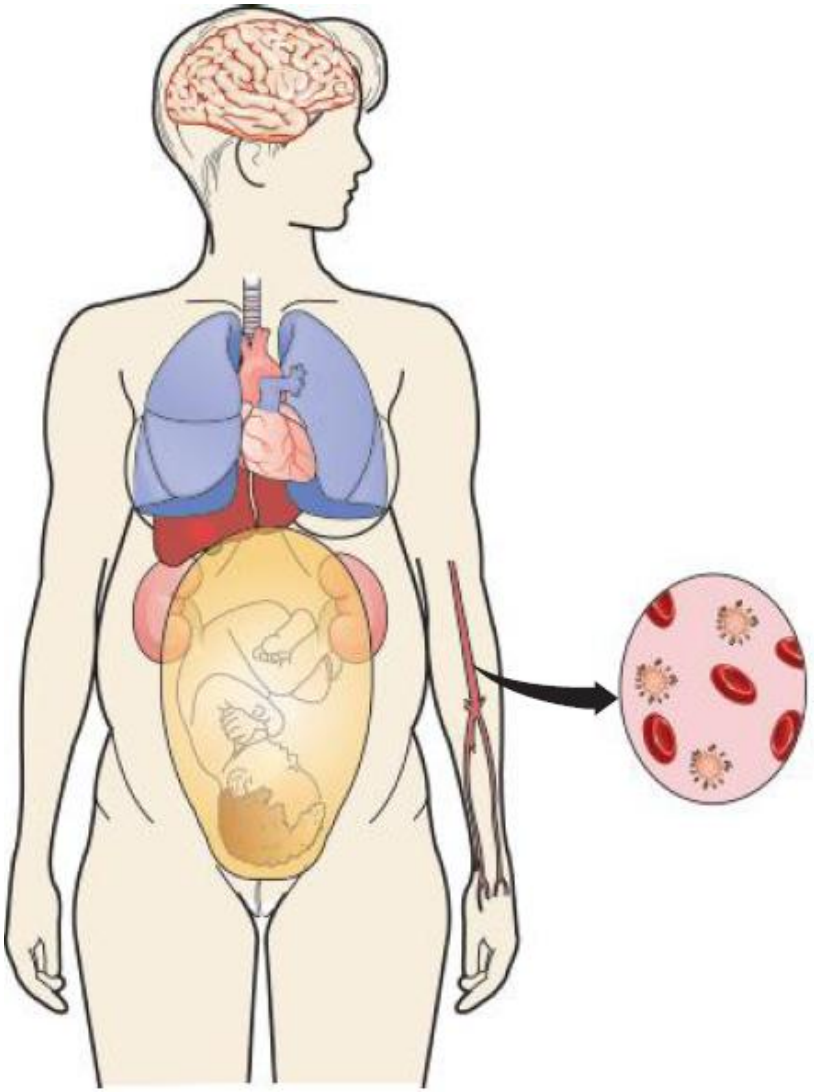
Coagulation abnormalities in preeclampsia



- Prolonged adrenergic stimulation
  - Endothelial cell damage
- Intravascular platelet activation, platelet consumption, platelet agglutination
  - Platelet thrombi
  - Occlusion of arterioles and capillaries
  - Thrombocytopenia
    - Platelet destruction-autoimmune mech. Levels of platelets specific immunoglobin
    - Platelet function affected

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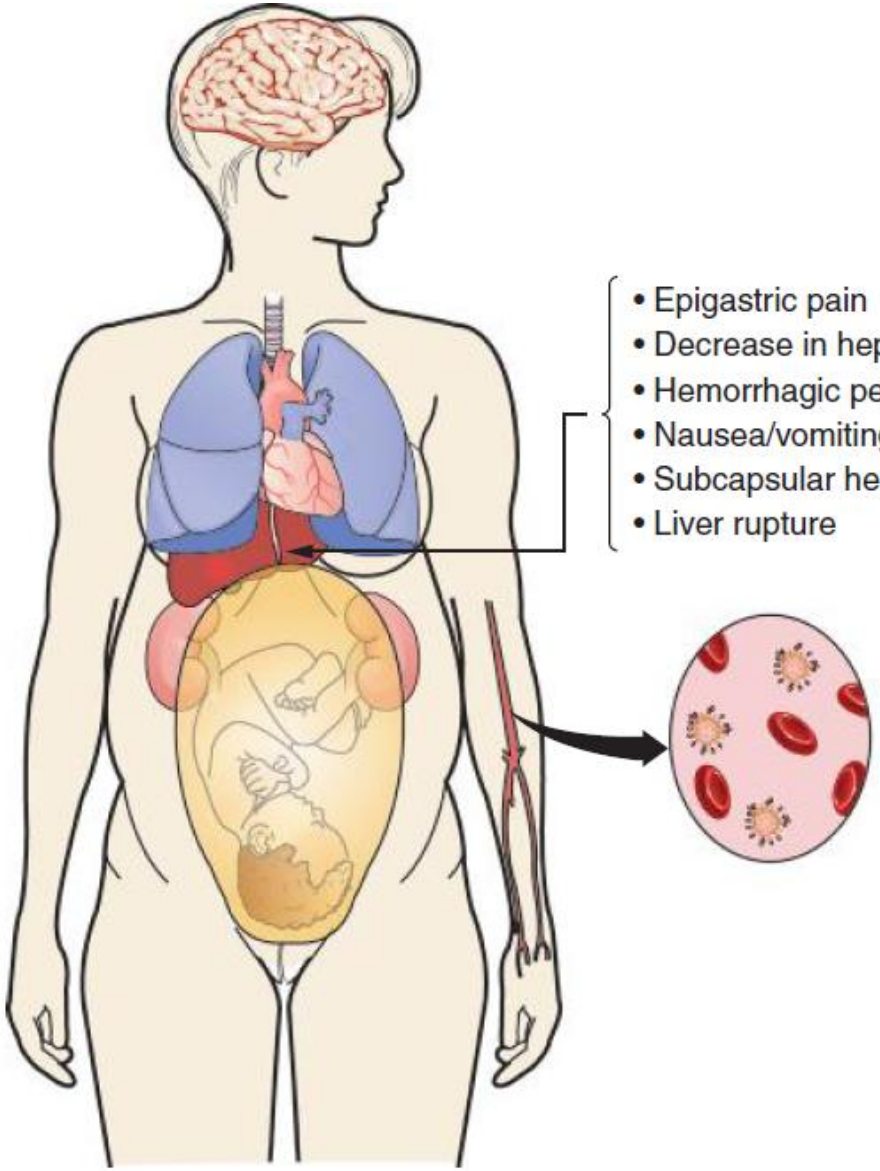
Hepatic changes in severe preeclampsia



- Epigastric pain
- Decrease in hepatic blood flow
- Hemorrhagic periportal necrosis
- Nausea/vomiting
- Subcapsular hematoma
- Liver rupture

Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

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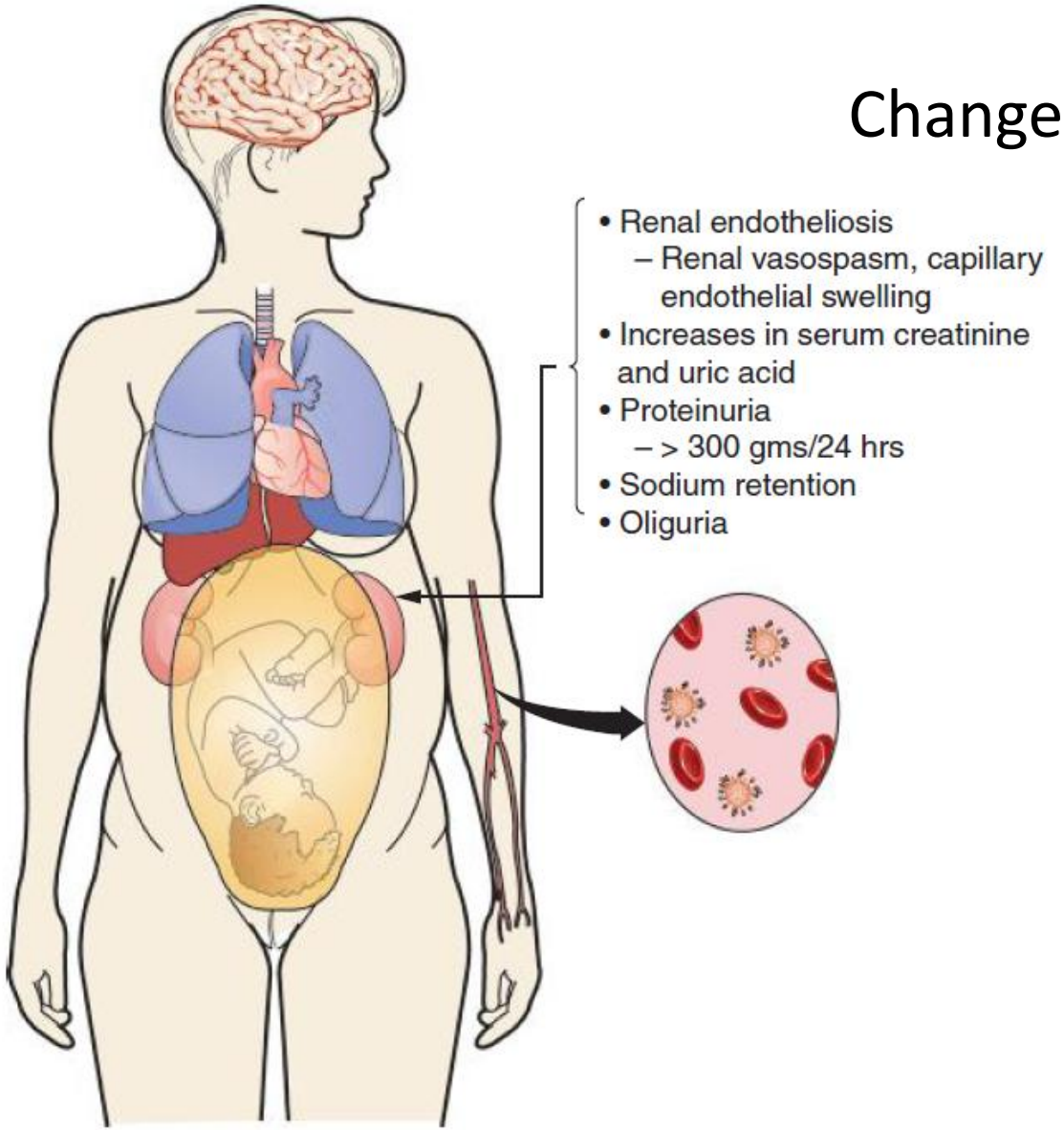
Changes in renal function



- Renal endotheliosis
  - Renal vasospasm, capillary endothelial swelling
- Increases in serum creatinine and uric acid
- Proteinuria
  - > 300 gms/24 hrs
- Sodium retention
- Oliguria

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Adverse Outcomes in Severe Hypertensive Disorders of Pregnancy

Maternal Complications

- Abruptio placentae
- Disseminated intravascular coagulopathy
- Eclampsia
- Renal failure
- Liver hemorrhage or failure
- Intracerebral hemorrhage
- Hypertensive encephalopathy
- Pulmonary edema
- Death

Fetal-neonatal Complications

- Severe intrauterine growth retardation
- Oligohydramnios
- Preterm delivery
- Hypoxia-acidosis
- Neurologic injury

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OBSTETRIC MANAGEMENT

Management of Mild Preeclampsia *>37 Weeks*

→ Induction of labor for delivery

Mild Preeclampsia *<37 Weeks*

• Maternal evaluation / week ; measurements of blood pressure, weight, questioning about symptoms & laboratory evaluation (urine protein, platelet, LFT)

• Fetal evaluation / 3 weeks ; ultrasonography to determine fetal growth & amniotic fluid volume

Obstetric Management of Severe Preeclampsia

→ Admitted & observed in a labor and delivery unit

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Guidelines for Management of Severe Preeclampsia

	Maternal	Fetal
Expeditious delivery (within 72 h)	One or more of the following: • Uncontrolled severe hypertension • Eclampsia • Platelet count <100,000/mm^3 • AST or ALT >2× upper limit of normal with RUQ or epigastric pain • Pulmonary edema • Compromised renal function • Abruptio placentae • Persistent, severe headache or visual changes	One or more of the following: • Repetitive late or severe variable heart rate decelerations • Biophysical profile ≤4 on two occasions, 4 h apart • Ultrasound EFW <5th percentile • Reverse umbilical artery diastolic flow
Consider expectant management	One or more of the following: • Controlled hypertension • Urinary protein of any amount • Oliguria (<0.5 mL/kg/h) which resolves with hydration • AST/ALT >2× upper limit of normal without RUQ or epigastric pain	One or more of the following: • Biophysical profile >6 • Ultrasound EFW >5th percentile • Reassuring fetal heart rate

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Goals for management

- prevent & control of seizures ; $MgSO_4$
- normalize blood pressure
- improve organ perfusion
- correct clotting abnormalities
- optimization of intravascular volume

Management

1. Management of labile hypertension
2. Need for frequent blood gas/laboratory studies (severe pulmonary edema)
3. Need for rapid central acting vasoactive medications
4. Estimation of intravascular volume status (oliguria)

Magnesium

- Magnesium reduces CNS irritability by decreasing activity at NMJ.
- potentiate the action of both depolarizing & nondepolarizing muscle relaxants → by decreasing Ach at NMJ
- provides uterine & smooth muscle relaxation
- monitored for magnesium toxicity with evaluation of deep tendon reflexes, respiratory depression & neurologic compromise
- loading 4 - 6 g over 20 - 30 minutes with a continued magnesium sulfate infusion of 1 g/h until 24 hours after delivery

Serum Mg level (mg/dL)	Effect
6-8	Therapeutic range

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Magnesium Sulfate Dosages, Serum Levels & Associated Findings

Magnesium Doses	
Loading dose:	6 g IV over 20–30 min (6 g of 50% solution diluted in 150 mL D_5W)
Maintenance dose:	2–3 g IV per h (40 g in 1 L D_5LR at 50 mL/h)
Recurrent seizures:	Reload with 2 g over 5–10 min. Other drugs such as benzodiazepam or barbiturates may be given.
Magnesium Levels and Associated Findings	
Loss of patellar reflexes	8–12 mg/dL
Feeling of warmth, flushing, double vision	9–12 mg/dL
Somnolence	10–12 mg/dL
Slurred speech	10–12 mg/dL
Muscular paralysis	15–17 mg/dL
Respiratory difficulty	15–17 mg/dL
Cardiac arrest	20–35 mg/dL

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Magnesium

Placental Transfer and Effects on the Fetus and Neonate

→ magnesium levels rise in the fetal blood within an hour

in the amniotic fluid within 2-3 hours

equilibration of maternal & fetal serum levels within 2 hours

→ mild vasodilatory effect on uterine vessels & placental blood flow

Neuroprotective Effects of Magnesium on the Fetus and Neonate

→ lower prevalence of cerebral palsy

→ risk of cerebral palsy 3.7% for fetuses exposed to Mg in utero versus 5.4%

→ absolute risk reduction of 1.7%

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CONTROL OF HYPERTENSION

Direct-acting Vasodilators

- Hydralazine
- Sodium Nitroprusside
- Nitroglycerine

β-Adrenergic Blocking Agents

- Labetalol

Calcium Channel Blocking Agents

- Nifedipine
- Nicardipine

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Treatment of Hypertension

Medication	Onset of Action (min)	Dose	Comments
Hydralazine	10–20	5–10 mg IV every 20 min up to a maximum of 40 mg.	Slow onset, delayed peak effect, causes a reflex tachycardia. Effects last 2–4 h.
Labetalol	5–10	20 mg IV, then 40–80 mg IV every 10–15 min up to a maximum dose of 300 mg IV. Can also be used for blunting hypertensive response to tracheal intubation.	Avoid in patients with bradycardia or asthma. Effects last 2–6 h.
Sodium nitroprusside	0.5–1	Start infusion at 0.3–0.5 μg/kg/min. Increase in increments of 0.5 μg/kg/min. Maximum dose 5 μg/kg/min.	When treatment lasts for ≥24–48 h, or if there is renal insufficiency, the risk of maternal and fetal cyanide toxicity increases. Risk is also increased when needing more than 2 μg/kg/min. Treatment: Stop the infusion. Effects last 2–3 min.
Nitroglycerin	1–2	Start infusion at 5 μg/min. Increase by 5–10 μg/min every 2–3 min up to a maximum dose of 200 μg/min.	Tolerance may develop. Excellent uterine smooth muscle relaxant.
Nicardipine	5–15	Start infusion at 2.5 mg/h. Increase rate by 2.5 mg/h up to a maximum dose of 15 mg/h.	Can cause reflex tachycardia. Does increase ICP. Contraindicated in heart blocks.

Antihypertensives

- Systolic blood pressure ≥ 160 mm Hg for prevention of intracerebral hemorrhage

- Hydralazine (→ increases uteroplacental & renal blood flow)
- IV labetalol & hydralazine
- Oral nifedipine
- In refractory severe hypertension → nitroglycerin & sodium nitroprusside

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FLUID MANAGEMENT

Oliguria with urine output <500 mL/24h
→ fluid challenge with 250 mL of crystalloid → Improved urine output

Diuretic can worsen XX

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ANESTHETIC MANAGEMENT

Preoperative Evaluation and Monitoring

- Hypertension is well controlled
- Seizure prophylaxis is initiated
- Volume status is optimized

Mild preeclampsia → standard monitoring

Laboratory investigations ; CBC c Plt count, BUN, Cr, LFT, UA

(INR → when platelet counts <100,000)

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ANESTHETIC MANAGEMENT

Analgesia for Labor & Vaginal Delivery

- Technique of Labor Epidural Analgesia
- Prophylactic Epidural Catheter Placement

Anesthesia for Cesarean Delivery : GA vs RA

Hypotension and the Use of Vasopressors

- Maternal MAP is maintained within 20%-30% of baseline values with IV fluids & vasopressors (ephedrine, phenylephrine)

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Anesthetic Management

- For cesarean delivery → sensory level of anesthesia must extend to T3 -T4
- adequately prepared with judicious hydration prior to neuraxial anesthesia

- General anesthesia → particular hazards ; RSI, difficult intubation, marked systemic & pulmonary hypertension

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Neuraxial Analgesia Considerations

- verify hemoglobin & platelet levels (stable platelet count 75,000-80,000) prior to placement of any neuraxial block

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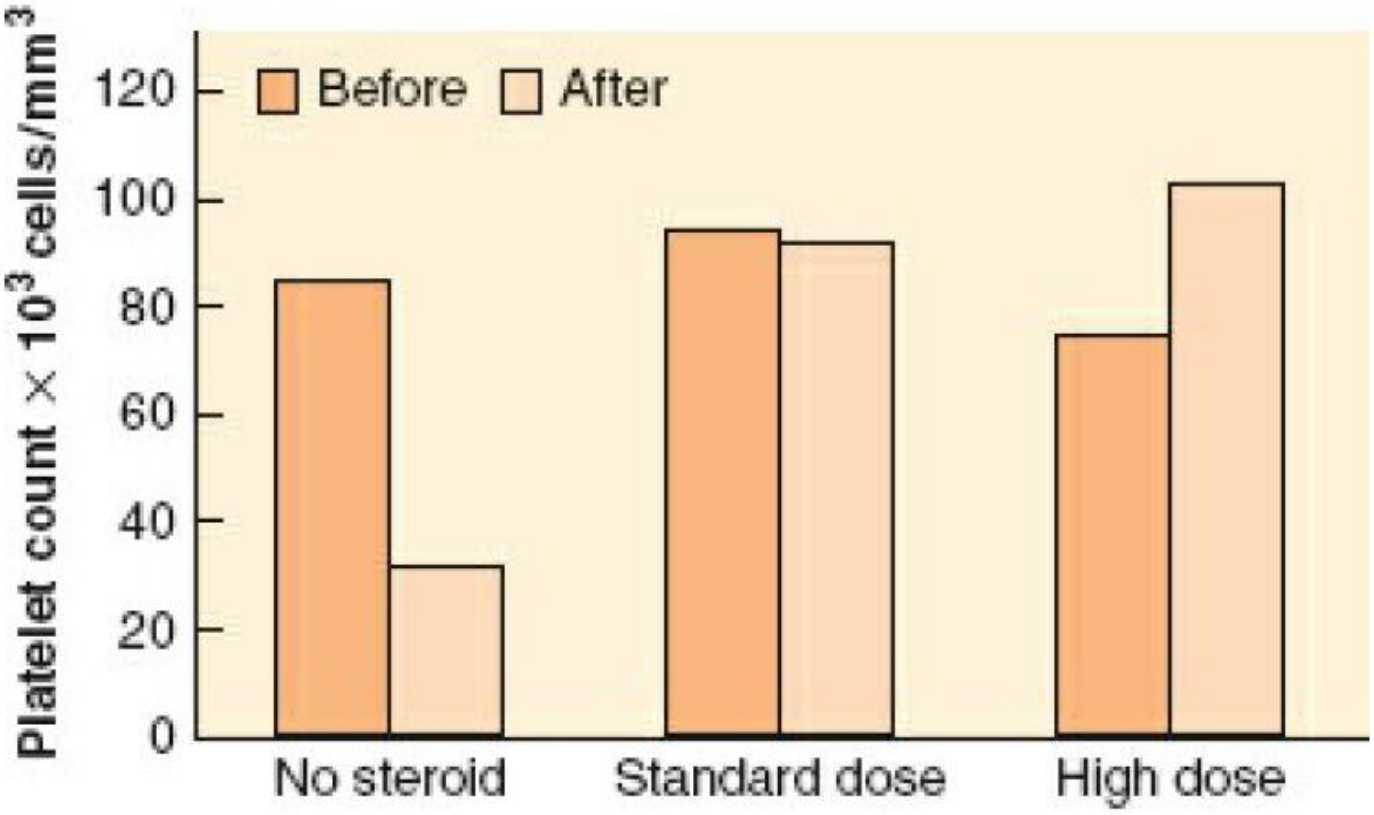
High-dose steroids (>24 mg of β- or dexamethasone in 24 hours) used to accelerate fetal lung maturity → prevent a worsening or even increase platelet count



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Eclampsia

defined as

- New onset of seizures *and/or*
- *Unexplained* coma during pregnancy or postpartum
- in patients with signs and symptoms of Preeclampsia

without a pre-existing neurologic disorder

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 28:, 5 ed., 2013. p.437-459.

Clinical Presentation

- Headache
- Blurry vision
- Scotomata
- Altered mental status
- Hyperreflexia
- Epigastric or right upper quadrant pain
- Eclamptic seizures

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 28:, 5 ed., 2013. p.437-459.

Eclamptic seizures

- begin with facial twitching , followed by a tonic phase lasting for 15-20 seconds
- progresses → generalized clonic phase & apnea lasting approximately 60 seconds followed by a postictal phase
- self-limiting but can recur
- cause respiratory arrest & cardiovascular collapse
- Mechanism of the seizures → loss of cerebral autoregulation, forced vasodilation, hyperperfusion resulting in vasogenic edema

Hypertensive disorders of pregnancy | Abnormal fetal positions, shoulder dystocia & multiple gestation | Preterm labor and delivery | Obstetric hemorrhage

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 28:, 5 ed., 2013. p.437-459.

Management of Eclampsia

Airway

- Apply jaw thrust
- Tilt the patient to the left or manually displace the uterus to the left with wedge
- Protect the head and body from injury

Breathing

- Attempt ventilation using a bag–valve–mask with 100% oxygen.
- Do *not* attempt to insert the oral airway. If necessary, insert a soft and well-lubricated nasal airway.
- Apply pulse oximeter and continuously monitor SpO_2

Circulation

- Secure intravenous access
- Continuously monitor the electrocardiogram
- Check blood pressure frequently and treat hypertension

Drugs

- Magnesium sulfate
  - 4–6 g IV over 15–20 min as a loading dose
  - 1–2 g/h IV for maintenance
  - 2 g IV over 5–10 min for recurrent seizures
- Antihypertensive medications
  - Labetalol 20–40 mg IV every 5–10 min or Hydralazine 5–10 mg IV every 15–20 min as needed

Anesthetic Management

- same as those for severe preeclampsia

- assessment of seizure control & neurologic status → signs of increased ICP & focal deficits

- Postpartum Long-term Follow-up
  - incidence of chronic hypertension 3-4 fold
  - increased risk of stroke & maternal death 2 fold
  - peripartum cardiomyopathy & myocardial infarction
  - Recurrent preeclampsia in subsequent pregnancies

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.

Abnormal fetal positions, shoulder dystocia & multiple gestation

- Abnormal fetal positions
  - Occipitoposterior
  - Face and Brow Presentation
  - Breech presentation
  - Shoulder dystocia
- Multiple gestations

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.

Occipitoposterior

- incidence of persistent occipitoposterior (OP) is about 5.5%
- leads to a prolonged labor
- prolonged and exaggerated pain
- high-risk labor → cesarean delivery or instrumental delivery

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.

Anesthetic management for occipitoposterior

- common indication for regional analgesia
- use of low dose local anesthetic solutions in

labor epidurals → profound relaxation of the pelvic floor muscles and perineum → during an instrumental delivery

2% lidocaine (with/without adjuvants), 0.5% bupivacaine or levobupivacaine

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.

Face and Brow Presentation

- incidence 1 in 500 - 600 births
- associated with
  - prematurity
  - low birth weight
  - fetal malformations
  - cephalopelvic disproportion
  - polyhydramnios

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.

Face and Brow Presentation

- Vaginal delivery is possible when the mentum is anterior (60%-80% of cases)
- 10%-12% mentum is transverse
- 20%-25% mentum is posterior

- Cesarean delivery rate for face presentation is 15%
- Brow presentation 1 in 1,500

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.

Face and Brow Presentation

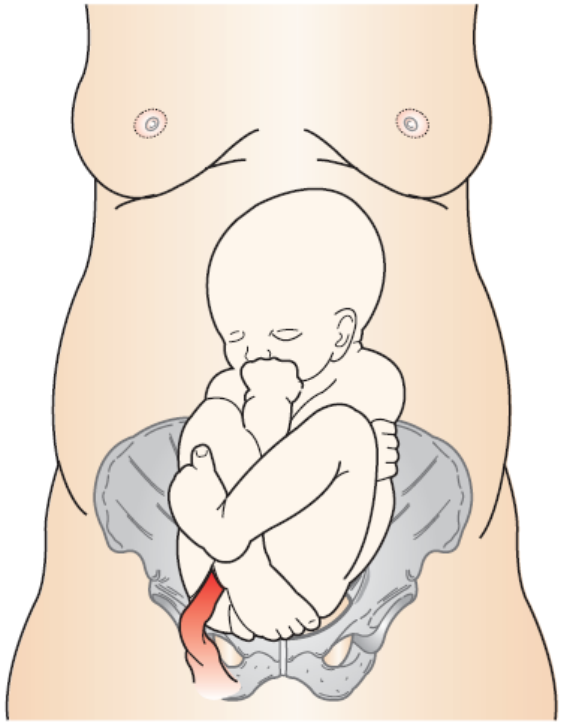
Ronald D. Miller, Basics of Anesthesia, Chapter 33:Obtetrics, 7 ed., 2018. p.571-578.
Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.

Breech presentation

- Incidence 3% - 4% of termed pregnancies
  (20%-40% at 28 weeks)
- External cephalic version (ECV) → success rate 60%
- Risks : - placental abruption
  - fetal bradycardia
  - rupture of membranes

- Clear guidelines for vaginal breech delivery

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.



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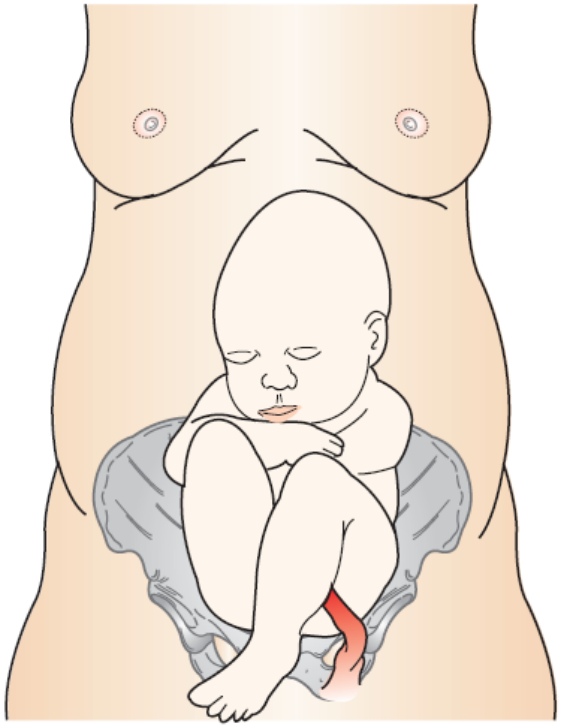

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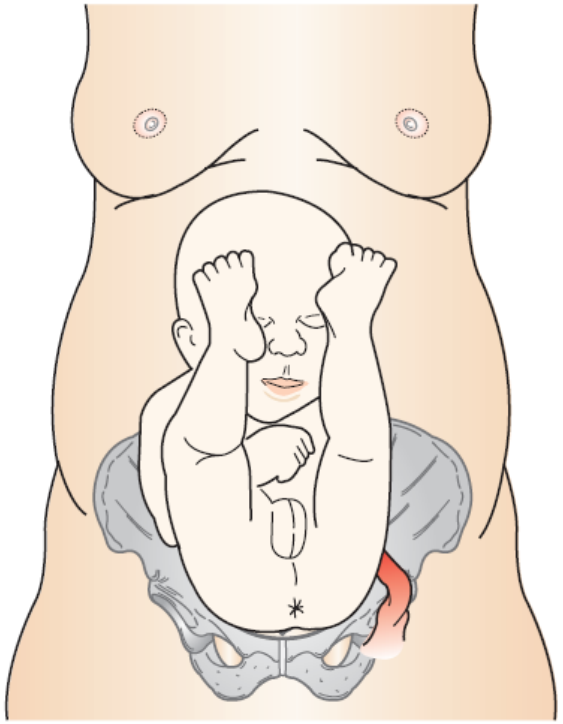

iii. Frank

Hypertensive disorders of pregnancy | Abnormal fetal positions, shoulder dystocia & multiple gestation | Preterm labor and delivery | Obstetric hemorrhage

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Factors Associated with Breech Presentation

Maternal Factors Associated With Breech Presentation	Fetal Factors Associated With Breech Presentation
Uterine distension or relaxation • Grand multiparity • Multiple gestation • Polyhydramnios Uterine abnormalities • Pelvic tumors (malignant and benign) • Uterine anomalies Obstetric conditions • Previous breech • Oligohydramnios • Placenta previa Non-obstetric conditions • Advanced age • Maternal diabetes • Smoking	Congenital fetal anomalies • Anencephaly • Hydrocephaly Low birth weight • Intrauterine growth retardation • Preterm delivery

Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

Mortality & Morbidity—for Mother & Baby

fetal hypoxia during breech delivery

1. Umbilical cord—due to a reduced distance between the umbilical cord insertion point and the fetal body part lowest in the birth → risk of pressure on the cord as the fetal pelvis moves downward

   "fetal head entrapment"

2. Placenta—owing to an often-protracted second stage of labor → reduction in placental perfusion during contractions

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Anesthetic Management of Breech presentation

- Labor Analgesia

  "Fetal Head Entrapment"
- Cesarean Delivery

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Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 18:, 5 ed., 2013. p.267-275.

Shoulder dystocia

- obstetric emergency
- Incidence 1% - 1.5% of all deliveries
- Risk factors : - macrosomia
  - diabetes
  - obesity (BMI >30 kg/m^2)
  - history of dystocia
  - labor induction
  - instrumented delivery
  - prolonged labor (first or second stage)

Shoulder dystocia

- Increased risk of postpartum hemorrhage 11%

- Fetal pH declines 0.04 unit/min between delivery of the head and trunk
- shoulder dystocia ≥ 7 minutes → increase in risk of neonatal brain injury

- fetal injuries & sequelae → brachial plexus injury, neurologic injury from asphyxia & broken clavicle

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Anesthetic Management in Shoulder dystocia

- as part of an emergency response → preexisting epidural catheter is useful → top-up with a concentrated, fast-acting local anesthetic such as 0.75% ropivacaine, 2% lidocaine

- "Zavanelli maneuver" → pelvic relaxation by
  - Tocolytics ; terbutaline or nitroglycerine (50-100 mcg IV)
  - General anesthetic

Multiple gestations

- Antepartum complications develop up to 80% of the multiple gestations;
  - preterm labor
  - preeclampsia
  - gestational diabetes
  - preterm premature rupture of membranes
  - intrauterine growth restriction
  - intrauterine fetal demise

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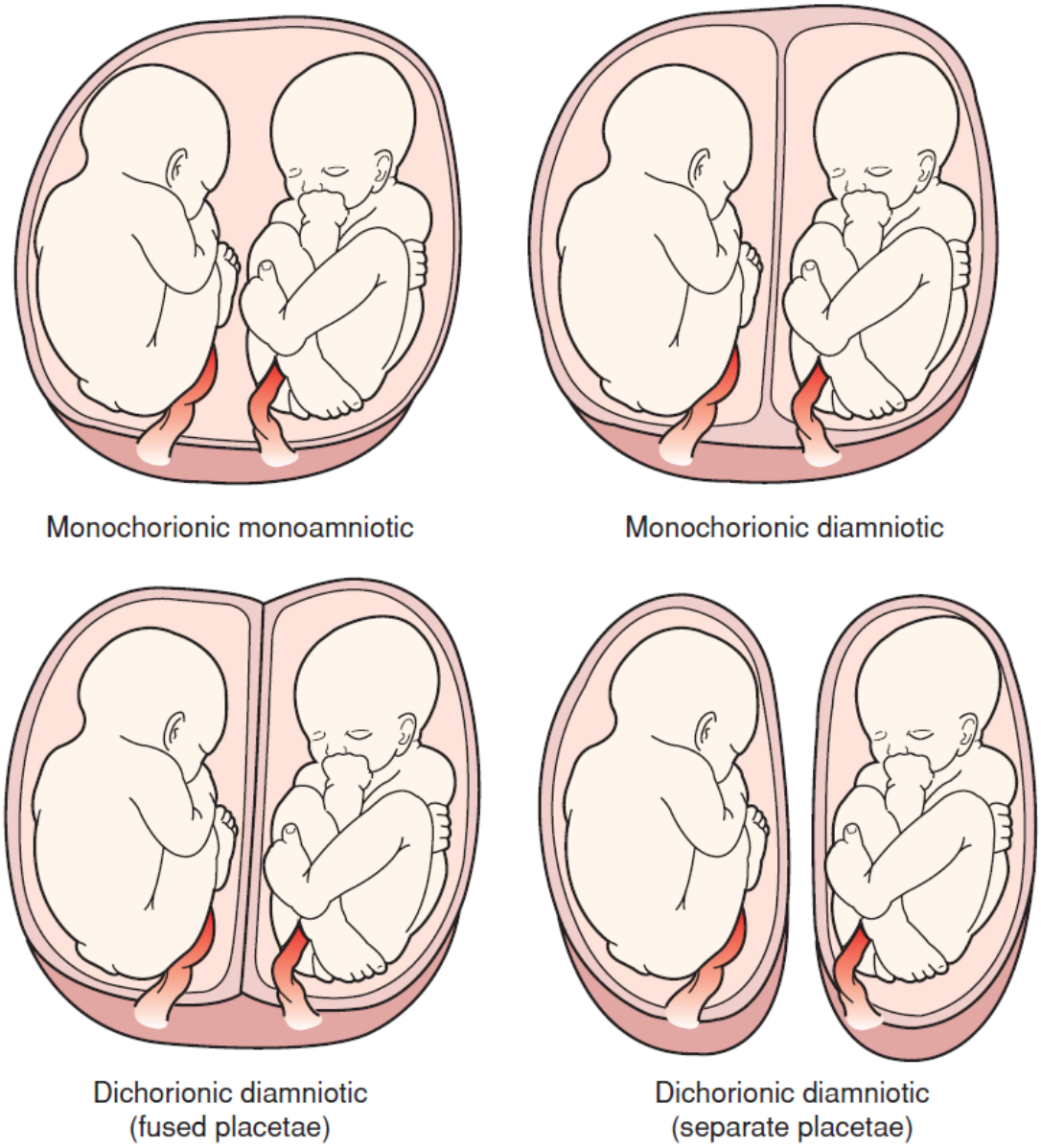

Monochorionic monoamniotic

Monochorionic diamniotic

Dichorionic diamniotic
(fused placetae)

Dichorionic diamniotic
(separate placetae)

Hypertensive disorders of pregnancy

Abnormal fetal positions, shoulder dystocia & multiple gestation

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Maternal Physiology During Multiple Gestation

Exaggeration of the normal adaptations of pregnancy

- increased blood volume & lower hematocrit
- increased cardiac output
- increased aortocaval compression
- reduced functional residual capacity (FRC)
- increased risk of aspiration,

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Complications of Multiple Gestation

Maternal Complications

- Preeclampsia
- Preterm labor
- Placenta previa/ abruption
- Hemorrhage
- Anemia
- Gestational diabetes

Fetal Complications

- Preterm delivery
- Congenital abnormalities
- Twin-to-twin transfusion syndrome
- Cord entanglement or prolapse
- Intrauterine growth retardation
- Malpresentation
- Difficulty in delivering second twin

Anesthetic Management in Multiple Gestation

- Vaginal Delivery
  - Epidural analgesia; controlling pain, reducing maternal desire to push inappropriately & allowing rapid conversion to anesthesia
- Cesarean Delivery
  - Regional anesthesia (standard dose of spinal agents)

IV oxytocin is not administered before all the babies have been delivered

increased risk postpartum hemorrhage due to uterine atony

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Preterm labor and delivery

- before 37 completed weeks of gestation
- occur in 8% to 10% of all births
- account for ~ 80% of early neonatal deaths
- preterm infants > 1,500 g → survive without severe long-term impairment

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Classification of preterm labor

Classification	GA (weeks)
Late preterm	34 - 36
Moderately preterm	32 - 33
Very preterm	≤32
Extremely preterm	≤28

Classification	Birth weight (g)
Low birth weight (LBW)	< 2,500
Very low birth weight (VLBW)	< 1,500
Extremely low birth weight (ELBW)	< 1,000

Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

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PATHOGENESIS

1. Activation of the Hypothalamic–Pituitary Axis

→ increased placental production of corticotropin-releasing hormone

1. Exaggerated Response to Inflammation & Infection
2. Decidual Hemorrhage → Vaginal bleeding
3. Pathologic Uterine Distention; multiple gestation, polyhydramnios

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RISK FACTORS

- Social Stress and Race; poverty, limited maternal education, young maternal age, unmarried status, inadequate prenatal care
- Infection & Inflammation; chorioamnionitis
- Genetic Factors; maternal history of PTB

Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

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DIAGNOSIS

- Cervical change;
  - cervical effacement of at least 80%
  - cervical dilatation > 2 cm
  - 4 regular painful contractions every 20 minutes or 8 every 60 minutes

only 20% of women evaluated for preterm labor have preterm delivery

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Severe problems may develop in preterm infants

- Respiratory distress syndrome
- Intracranial hemorrhage
- Hypoglycemia
- Hypocalcemia
- Hyperbilirubinemia

Causes of enhanced drug sensitivity in preterm newborn

- Less protein available for drug binding
- Higher levels of bilirubin, which may compete with the drug for protein binding
- Greater drug access to the CNS because of a poorly developed blood–brain barrier
- Greater total body water & lower fat content
- A decreased ability to metabolize & excrete drugs

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THERAPY FOR WOMEN IN PRETERM LABOR

- ACUTE TOCOLYSIS
  - Overview of Tocolytic Therapy

- ANTENATAL CORTICOSTEROIDS
  - Recommended for anticipated preterm delivery within 7 days in GA 24 -34 weeks
  - Side Effects; transient decrease FHR after 48-72 hours

    transient hyperglycemia (12 hr-last for 5 days)

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Indications & Contraindications for Inhibition of Preterm Labor

Indications

- Gestational age ≤37 wks
- Cervical change or cervical effacement ≥80%, or cervical dilatation >2 cm together with four regular painful contractions every 20 min or eight every 60 min
- Recent intra-abdominal surgery causing preterm labor

Contraindications

- Chorioamnionitis
- Non-reassuring fetal status
- Severe fetal growth restriction
- Severe preeclampsia or eclampsia
- Maternal hemorrhage with hemodynamic instability
- Lethal fetal anomaly
- Intrauterine fetal demise

Hypertensive disorders of pregnancy | Abnormal fetal positions, shoulder dystocia & multiple gestation | Preterm labor and delivery | Obstetric hemorrhage

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Tocolytic Management of Acute Preterm Labor

Tocolytic Management of Acute Preterm Labor			
Tocolytic Agent	Route of Administration (Dosage)	Maternal Adverse Effects	Fetal Adverse Effects
Magnesium sulfate	IV: 4–6 g bolus, then 2–3 g/h infusion	Cardiorespiratory arrest Pulmonary edema Hypotension Headache Weakness Nausea	Decreased beat-to-beat variability Neonatal drowsiness Hypotonia
β_2-adrenergic Agonists			
Terbutaline sulfate	SQ: 0.25 mg q20 min IV: 2 μg/min to a maximum of 30 μg/min	Tachycardia Cardiac dysrythmias Palpitations Myocardial ischemia Chest pain Shortness of breath Pulmonary edema Tremor Anxiety and restlessness Nausea and vomiting Rash Hypokalemia Hyperglycemia	Tachycardia Hypotension Ileus Hyperinsulinemia Hypoglycemia

Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

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Tocolytic Management of Acute Preterm Labor

Prostaglandin Inhibitors			
Indomethacin	Oral: 50–100 mg loading dose followed by 25 mg q4–6h Rectal: 100 mg q12h	Interstitial nephritis Platelet dysfunction Gastrointestinal effects (nausea, heartburn)	Premature closure of the neonatal ductus arteriosus Persistent pulmonary hypertension Oligohydramnios
Calcium Channel Blockers			
Nifedipine	Oral: 20–30 mg q4–8h up to a maximum of 180 mg/day	Hypotension Reflex tachycardia Headache Nausea Flushing Hepatotoxicity Respiratory depression	None

- anesthetic drugs & techniques for delivery → prevention of asphyxia & trauma to fetus

- For labor & vaginal delivery → well-conducted neuraxial anesthesia is advantageous → providing good perineal relaxation

- Preterm infants with breech presentation

→ usually delivered by cesarean as are very low-birth-weight infants (<1,500 g)

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Delta-9-tetrahydrocannabinol (**THC**)

- readily crosses the placenta → directly affect the fetus
- associated with preterm labor & IUGR

Hypertensive disorders of pregnancy | Abnormal fetal positions, shoulder dystocia & multiple gestation | Preterm labor and delivery | Obstetric hemorrhage

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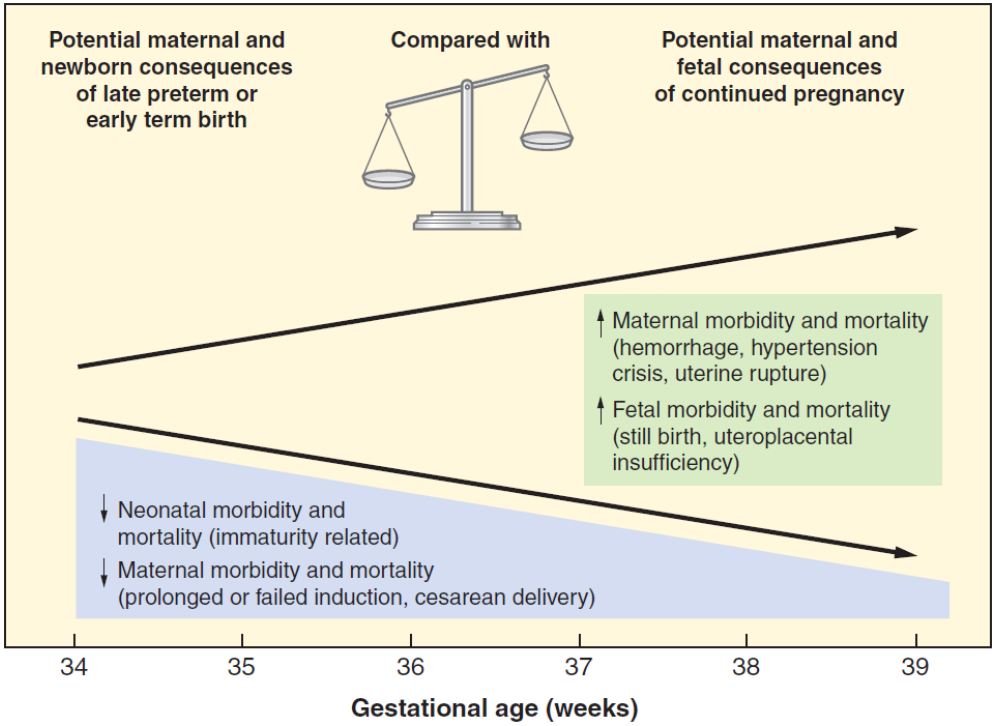
INTRAPARTUM MANAGEMENT OF THE LOW BIRTH WEIGHT FETUS

Balancing the risks of continuing the pregnancy with the risks of delivery before term



Hypertensive disorders of pregnancy

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Mode of Delivery and Anesthetic Management

- *Cesarean Versus Vaginal Delivery;* non-vertex presentation, VLBW, or ELBW

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Complications of the Preterm Infant

- *Short-term Complications of the Preterm Infant;* respiratory distress, retinopathy of prematurity, patent ductus arteriosus, bronchopulmonary dysplasia, sepsis, NEC, severe IVH

- *Long-term Complications of the Preterm Infant;* asthma, bronchopulmonary dysplasia, feeding problems, vision & hearing impairment, gastroesophageal reflux, increased risk of SIDS

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Obstetric hemorrhage

- Etiology
- Novel pharmacologic intervention
- Blood conservation techniques
- Hemorrhage potocol

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4 categories of obstetric hemorrhage

1. Abnormal tissue (placentation)
2. Abnormal tone (atony)
3. Abnormal coagulation
4. Trauma (uterine rupture, cesarean delivery)

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Etiology of obstetric hemorrhage

1. Placenta Previa
2. Massive Hemorrhage
3. Abruptio Placentae
4. Uterine Rupture
5. Retained Placenta
6. Uterine Atony
7. Placenta Accreta

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Placenta Previa

- Incidence 1 in 200 pregnancies
- Risk factors :
  - advanced age
  - multiparity
  - assisted reproductive techniques
  - prior hysterotomy
  - prior placenta previa
  - smoking
  - multiple gestation
  - cocaine abuse
- Classic presentation is painless vaginal bleeding that typically occurs preterm in the third trimester.

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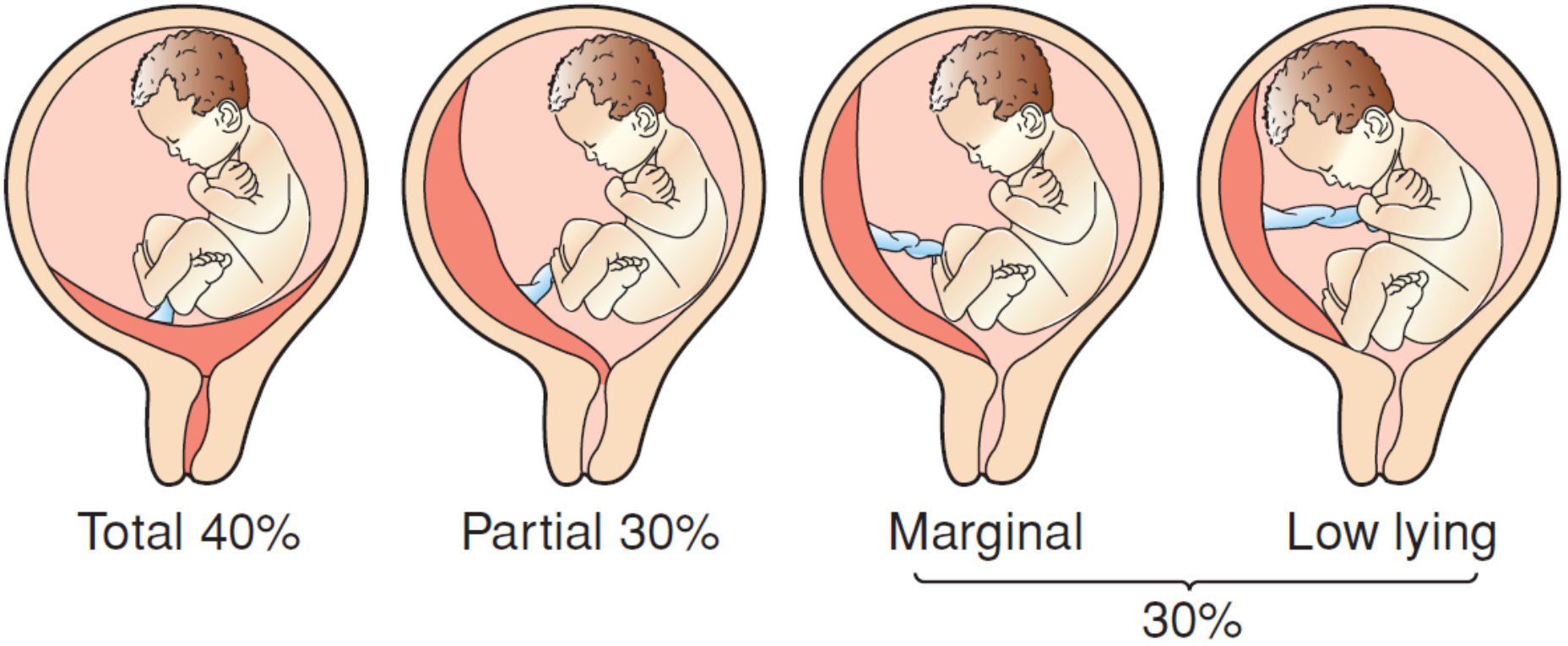
Classification of placenta previa



Hypertensive disorders of pregnancy

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Placenta Previa

- Trial of labor is acceptable if the placenta edge is > 2 cm from the internal os
- If the placenta is within 1 cm → cesarean delivery

- Neuraxial anesthesia is an appropriate choice if there is no active bleeding or hypovolemia.
- 2 large-bore IV lines with fluid warmers & availability of invasive monitoring is suggested

Massive Hemorrhage

- Ketamine (1 - 1.5 mg/kg) or Etomidate (0.3 mg/kg) IV → for induction of anesthesia
- activation of a massive transfusion protocol (1:1 ratio)
- Empiric tranexamic acid ??

- Uncontrolled hemorrhage consider
  - uterine artery ligation
  - B-Lynch sutures
  - intrauterine balloon
  - use of arterial embolization by interventional radiology if the patient is stable for transport
  - hysterectomy

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Abruptio Placentae

- Abruptio placentae → separation of the placenta from the uterine wall after GA 20 weeks (usually in the final 10 weeks of gestation)
- Incidence 0.4 - 1 in 100 pregnancies
- 10% - 20% of all perinatal deaths

- Risk factors :
  - advanced age -- hypertension
  - trauma -- smoking
  - cocaine use -- chorioamnionitis
  - premature rupture of membranes -- placenta previa
  - history of prior abruption -- multiple gestation
  - preeclampsia

Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

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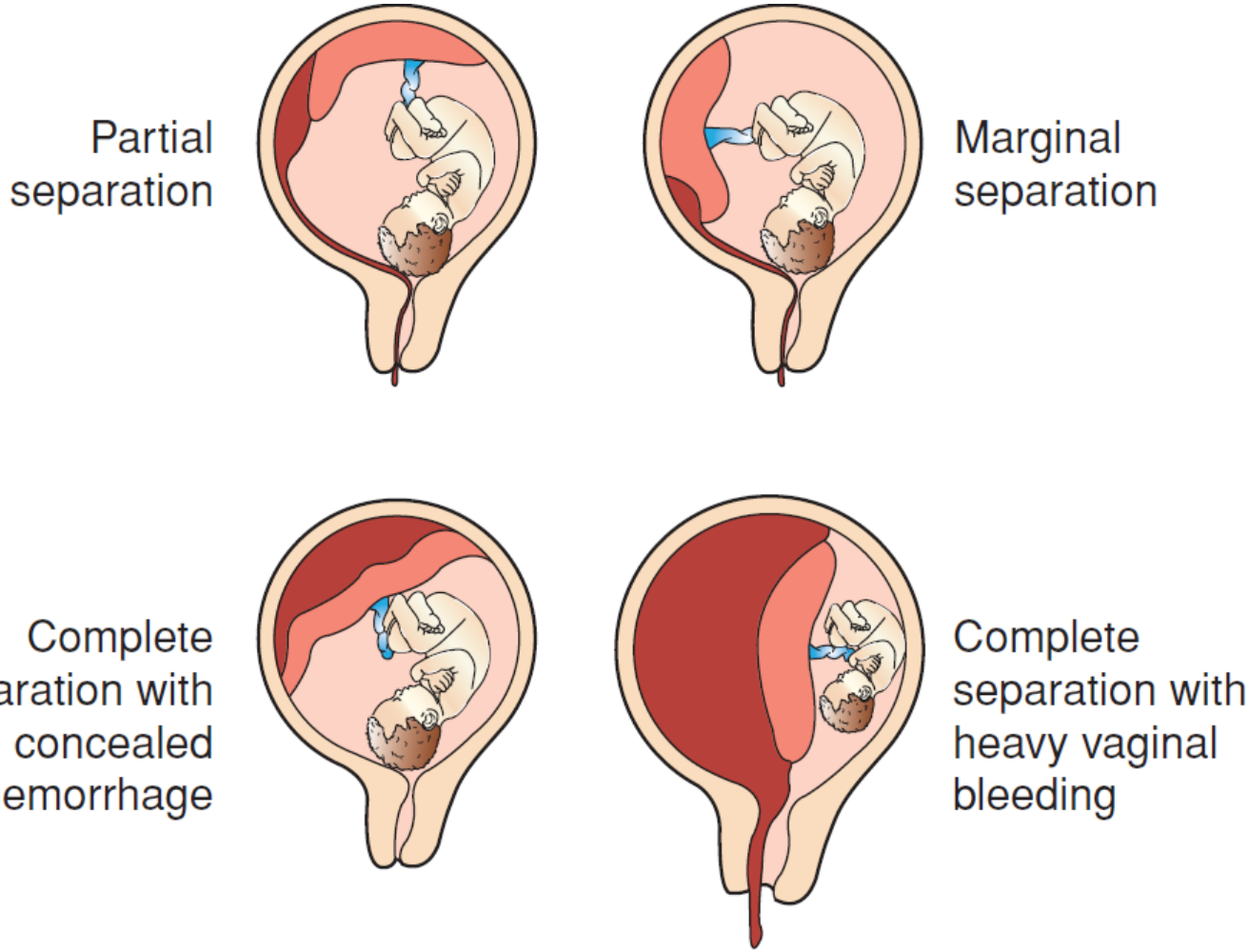
Abruptio Placentae



Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

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Grading of Placental Abruption

	Class 0	Class 1	Class 2	Class 3
Vaginal bleeding	None	None–mild	None–moderate	None–severe
Uterine tenderness	None	Slight	Moderate	Severe
Maternal hemodynamics	Stable	Normal HR Normal BP	Tachycardia Orthostatic hypotension	Hypovolemic shock HR > 120/min SBP < 80 mm Hg
Hypofibrinogenemia	None	None	Hypofibrinogenemia, mild (>150 mg/dL)	Hypofibrinogenemia, severe (<150 mg/dL)
Coagulation profile	Normal	Normal	Mild abnormality	Frank coagulopathy
Fetal status	Reassuring	Reassuring	Fetal stress/distress	Fetal distress

Abruptio Placentae

Complications

- Couvelaire uterus (when extravasated blood dissects between myometrial fibers)
- Renal failure
- Disseminated intravascular coagulation
- Anterior pituitary necrosis (Sheehan syndrome)

- maternal mortality rate is high (1.8% - 11.0%)
- perinatal mortality rate is higher (50%)

Abruptio Placentae

- Definitive treatment → deliver the pregnancy

- Anesthetic plan is based on both delivery urgency & abruption severity
  - epidural analgesia can be used for labor & vaginal delivery
    → if no signs of - maternal hypovolemia
    - active bleeding
    - clotting abnormalities
    - fetal distress
  - General anesthesia → severe hemorrhage, emergency C/S

Uterine Rupture

- a trial of labor after cesarean (TOLAC) is associated with a $\leq$ 1% incidence of uterine rupture
- associated with
  - rapid spontaneous delivery
  - motor vehicle trauma
  - trauma from instrumented vaginal delivery
  - large or malpositioned fetus
  - excessive oxytocin stimulation

Uterine Rupture

- S/S :
  - fetal bradycardia
  - persistent abdominal pain
  - vaginal bleeding
  - cessation of contractions
  - loss of station
  - breakthrough pain with epidural analgesia
  - FHR monitoring → deceleration (most common)

Uterine Rupture

- Management
  - immediate evaluation
  - aggressive resuscitation
  - general anesthesia for emergent cesarean delivery
  - Hysterectomy ??

Retained Placenta

- 2% - 3% of all vaginal deliveries
- manual removal of the placenta with analgesia provided by
  - IV administration of opioids
  - inhalation of nitrous oxide
- If uterine relaxation is necessary for placenta removal → boluses 200 µg IV nitroglycerin

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Uterine Atony

- Risk factors :
  - retained products - C/S
  - high parity - long labor
  - Macrosomia - polyhydramnios
  - excessive oxytocin augmentation
  - chorioamnionitis
  - hypertensive disorders of pregnancy
  - antepartum hemorrhage

Uterine Atony

- Treatment: Bimanual massage
  - IV Oxytocin
    - oxytocin infusion of 20-40 IU diluted in 1 L of crystalloid
    - bolus of IV oxytocin 3 IU then infusion
  - Methylergonovine (0.2 mg IM) but contraindicated in

    - preeclampsia
    - pulmonary hypertension
    - ischemic cardiac disease
  - Prostaglandin F2α (0.25 mg IM) (associated with nausea, tachycardia, pulmonary hypertension, desaturation & bronchospasm)
  - Prostaglandin E1 (600 µg oral/sublingual/rectal) (cause hyperthermia)

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Uterotonic Therapy

Drug	Dose	Side Effects
Oxytocin	20–40 U in 1,000 mL LR by continuous IV infusion	Hypotension, tachycardia
Ergot alkaloids (Methergine)	0.2 mg IM q2–4h prn	Hypertension, vasoconstriction Coronary vasospasm Bronchospasm
Carboprost	0.25 mg IM q15–60 min prn	↑ cardiac output ↑ pulmonary vascular resistance Bronchospasm Nausea
Misoprostol	800–1,000 µg PR/PV/PO q2h	Fever Nausea
Dinoprostone	20 mg PO q2h	Hypotension Nausea

Hypertensive disorders of pregnancy

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Placenta Accreta

- Incidence 1 in 533 pregnancies
- association with placenta previa → be prepared to treat sudden massive blood loss

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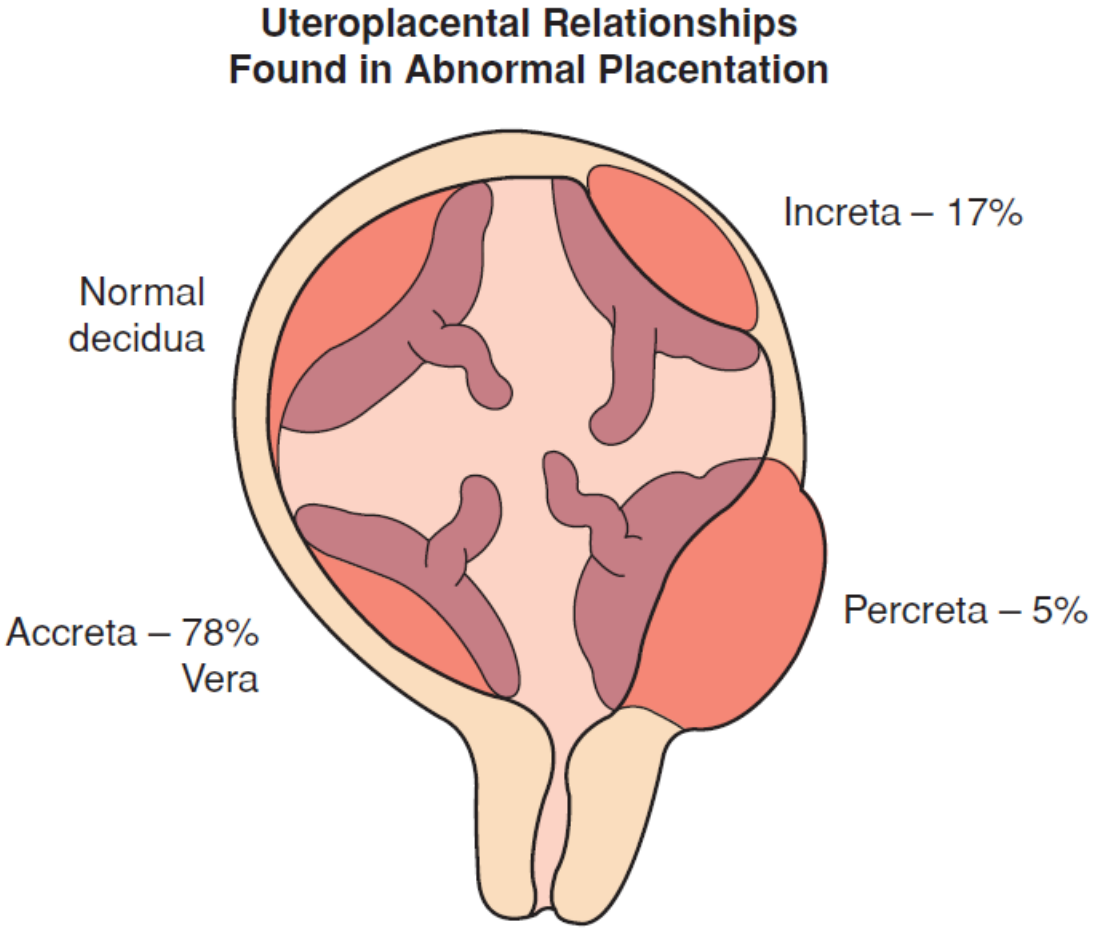
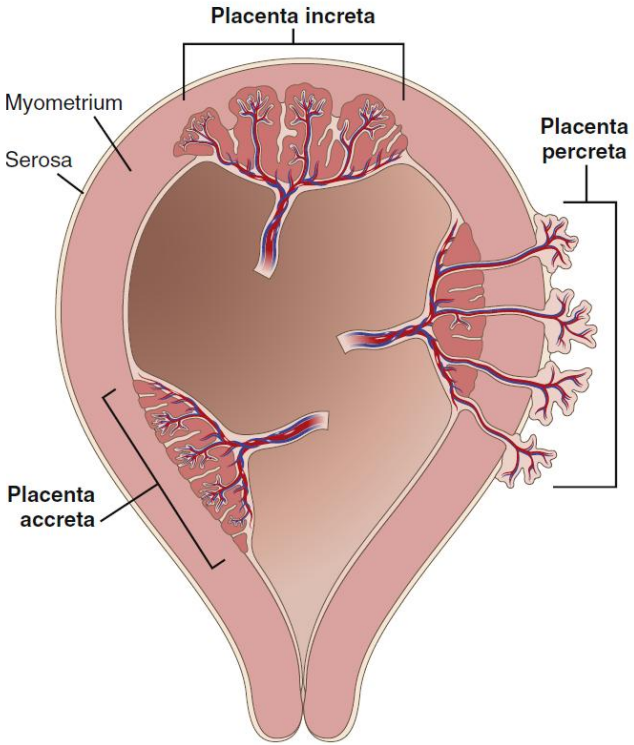
Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 21, 5 ed., 2013. p.311-328.

Placenta Accreta





Hypertensive disorders of pregnancy → Abnormal fetal positions, shoulder dystocia & multiple gestation → Preterm labor and delivery → Obstetric hemorrhage

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 21, 5 ed., 2013. p.311-328.

Risk of Having a Placenta Accreta Relative to Prior Cesarean Deliveries

Number of Prior Cesarean Deliveries	% of Patients with Placenta Accreta[a]	% of Patients with Placenta Accreta[b]
0	5	3
1	24	11
2	47	40
3	40	61
4 or more	67	67

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Paul G Barash. Clinical anesthesia. Chapter 41:Obtetrics anesthesia, 8 ed., 2017. p.2871-2884.
Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 21, 5 ed., 2013. p.311-328.

Postpartum hemorrhage

- defined as blood loss > 500 mL after vaginal delivery or > 1,000 mL after cesarean section

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 21, 5 ed., 2013. p.311-328.

Novel pharmacologic intervention

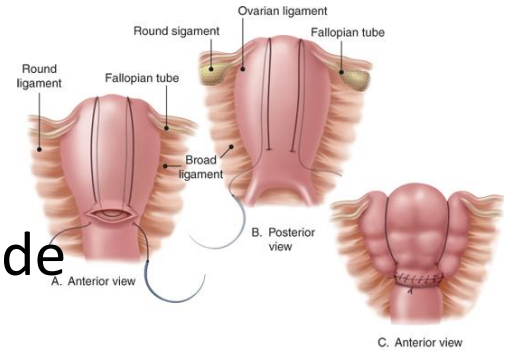
- Recombinant Factor VIIa (rFVIIa) → off-label

- Antifibrinolytics;
  - Tranexamic acid (50 - 100 mg/kg)
  - Epsilon aminocaproic acid (10 - 15 g)

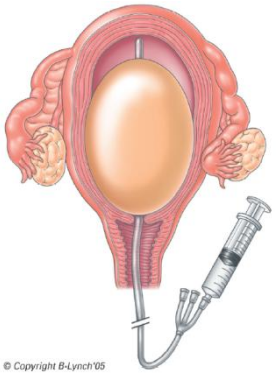
Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 21, 5 ed., 2013. p.311-328.

OBSTETRICAL INVASIVE MANAGEMENT OF HEMORRHAGE

- B-Lynch Technique



- Uterine Balloon Tamponade



- Devascularization of the Uterus
  - Ligation of Uterine Arteries
  - Ligation of Ovarian Arteries
- Hypogastric Artery Balloon Catheters
- Radiologic Embolization of Uterine & Ovarian Arteries
- Cesarean or Postpartum Hysterectomy

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HEMORRHAGE & BLOOD TRANSFUSION

- TRALI (within 1-2 hours)→ cause of morbidity & mortality
  - severe hypoxemia, bilateral pulmonary edema, hypotension & fever
- TACO
- TRIM (transfusion-related immunosuppression)

- Stored blood → decreased 2, 3-diphosphoglycerate (2, 3 DPG)
  → oxyhemoglobin dissociation curve to the left

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 21, 5 ed., 2013. p.311-328.

TRANSFUSION TRIGGERS IN THE PERIPARTUM PERIOD

- Red Cell Transfusion --Indicated when Hb < 6-7 g/dL
- Plasma → greatest risk of TRALI
- Platelets -- Indicated when platelet count < 50,000/µL
- Cryoprecipitate -- indicated for hypofibrinogenemia
- Prothrombin Complex Concentrates (PCC)

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 21, 5 ed., 2013. p.311-328.

TRANSFUSION TRIGGERS IN THE PERIPARTUM PERIOD

- Blood Conservation Therapy & Blood Management
  - Iron & Erythropoietin
  - Predelivery Autologous Blood Donation → limited?
  - Acute Normovolemic Hemodilution → limited?
  - Blood Salvage

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 21, 5 ed., 2013. p.311-328.

Hemorrhage Protocols

- Underestimation of blood loss
- Delay in administration of blood
- Lack of working equipment
- Delay in response from obstetrical team

Paul G Barash. Clinical anesthesia. Chapter 41:Obtetrics anesthesia, 8 ed., 2017. p.2871-2884.

Hemorrhage potocol

- Massive hemorrhage; defined as PRBCs transfusion > 10 units
  → PRC : FFP : platelets = 1:1:1 ratio
- Early administration of platelets & cryoprecipitate
- Cautions → hypothermia, metabolic acidosis, coagulopathy
- Point-of-care testing of clotting with thromboelastography (TEG) or rotational thromboelastometry (ROTEM)

Shnider and Levinson's, Anesthesia for Obtetrics, Chapter 28:, 5 ed., 2013. p.437-459.

Massive Transfusion Protocols

- During massive blood loss
- Goal is to approximate whole blood
  - Concept is FFP and platelets relative to RBC
- Many protocols exist
  - Red blood cells: 6 units
  - FFP: 6 units
  - Platelets: 1 apheresis unit (6 units platelets)
  - Cryoprecipitate: 1 pooled unit (5 units cryo)

Paul G Barash. Clinical anesthesia. Chapter 41:Obtetrics anesthesia, 8 ed., 2017. p.2871-2884.

Blood conservation techniques

"Intraoperative cell salvage"

- antifibrinolytic drug tranexamic acid

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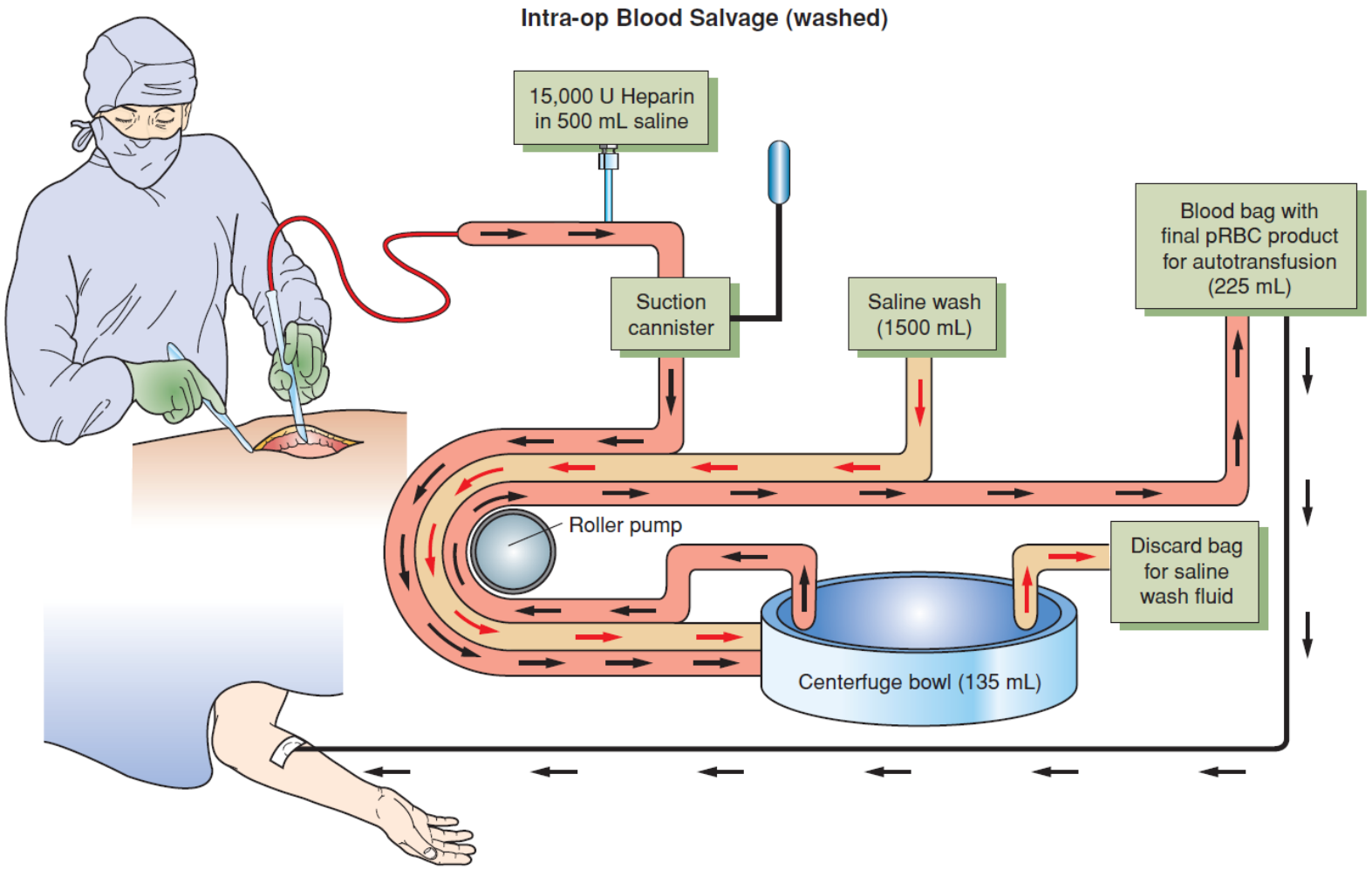
Typical blood salvage device set-up in operation



Hypertensive disorders of pregnancy

Abnormal fetal positions, shoulder dystocia & multiple gestation

Preterm labor and delivery

Obstetric hemorrhage

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Anesthetic Management in Complicated Obstetrics

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