Preeclampsia, Previa, or Placental Abruption: Help! The P's of Complicated Pregnancies

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Disclosure

- No financial disclosures
- No off-label use

Learning Objectives

- Understand the etiology of preeclampsia
- Design an anesthetic plan considering the pathophysiology of preeclampsia
- Understand the risks of thrombocytopenia
- Perform a risk-benefit analysis of regional anesthesia in a patient with low platelets

A 16-year old parturient

- G1P0, Caucasian, 70 kg
- 35 weeks singleton gestation
- BP 170/110 mmHg
- Plt 50,000/μL

What in this pt's history is a risk factor for preeclampsia?

- A. Age
- B. Race
- C. Gestation
- D. Weight

Classic Medical Teaching : Triad

- Proteinuria
- Raised blood pressure
- Edema

What About Preeclampsia?

- Typically after 20th week gestation but rarely before the 24th week
- Can occur earlier with hydatidiform mole
- Complicates 5-8% of pregnancies
- More likely to occur at extremes of reproductive ages
- Largest Risk Factor: first pregnancy

Advanced Maternal Age

- 177 women age > 45 yr
- Compared to 5310 women < 45 yrs
- 19.7% vs 4.5% for preeclampsia

Yogev Y. Am J Obstet Gynecol 2010;203:558,e1-7

Subsequent Preeclampsia

- 1515 women with preeclampsia identified
- 1354 followed on subsequent pregnancy
- 70% had normotensive subsequent pregnancy
- Double risk of stillbirth, placental abruption, and preterm delivery

Brown MA. BJOG 2007;114:984-993

Wikstroem AK. Am J Obstet Gynecol 2011;204:148

Subsequent Preeclampsia

- 598 parturients with recurrent preeclampsia vs 2934 nulliparous with preeclampsia
- Greater incidence of:
  - Severe preeclampsia (17.9% vs 5.3%)
  - Preterm delivery (67% vs 33%)
  - Abruptio placentae (6.7% vs 1.5%)

Hnat MD. Am J Obstet Gynecol 2002;186:422-6

ACOG Definition

- Systolic blood pressure ≥ 140 mmHg
- Diastolic blood pressure ≥ 90 mmHg
- 0.1 gm/L protein in urine or more than 0.3 gm/24 hr

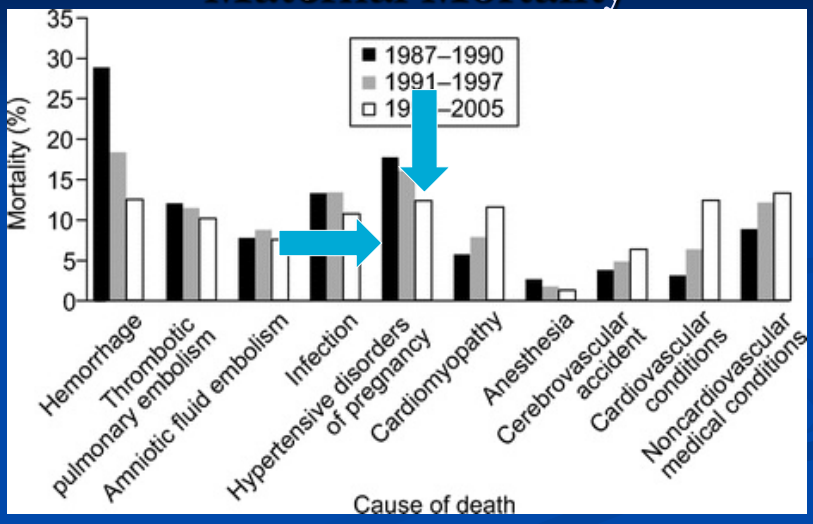
Severe Preeclampsia

- Systolic blood pressure ≥ 160 mmHg
- Diastolic blood pressure ≥ 110 mmHg
- Proteinuria ≥ 5 gm/24 hrs
- Oliguria ≤ 400 ml/24 hrs
- Cerebral visual disturbances
- HELLP
- Epigastric pain
- Pulmonary edema
- Intrauterine growth retardation

Laboratory Manifestations

proteinuria	elevated hemoglobin
elevated creatinine	thrombocytopenia
elevated uric acid	elevated PT and Ptt
elevated liver enzymes	microangiopathic hemolytic anemia

Preeclampsia: A Significant Cause of Maternal Mortality



Berg CJ. Obstet Gynecol 2010:116:1302

What is the most common cause of mortality in preeclamptics?

- A. liver hematoma
- B. pulmonary edema
- C. placental abruption
- D. cerebral hemorrhage

Life Threatening Manifestations

seizure	DIC
cerebral hemorrhage	pulmonary edema
renal failure	ventricular dysfunction
hepatic failure	placental abruption
liver hematoma	

Anesthetic Management Does Matter

- 303862 women undergoing C/sect
  - 295295 without preeclampsia
  - 8567 with preeclampsia
- 303 developed stroke
- Increased risk with general anesthesia
  - Hazards Ratio 2.38

Huang CJ. Br J Anaesth 2010;105:818

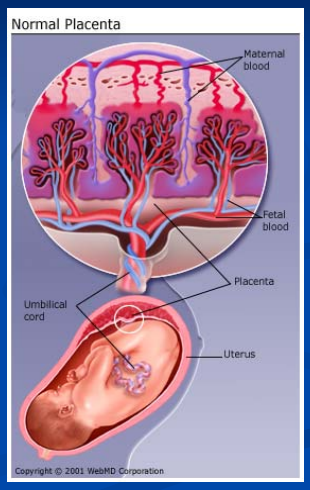
Model to Predict Risk for Adverse Outcome

- PIERS (Preeclampsia Integrated Estimate of Risk)
- Predictors of Adverse Outcome: gestational age, chest pain, dyspnea, oxygen saturation, platelet count, creatinine, aspartate transaminase concentration
- Applied to 261 women with preeclampsia who had an adverse outcome
- Model predicted 75% of adverse outcomes

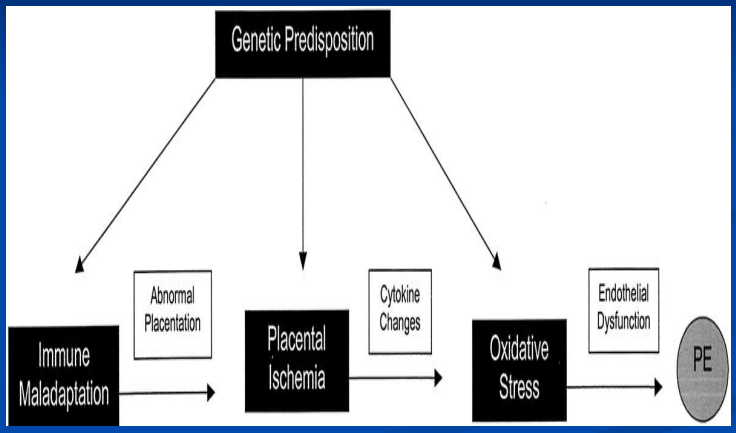
von Dadelszen P. Lancet 2010;377:219-27

Etiology: Two Step Process

- Requires input
  - From placenta
  - From mother
    - Via underlying susceptibility



Etiology of Preeclampsia



Immunologic Mechanism for Preeclampsia

- 823 women who underwent IVF
  - 438 donor sperm
  - 275 partner sperm
- Incidence of preeclampsia
  - 10.9% vs 7.2%
- Risk for preeclampsia
  - Use of donor sperm
  - Number of previous cycles (first has highest risk)

Kyrou D. Fert Steril 2010;93:1124-7

Genetic Basis for Preeclampsia

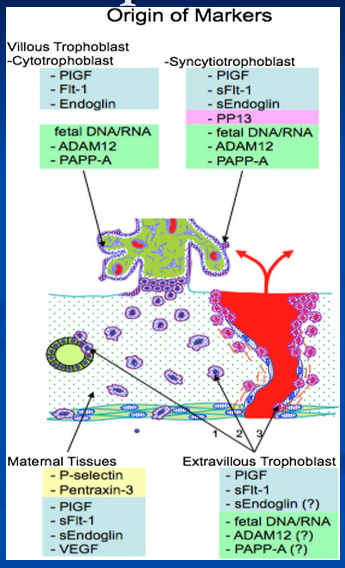
- 37 preeclamptic and 58 normal pregnancies
- 26,504 expressed transcripts
- Preeclampsia-associated genes
- Heritability – 55%
- Contributions from maternal and fetal genes

Williams PJ. Best Pract Res Clin Obstet Gynaecol 2011;25:405

Loeset M. Am J Obstet Gynecol 2011;204:84

Etiology of Preeclampsia

- Placenta develops from trophoblasts which differentiate into two types
- In preeclampsia, dysfunctional trophoblasts result in inadequate invasion into myometrium
- Biochemical markers are products of trophoblasts
  - Refect placental dysfunction



Cetin I. Placenta 2011;32:S4

Placentation

- Involves angiogenic-related gene products
- Angiogenic
  - Placental growth factor (PlGF)
  - Vascular endothelial growth factor (VEGF)
- Antiangiogenic
  - Endoglin
  - Soluble fms-like tyrosine kinase 1 (sFlt1)

VEGF

- Induces nitric oxide and prostacyclins
- Endothelial-specific mitogen
- Necessary for fenestration of endothelia cells
- Antagonized by sFlt1

Baumwell S. Nephron Clin Pract 2007;106:72-81

PlGF

- Antagonized by sFlt1
- Lower in women with subsequent preeclampsia
- Calcium for Preeclampsia Prevention
  - Early onset of decreased levels
  - Measured ratio of PlGF and sFlt1

Levine RJ. Clin Obstet Gynecol 2005;48:372-386

sFlt1

- Sequesters VEGF and PlGF
- Circulating levels correlate with severity of disease
- Can be measured in urine and blood
- Inject sFlt1 in pregnant rats develop symptoms of preeclampsia
- Preeclampsia – levels increase by 20 weeks gestation
  - Increase occurs 5 weeks before onset of disease
- Smoking inhibits sFlt1

Levine RJ. Clin Obstet Gynecol 2005;48:372-386

Endoglin

- Highly expressed on cell membranes of vascular endothelium
- Inhibits capillary tube formation
- Up-regulated in preeclampsia
- Antiangiogenic protein
- Blood specimens from Calcium for Preeclampsia Prevention (1992-1995)
  - Levels increase 2-3 months before disease

Levine RJ. NEJM 2006;355:992-1005

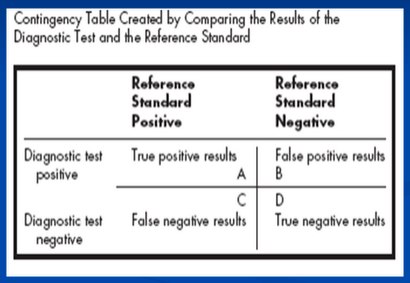
Prediction of Preeclampsia

- Serum from 240 women between 13 and 16 weeks gestation
- Measured serum levels of sFLT-1 and PlGF
- 27 women had preeclampsia
- PLGF (81.1 vs 118 pg/mL)
- sFlt1 (3,281 vs 1303 pg/mL)
- Sensitivity: sFlt1 100; PlGF 81.5
- Specificity: sFlt1 98.6; PlGF 97.2
- Similar changes seen in IUGR

Shokry M. Acta Obstet Gynecol 2010;89:143-6

Two commercial immunoassays

- Triage placental growth factor assay
- Elecsys soluble Fms-like tyrosine kinase-1/placental growth factor ratio
- 44 patients with preeclampsia/84 controls
  - Triage - 100% sensitivity; 96% specificity
  - Elecsys - 92% sensitivity; 100% specificity


Contingency Table Created by Comparing the Results of the Diagnostic Test and the Reference Standard

	Reference Standard Positive	Reference Standard Negative
Diagnostic test positive	True positive results A	False positive results B
Diagnostic test negative	False negative results C	True negative results D

Benton SJ. Am J Obstet Gynecol 2011;205:469

Predicting the Future

- Increased incidence of cardiovascular morbidity/mortality
- RR 1.3 to 3.07

Harskamp RE. Am J Med Sci 2007;334:291-295

Meta-Analyses of Cardiovascular Risk

- 5 case-control and 10 cohort studies
- 116,175 women with and 2,259,576 women without preeclampsia
- Increased risk of
  - Cardiac disease (RR 2.33)
  - Cerebrovascular disease (RR 2.03)
  - Cardiovascular mortality (2.29)

McDonald SD. Am Heart J 2008;156:918

Risk Factor for CVD

- Cigarette smoking
- SBP > 120, DBP > 80
- Increased cholesterol
- Obesity
- Poor diet
- Physical inactivity
- Metabolic syndrome
- History of Preeclampsia

Circulation 2011;123:1243

Modification of Risk

- Utility of aspirin continually debated
- Meta-Analysis of 34 studies
- Low dose aspirin started at 16 weeks gestation or less
  - RR 0.47 (0.34-0.65)
  - No benefit if started after 16 weeks

Bujold E. Obstet Gynecol 2010;116:402-14

Children Born to Mothers with Preeclampsia

- 1,618,481 single gestations in Denmark
- Preeclampsia at Term
  - Increased risk of respiratory disease
  - Increased risk of hypertension
- Preeclampsia Preterm
  - Decreased risk of cerebral palsy

Wu CS. Am J Obstet Gynecol 2011;204:157
Palmsten K. Obstet Gynecol 2010;116:858

Children Born to Mothers with Preeclampsia

- Adults who participated in New England Family Study between 2001 and 2004
- Collaborative Perinatal Project (1959-1966)
- 1625 adults identified; 98 born to mothers with preeclampsia
- Risk of being prescribed antihypertensive(17.4% vs 8.8%)
- Odds Ratio 1.97

Palmsten K. Obstet Gynecol 2010;116:858-64

Therapeutics

- The only known treatment for preeclampsia is delivery of the fetus and placenta

HYPITAT (Hypertenion and Preeclampsia Intervention Trial at Term)

- 756 women diagnosed with preeclampsia between 36 and 41 weeks
- Randomized to expectant mgmt (E) or induction(I)
- Poor maternal outcome: 44%E vs 31%I
- No difference in neonatal outcome

Koopmans CM. Lancet 2009;374:979

- Economic analysis
- Costs of expectant, induction, mgmt of complications for one year
- Induction resulted in a saving of $1,180 for I
- Mostly from testing for expectant mgmt

Vijgen SMC. BJOG 2010;117:1577

Therapeutics

- Anticonvulsants used to prevent eclampsia and improve outcome
- Only 1-2% of those with preeclampsia will develop eclampsia

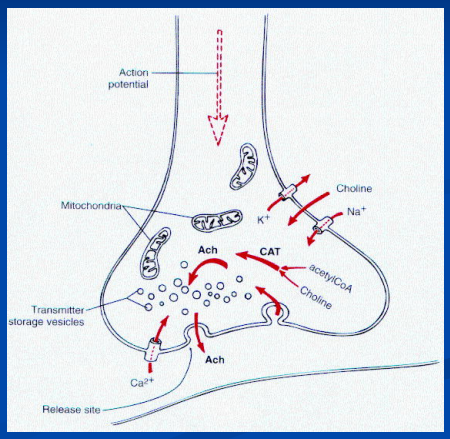
What is the best medication for the prevention of seizures?

- A. phenytoin
- B. nimodipine
- C. labetalol
- D. magnesium

Magnesium: Anticonvulsant for Preeclampsia

- Magnesium: More than halves risk of eclampsia
- Side Effects:
  - Flushing
  - Weakness
  - Increased sensitivity to nondepolarizing muscle relaxants

Duly L. Cochrane Database of Systematic Reviews 2010;11:CD000025



Duly L. Cochrane Database of Systematic Reviews 2010;11:CD000025

Magnesium: Only Seizure Prevention?

- Neuroprotection
- Lower incidence of cerebral palsy with lower doses

Pryde PG. Obstet Gynecol 2009;114:669-73

Time to Resolution of Symptoms

- 205 preeclamptic women between 1990 and 1992
- 3 months postpartum
  - 39% hypertensive
  - 14% proteinuria
- 2 years postpartum
  - 18% hypertensive
  - 2% proteinuria

Berks D. Obstet Gynecol 2009;114:1307-14

Spinal anesthesia is contraindicated in pts with severe preeclampsia.

- A. True
- B. False

Spinal Anesthesia in Severe Preeclampsia

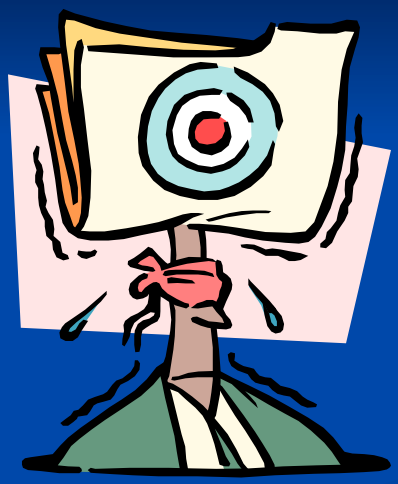
- Prospective study of 60 parturients (30 with severe preeclampsia) undergoing cesarean delivery during spinal anesthesia (8-12 mg hyperbaric bupivacaine)
- Severely preeclamptic patient had a less frequent incidence of hypotension
- Less ephedrine and less fluids in preeclamptic group

Aya AG. Anesth Analg 2003;97:867

Prospective Study

- 100 patients with severe preeclampsia (by BP) randomized to:
  - Epidural Lidocaine 2% with epinephrine (n=47)
  - Spinal Bupivacaine 0.5% (n=53)
- Higher incidence of hypotension (51% vs 23%)
- Short duration of hypotension (<1 min)
- No difference in Apgar, umbilical pH

Visalyaputra S. Anesth Analg 2005;101:862-8

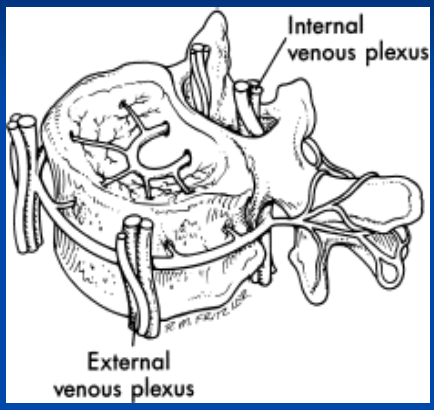


Epidural Analgesia in the Parturient with Preeclampsia and Low Platelets

What is my largest concern with epidural in a pt with thrombocytopenia?

- A. Seizure
- B. Hypotension
- C. Epidural Hematoma
- D. Nerve Injury

Risk of Bleeding and Major Conduction Anesthesia

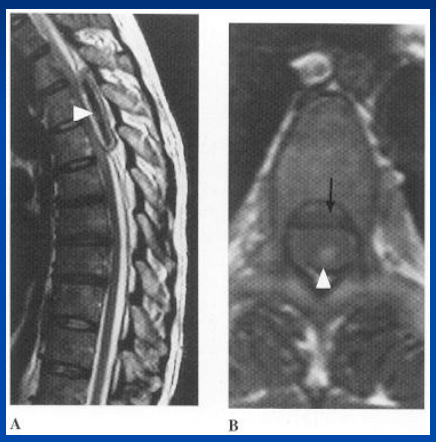


- Spinal/epidural hematoma
- More common in epidural space
- Presents with severe back pain and progresses to paraplegia
- Diagnosis confirmed by MRI or CT scan

PRACTICE GUIDELINES FOR OBSTETRIC ANESTHESIA

- Both the consultants and ASA members agree that, for patients with suspected preeclampsia, a platelet count reduces maternal anesthetic complications
- Adopted 2006

Risk of Epidural Hematoma



- 1906 – 1994 – 61 cases of spinal hematoma involving neuraxial anesthesia
  - 42 involved the use of anticoagulant drugs or presence of clotting disorder
  - 36% involved multiple difficult traumatic placement
  - 46 cases with epidural anesthesia occurred after catheter removal
- Vandermeulen EP. Anesth Analg 1994;79:1165-77

My lowest limit for platelet count is:

- A. 100,000
- B. 80,000
- C. 60,000
- D. 40,000

Major Conduction Anesthesia in Patients with Low Platelets

Author	# of Pts	Plt Count X 1000/μL	Anesth	Outcome
Roberts	132	≤ 50	NS	NO CNS Bleed
	160	50-100	NS	No CNS Bleed
Tompkins	23	100-150	epidural	No complication
	5	75-100	epidural	No complication
	4	50-75	epidural	No complication
	2	<50	epidural	No complication

Major Conduction Anesthesia in Patients with Low Platelets

Author	# of Pts	Plt Count x 1000/μL	Anesth	Outcome
Beilin	30	69-98	epidural	No complication
Hew-Wing	1	2	epidural	No complication
Rolbin	2	50-74	epidural	No complication
	1	75-99	epidural	No complication
	13	100-125	epidural	No complication

Two Additional Points to Ponder

Author	# of Pts	Plt Count X 1000/μL	Anesth	Outcome
Rolbin Bertram	4 1	100-125 26	Spinal epidural	No complication Excellent
Yuen	1	71	epidural	Epidural Hematoma

Evidence

- 42 cases of epidural catheters placed in parturients with platelet counts < 100,000/μL
- One case report of epidural hematoma

What About That Epidural Hematoma

- 20 year old G1P0 35-week gestation
- Admission plt count – 49,000/μL
- Plt count 3 days later – 71,000/μL
- Transfused 6 units platelets
- Cesarean Section – no excessive bleeding and epidural pulled at the end of surgery
- Seizure with sparing of lower limbs

Yuen TST. Anaesthesia 1999;54:350-4

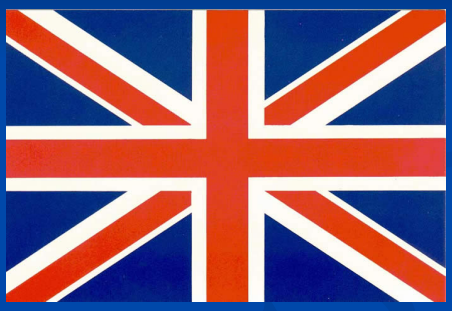
What About That Epidural Hematoma

- CT scan – multiple air bubbles at the basal cistern, sulci, and parietofrontal region
- 2x1 cm hematoma compressing spinal cord
- Laminectomy – 4 ml clot removed
- Should we wait to pull catheters?

Yuen TST. Anaesthesia 1999;54:350-4

Review from England

- Reviewed literature in obstetric patients
- Safe
  - 80,000 for spinal/epidural
  - 40,000 for LP
- Individual decision
  - 50 – 80,000 Epidural/ spinal
  - 20-40,000 LP



Van Veen JJ. BJH 2009;148:15-25

Platelet Dysfunction and Preeclampsia

- Measured bleeding times:
  - 44% with preeclampsia had normal platelet counts and prolonged bleeding time
- Measured time to occlude aperature
  - Preeclamptic patients had a 14 sec difference with Epi
- Current teaching: Studies of aberrations of platelet function are contradictory

Kazmi RS. Sem Thromb Hemost 2011;37:131

Summary

- Angiogenic proteins play a prominent role in the disease process
- Spinal anesthesia is not contraindicated in the severe preeclamptic
- Decision to place epidural is clinical not laboratory based

Parting Thought About Preeclampsia

- 15 women with preeclampsia
- Epidural catheter inserted at T6-7
- Achieved BP control with epidural analgesia
- No magnesium
- Duration of analgesia
  - Avg 5 days
  - Range 2-7 days

Malvasi A. J Obstet Gynecol 2009;29:114-8

Another Problem: Hemorrhage

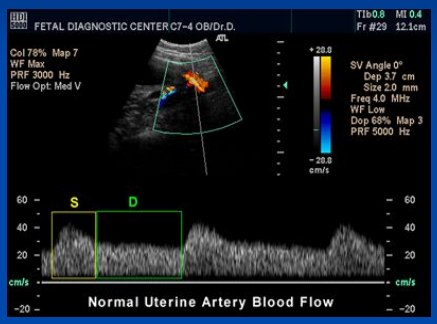
- Traditional
  - > 500 ml in vaginal delivery
  - >1000 ml in cesarean delivery
  - Typically exceeded
  - Grossly underestimated
- Hemodynamic definition
  - Bleeding that results in hemodynamic instability
  - >1500 ml blood loss before compensatory mechanisms fail

Werner HR. Acta Obstet Gynecol 2011;90:421

What is uterine blood flow at term?

- A. 50 ml/min
- B. 200 ml/min
- C. 350 ml/min
- D. 500 ml/min

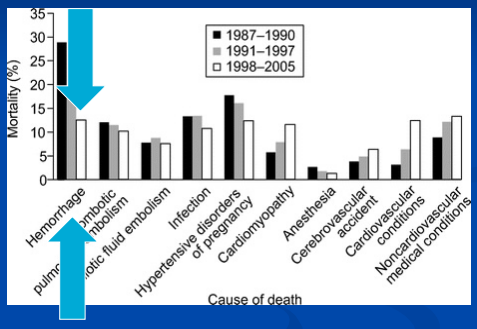
Uterine Blood Flow



- Nonpregnant – 50 ml/ min
- Term – 500-700 ml/min

Maternal Deaths in the United States

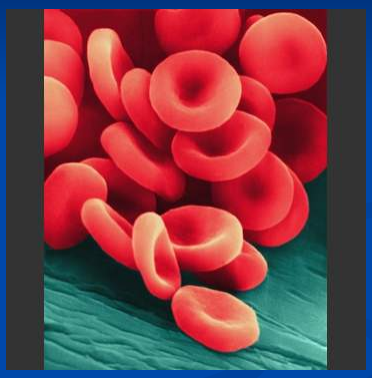
- Accounts for 12% of maternal deaths
  - Increase in placenta accreta



Berg CJ. Obstet Gynecol 2010;116:1302

Epidemiology of Postpartum Hemorrhage

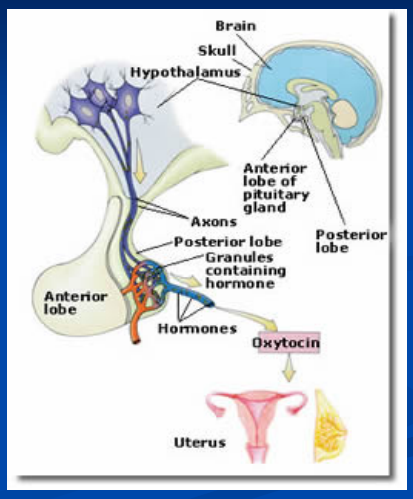
- Nationwide Inpatient Sample
- In 2004
  - 2.9% of all deliveries had PPH
    - Uterine atony 79%
  - 19.1% of deaths due to PPH



Bateman BT. Anesth Analg 2010;110:1368-73

Oxytocin Resistance

- 54 women with severe PPH (required transfusion) matched to 54 who did not
- Higher oxytocin use during labor, 10054 units vs 3762 units (areas under curve)
- Oxytocin receptor desensitization



Grotegut CA. Am J Obstet Gyencol 2011;204:56

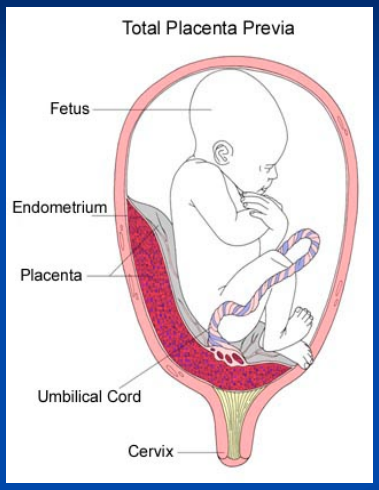
Which of the following is a cause of antepartum hemorrhage?

- A. placenta abrutpion
- B. uterine atony
- C. vaginal tear
- D. placenta accreta

Antepartum Hemorrhage

- Placenta Previa
- Placental Abruption

Placenta Previa



- Complete – 37%
- Partial – 27%
- Low-lying – 46%

Risk Factors

- Previous C-section
- Previous uterine surgery
- Smoking
- Older age
- Multiparity
- Multiple pregnancy

Placenta Previa

- Painless vaginal bleeding
- Generally occurs during cervical dilation
- Blood is bright red that clots
- Diagnosed via transvaginal ultrasonography (99% accuracy)

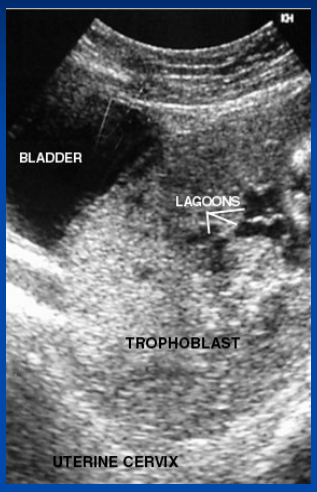
Management of Placenta Previa

- Bed rest if not bleeding
- Schedule cesarean section
- If bleeding, urgent cesarean section

What is the one question to ask a patient with a placenta previa?

- A. How much bleeding?
- B. Any previous cesarean sections?
- C. How long have you known?
- D. Is this your first pregnancy?

Placenta Previa and Previous Cesarean Section



- High risk of placenta implanting in or on the myometrium
- Accreta – onto
- Increta – in
- Percreta - through

Incidence of Placenta Accreta

- Risk of Placenta Accreta for C-section 1-6
  - 0.2%, 0.3%, 0.6%, 2.1%, 2.3%, and 7.7%
- Risk of Placenta Accreta with Placenta Previa for C-Section 1-5
  - 3%, 11%, 40%, 61%, and 67%

Silver RM. Obstet Gynecol 2006;107:1226

Morbidity of Nonemergent Hysterectomy

- 29 patients identified
  - Mulitparous, >2 cesarean sections, 21 placenta previa
- Average Operative Time: 216 minutes
- Blood loss: 4061 ml
- Morbidity:
  - Ureteral transection
  - Cystotomy
  - Cystectomy
  - Postoperative hemorrhage

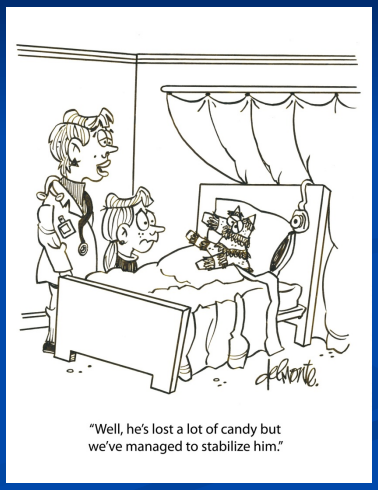
No predictor for hemorrhage with placenta accreta

Hoffman MS. Am J Obstet Gynecol 2010;202:628

Wright JD. Am J Obstet Gynecol 2011;205:38

Transfusion and Placenta Accreta

- Retrospective review of 66 women with placenta accreta
- Incidence of transfusion 95%
  - Mean RBC 10 units (0-48)
    - 39% required 10 or more units
    - 11% required 20 or more
  - Range of Platelets 0-64
  - Range of cryoprecipitate 0-30

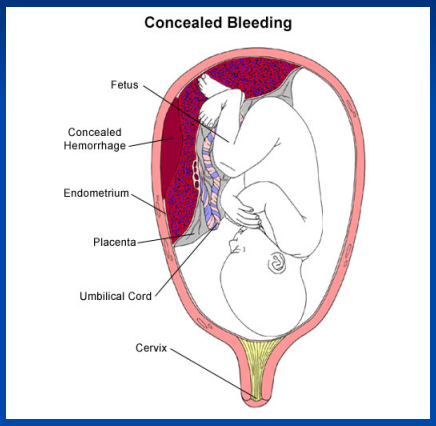


Stotler B. Transfusion 2011;51:2627

What is the leading cause of DIC in pregnancy?

- A. placenta previa
- B. placenta accreta
- C. abruptio placenta
- D. uterine atony

Placental Abruption



- Separation of the placenta after 20 weeks gestation but before birth of fetus
- Incidence – 0.2-0.4% pregnancies

Risk Factors for Placental Abruption

- Preeclampsia
- Hypertension
- Multiparity
- Hx of placental abruption
- Cocaine
- Trauma

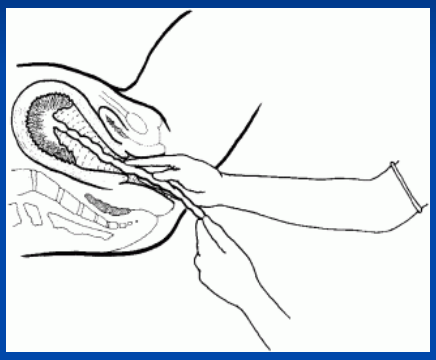
Placental Abruption

- Painful bleeding
- Bleeding may be concealed
- Associated with disseminated intravascular coagulopathy

Postpartum Hemorrhage

- 3-5% of all deliveries
- Major causes
  - Retained placenta
  - Uterine atony
  - lacerations

Retained Placenta



- Incidence – 1% of all deliveries
- Requires manual exploration of uterus
- Treated with nitroglycerin 50 to 100 μg

Uterine Atony

- Incidence – 2-5% of all deliveries
- Risk Factors
  - Multiparity
  - Multiple births
  - Operative vaginal deliveries
  - Polyhydramnios
  - Large infants
  - Retained placenta
  - chorioamnionitis

Treatment of Uterine Atony

Oxytocin	10-40 units to 1 L	Continuous	Hypo-tension?
Methylergonovine	0.2 mg im	Every 2-4 hour	Avoid if hyperten-sive
15-methyl PGF2α	0.25 mg im	Every 15-90 min, limit 8 doses	Avoid if asthmatic
Dinopros-tone (PGE2)	Suppository 20 mg	Every 2 hr	Avoid if hypotensive
Misoprostol (PGE1)	800-1000 mcg rectally		

Hemorrhage in the Obstetric Patient

- Resuscitation – notify blood bank
- Hysterectomy or bilateral ligation of the internal iliac arteries
- New technique – suture the uterus (works if bimanual compression of the uterus decreases the bleeding)
- Consider arterial embolization

Systematic Review of Postpartum Hysterectomy

- 24 articles of 981 cases of emergency postpartum hysterectomy
- Additional surgical intervention
  - Adnexectomy
  - Ligation of internal iliac, uterine, and hypogastric arteries
- Maternal Death: 26 of 981 cases
- Risk factors:
  - Multiparity
  - Previous cesarean delivery
  - Abnormal placentation

Rossi AC. Obstet Gynecol 2010;115:637

Guidelines for Obstetric Anesthesia

- Adopted in 2006
- Suggested Resources for Obstetric Hemorrhagic Emergencies
  - Large bore intravenous catheters
  - Fluid warmer
  - Forced air body warmer
  - Availability of blood bank resources
  - Equipment for infusing intravenous fluids and blood products rapidly

Summary of Hemorrhage

- Hemorrhage remains a major cause of maternal morbidity
- Increase cesarean sections worsens the prognosis with placenta previa
- Uterine atony can be treated with any of the oxytocics
- Uterine blood flow at term 500-700 ml/min

Perimortem Cesarean Section

- Greek mythology – Asklepios was delivered by father Apollo from womb of dead Koronis
- 715 BC – fetus to be cut from abdomen
- Scipio, general who defeated Hannibal was born this way
- Jacob Nufer, 1500AD, sectioned his own wife and both lived

Why Do a Perimortem Cesarean Section

- 27-year old G1P0 at 37 weeks gestion
- Developed massive hemoptysis
- 25 minutes CPR
- Performed cesarean delivery
- Able to resuscitate mother

DePace NL. JAMA 1982;248:971

Perimortem Cesarean Section – Good for the Mom?

- Relieves aortocaval compression
- Allows for effective chest compression
- 35-year old G5P3 at term - cardiac arrest
- 9 minutes of CPR then C/S
- After delivery, immediate palpable radial pulse

Finegold H. Anesthesiology 2002;96:1278

Perimortem Cesarean Section - Good for the Baby?

- 0-5 minutes – 42 infants – all normal
- 6-10 minutes – 8 infants – 7 normal and one with neurologic impairment
- 11-15 minutes – 7 infants – 6 normal and one severe impairment
- 16-greater minutes – 3 infants – all with neurologic impairment

Katz VL. Obstet Gynecol 1986;68:571

Five Minute Rule – Valid?

- Ovid medline search from 1985 – 2004
- 38 cases of perimortem cesarean delivery
  - 34 infants survived
  - Of 20 arrests with potentially resuscitable causes
    - 13 mothers survived and were discharged in good condition
    - 12/18 reported immediate return of maternal pulse

Katz V. Am J Obstet Gynecol 2005;192:1916

Five Minute Rule – Valid?

Table I Perimortem cesarean deliveries with surviving infants with reports of time from maternal cardiac arrest to delivery of the infant, 1985-2004[6,7,11,12,14-16,20-23,25-27,29,31,33-35]

Time (min)	Gestational age (wk)	Number of patients
0-5	25-42	8 (normal infant) (retinopathy of prematurity and hearing loss) 3 (condition not reported)
Subtotal		12
6-10	28-37	1 (normal infant) 2 (neurologic sequelae) 1 (condition not reported)
Subtotal		4
11-15	38-39	1 (normal infant) 1 (neurologic sequelae)
Subtotal		2
>15	30-38	4 (normal infants) 2 (neurologic sequelae) 1 (respiratory sequelae)
Subtotal		7
Total		25

Table III Effect of perimortem cesarean section on maternal circulation, reported cases 1985-2004[7,9-18,22,23,27-29,33,35]

Time from maternal cardiac arrest until delivery (min)	Return of spontaneous circulation and or improvement in hemodynamic status	No change
0-5	5	2
6-10	3	—
11-15	1	—
>15	4	5
Not reported	1	1
Total	12	8

- Katz V. Am J Obstet Gynecol 2005;192:1916

Five Minute Rule

- 4 minutes of resuscitation
- If not successful, then cesarean section at 5 minutes
- Only applies to gestations greater than 20 weeks
- Fetal viability is 24 weeks gestation

Knowledge of CPR in Pregant Women

- Survey sent to anesthesia, ob, EM faculty and residents
- 74 completed survey
- Anes scored highest
- 25% answered 5 minute rule correctly

"It's OK, this is a teaching hospital. Some people just have to learn that the hard way."

Cohen SE. Int J Obstet Anesth 2008;17:20-5

Summary

- Angiogenic proteins play a prominent role in the disease process
- Spinal anesthesia is not contraindicated in the severe preeclamptic
- Decision to place epidural is clinical not laboratory based
- Hemorrhage will only increase as the number of cesarean deliveries increase
- Five Minute Rule and 30 Minute Rule

Thanks!!

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