

# **OBSTETRIC CATASTROPHES**

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# Lecture Organization

- **Embolism**

  - Pulmonary Embolism**

  - Amniotic Fluid Embolism**

- **Eclampsia**

- **Hypertensive Crisis**

- **Local Anesthetic Toxicity**

- **Cardiopulmonary Arrest**

# Pulmonary Embolism

**Pulmonary embolism, along with amniotic fluid embolism, accounts for the leading cause of maternal mortality in the United States (Koonin, et al; 1989 MMWR)**

# Virchow's Triad:

- Stasis
- Hypercoagulability
- Vascular Damage

# DVT: Key Facts

- 40% of asymptomatic patients with DVT have radiographically documented pulmonary embolism
- DVT of pelvic venous system is often an asymptomatic condition until clinical pulmonary embolism develops
- Untreated pulmonary embolism mortality is up to 30%. Treated mortality is 3%

(Moser et al, 1994; Cunningham et al, 1997; Togliola & Weg, 1996)

# Diagnosis of Pulmonary Embolism

- Chest X-ray
- ECG
- Arterial blood gas
- D-dimer
- Ventilation-perfusion scintigraphy
- Angiography
- Thoracic enhanced CT
- Extremity Doppler

# Chest X-Ray Findings in PE:

- *Hampton's Hump:*  
pleural based density at CPJ
- *Westermarck's Sign:*  
peripheral oligemia with proximal vessel dilatation
- *Most common finding is normal X-Ray (30%)!*

# ECG Changes in PE:

- p-pulmonale, RBBB, RAD
- S1 Q3 T3
- New Onset A-Fib
- *Most common finding is normal (or sinus tach) ECG*

## Arterial blood Gas (ABG) in PE:

- Hypoxemia typical of moderate to large PE (from shunt and V/Q mismatching)
- Room air PaO<sub>2</sub> > 85 mmHg is reassuring- 15% of angiographically detectable PE's have room air PaO<sub>2</sub> greater than 85 mmHg.
- Hyperventilation of pregnancy confounding as both overlay of clinical presentation (pulmonary embolism presents with hyperventilation) and in the interpretation of PaO<sub>2</sub> (lower alveolar PCO<sub>2</sub> produces a higher PAO<sub>2</sub> for a given FIO<sub>2</sub>)
- Oxygen administration before ABG analysis confuses clinical picture!

(Robin, 1977; Phelan, 1997)

# **D-Dimer in the Diagnosis of Pulmonary Embolism**

- **D-Dimer testing measures level of specific fibrin degradation product**
- **Some studies suggest that D-dimer is elevated in patients with deep venous thrombosis**
- **Data on non-pregnant patients is mixed - best results show high sensitivity and low specificity (good screening test?). Others show less favorable results**
- **Pregnancy associated changes in hemostatic system may make D-dimer less reliable during pregnancy**

**(Ginsburg et al, 1998; Kutinsky et al, 1999)**

# **Etiology of PE:**

- **Often from proximal lower extremity clots (i.e. above knee)**
- **Clots in other locations are not unheard of, especially in pregnancy!**

**1/2 of pulmonary emboli during pregnancy arise from pelvic veins**

**(Erdman, 1990; Williams OB, 1993; Dunmire, 1989)**


# Radiographic Diagnosis of Pulmonary Embolism During Pregnancy:

- **Ventilation/Perfusion (V/Q) Scanning**
- **Pulmonary Angiography**
- **Spiral/Helical CT**

## V/Q Scintigraphy:

- Q = Technetium 99m (16 mRad)
- V = Xenon 133 (10 mRad)
- Interpretation of results:
  - Normal =no perfusion defects
  - High Probability
    - (> 85% PE with mismatched defect)
    - 2 Defects- segmental or greater

## V/Q Continued...

- Intermediate Probability
  - Low Probability
  - Indeterminate
- Segmental or subsegmental defects with or w/out vent. defects
- 

**Statistics- Normal and High Probability scans are very predictive. Intermediate and low probability scans are not accurate. 4% of those with low, indeterminate and normal scans have emboli! (PIOPED [Natl heart, Lung, and Blood inst.] trial, 1990)**

## V/Q Continued:

### Bottom Line

If the *a priori* risk of PE is high, and the V/Q is indeterminate, low or moderate - consider either treatment (or angiography) anyway

### V/Q is useful because -

If *a priori* low and scan normal, then PE not likely

High Probability is predictive of PE

Selective angiography can be used on suspicious V/Q areas - limiting dye use

Test has scant morbidity and 0 mortality

## **Lower Extremity Doppler- PE**

- **If lower extremity DVT is identified, then issue to anticoagulate is settled (DVT is treated by anticoagulation)**
- **Absence of lower extremity DVT does not exclude PE in non-pregnant patients**
- **Pregnancy has a higher rate of non lower extremity thrombosis - lower extremity DVT probably even less useful**

# Pulmonary Angiography in Dx of PE in Pregnancy:

- “Gold Standard” for diagnosis (95+% sensitivity and specificity)
- Invasive
  - 1-4% risk of arrest
  - Mortality 0.1 - 0.4%
- Selective angiography may be performed (when one embolic site found, test terminated)
- Radiation exposure risks (and “pseudorisks”) consideration in pregnancy

# Helical-Spiral CT

- **Technique uses high-speed contrast enhanced thoracic CT**
- **Preliminary results- great promise**
- **Very operator (radiologist) dependent**
- **Fairly specific (90-95%), but only moderately sensitive (50-60%)**
- **Best presently used as a confirmatory rather than a screening test**

**(Garg et al, 1998; Drucker et al, 1998)**

# Treatment- Pulmonary Embolism in Pregnancy

- Anticoagulation is mainstay of pharmacotherapy
- Supportive care should not be forgotten during the rush to diagnose and treat
- Likelihood of repeat events very high after initial embolism. Risk is not eliminated, even with anticoagulation.

# Heparin

- **Molecular Weight-15,000 d (4000 d if LMW Heparin)**
- **Activates AT III**
- **Increased fetal M/M reported- probably due to M/M in patients that was due to their underlying diseases requiring Heparin - not the Heparin itself**

**(Hall, 1980. Refuted by Ginsburg, 1989)**

# Heparin Continued (2)

- Antidote - Protamine sulfate
  - 1mg protamine reverses 1mg  
(approx 100 units heparin)
- Complications
  - bleeding
  - thrombocytopenia
  - Osteoporosis (risk 1/50?? with prolonged  
use dose related effect argued [.20k/day for  
> 6 mos)
  - (Rayburn, 1992; Hirsch, 1991)

## Heparin Cont. (3)

**Dosage- Acute Tx of Pulmonary Embolism**

**Intravenous- 5-10,000 unit bolus  
(65-75 U/kg)- followed by  
1000 U/hr**

**(20,000 U/Liter = 1000 U/hr at 50 cc/hr)**

**Therapeutic Goal- APTT 1.5-2.5 X Control**

## Heparin Cont (4)

IV Heparin is continued for 7-10 days

Afterwards, conversion to SQ dosing

10-20,000 U q 8-12 hrs to

maintain APTT at middose 1.5-2.0 X

Control

If Postpartum, may convert to Coumadin  
from IV Heparin

(Williams OB, 1993, Hirsch, 1991 and others)

# Low Molecular Weight Heparin

- More selectively inhibits X to Xa conversion
- Less theoretical risk of spontaneous bleeding
- When lower risk “abused”, reports of spontaneous epidural hematomas noted
- With proper use, may be better (albeit expensive) alternative to unfractionated heparin
- Use and indications should be equivalent to unfractionated heparin

(ACOG, 1998 and others)

# Low Molecular Weight Heparin (2)

- Anticoagulation dose = 1 mg/kg every 12 hours in non-pregnant subjects
- Optimal dose in pregnancy not known
- Must monitor factor anti Xa effect (0.4-1.0 U/mL 3-4 hours after injection)
- aPTT will NOT be prolonged
- Large trials pending

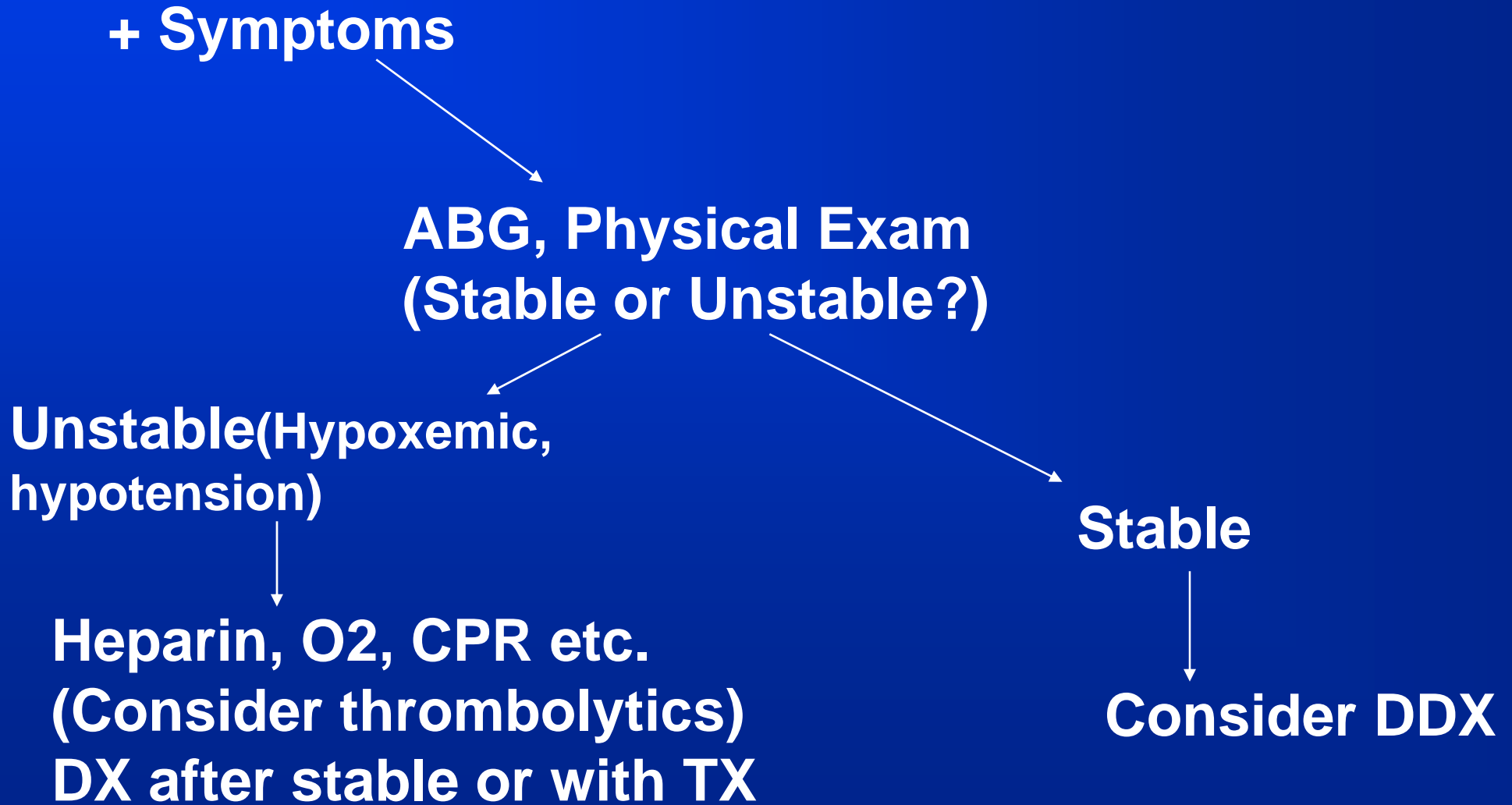
(Thompson et al, 1998; Sanson et al, 1999; Aguilar and Goldhaber, 1999)

# Thrombolytic Therapy:

- **Relative contraindication AT DELIVERY**
- **Some case-report experience**
- **Significant bleeding with use**
- **USE AS ALTERNATIVE TO THORACOTOMY (OR DEATH) IN UNSTABLE patient.**
- **PA-catheter directed treatment may allow lower dose**

**(Garite and Briggs, 1997; Nishimura et al, 1998)**

# Dx/Tx Algorithm for PE in Pregnancy (1)



## Dx/Tx PE Continued (2)

Consider DDX

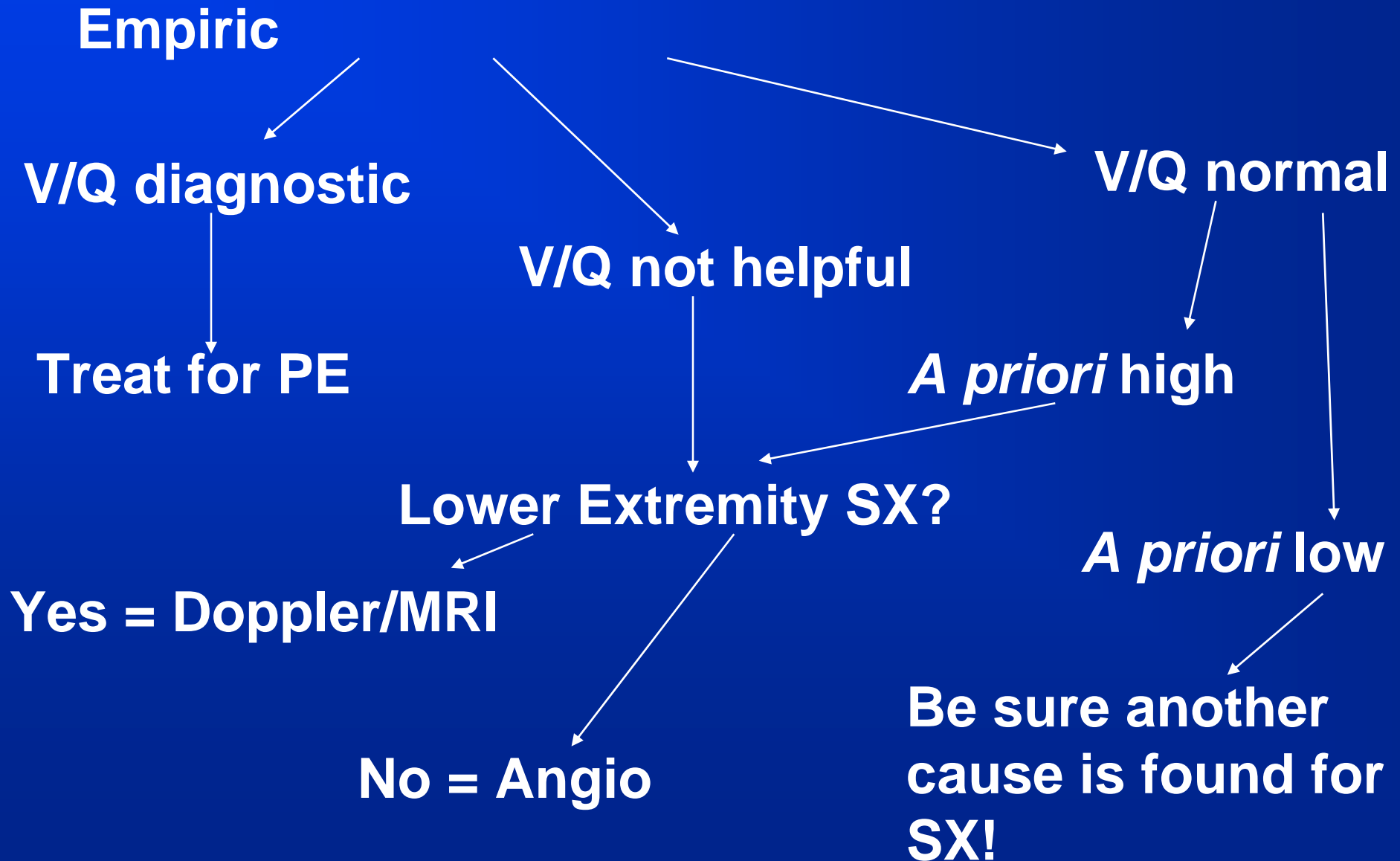
ABG (if not done), ECG,  $\pm$  CXR  
(no delay!)

Other Cause= TX

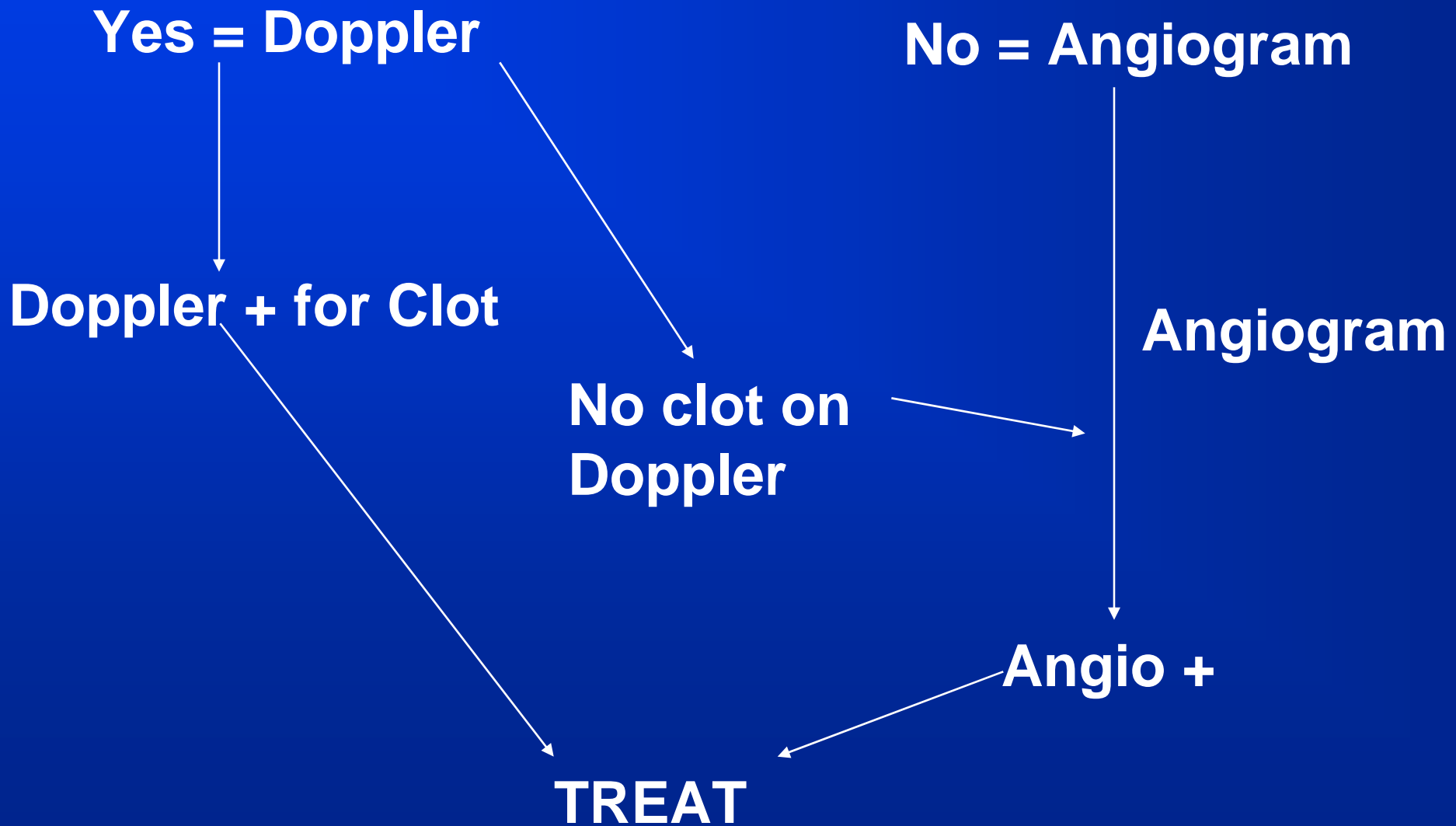
PE still not ruled out-  
**SUSPECTED**

Consider Empiric Heparin  
V/Q Scan (heparin if V/Q delayed)

## DX/TX PE Cont. (3)



# DX/TX Algorithm for PE Cont (4)



# Management of Labor in Patient Who is Anticoagulated:

1. Stop full-dose heparin
2. Minidose heparin during labor, delivery and for 6-24 hours postpartum
3. If APTT does not normalize soon enough after full heparin stopped (i.e., patient near delivery), consider protamine
4. 6-24 hrs postpartum, restart full dose tx.- consider changeover to Coumadin when out of immediate danger for postop bleeding

# Amniotic Fluid Embolism

- **Frequency- 1/15,000 - 1/20,000 Pregnancies**
- **Catastrophic Consequences**
- **Multisystem Collapse**
- **Mortality Quoted as High as 80% (Probably Lower Now)**

# **Pathophysiology- Animal Data:**

- **Amniotic fluid thought to be composed of some abnormal factor or mediator**
- **Factor is heat stable**
- **Factor is soluble?**
- **Possible relationship with anaphylactoid phenomenon**

**(Hankins, 1995; Hankins, et al, 1993; Clark, 1995)**

## **Situations Related or NOT Related to AFE:**

- **Uterine Hyperstimulation-** AFE registry suggests that hyperstimulation is **EFFECT** rather than cause of hyperstimulation
- **Oxytocin use-** NOT RELATED
- **Drug Allergy and/or Atopy-** RELATED, with 41% of patients in AFE registry with allergies
- **Normal labor!!??**

**(Clark, 1997)**

# Amniotic Fluid Embolism (AFE)- Mechanism

Abnormal Mediator Released  
in Central Circulation

Pulmonary Filtration of Mediator

Transient (Severe) Pulmonary  
Vasoconstriction

Right Ventricular  
Failure

Severe Hypoxemia



# Amniotic Fluid Embolism- Mechanism

**Right Ventricular Failure**

**Acidemia**

**Left Ventricular Failure**

**Resolution of Right Heart Findings  
Continued Manifestations of Left  
Ventricular Pump Failure**



# **AFE- Symptomatology**

- **Unexplained Hemodynamic Collapse-  
Most Common**
- **10-15% Present With Coagulopathy-  
40% Who Survive Initial Events  
Develop Coagulopathy**
- **20% Present With Seizure**
- **70% Develop Respiratory Insufficiency**

(Morgan, 1979; Clark, 1986)

# **AFE- Differential Diagnosis**

- **Pulmonary Embolism**
- **Venous Air Embolism**
- **Myocardial Infarction**
- **Eclampsia**
- **Anaphylaxis**
- **Local Anesthetic Toxicity**

# AFE- TREATMENT

- Recognition is First Step
- Eliminate Other Causes
- Support- Hemodynamic and Respiratory Support (LEFT Ventricular Failure)
- Control Coagulopathy
- Undertake Delivery (If Not Delivered)
- Evaluate Necessity For Prolonged Hemodynamic or Respiratory Support

# **AFE- Hemodynamic Support**

- **LEFT ventricular failure predominates**
- **Pressor/inotrope agents may be necessary**
- **Oxygen/mechanical ventilation as necessary**
- **Aggressive correction of coagulopathy**

# Eclampsia

- **Complicates approximately 5% of patients with preeclampsia (EPH) (untreated)**
  - **Significant cause of M/M in patients with EPH**
  - **Majority of cases occur intrapartum**
    - May occur up to one month postpartum (but rare after 3-10 days postpartum)**
    - Cerebral edema or pulmonary edema predict poor outcome**
- (Williams Obstetrics, 1997 and other sources)**

## Definitions Cont (4)

### Severe Preeclampsia-

SBP > 160 torr or DBP > 110 torr

Proteinuria > 5.0 gm/ 24 hr

Oliguria

Preeclampsia-associated CNS  
symptoms

Epigastric Pain

Pulmonary Edema

HELLP

IUGR

# Pregnancy Induced Hypertension (PIH) Factoids:

- No relationship between the degree of proteinuria and propensity for eclampsia
- In patients that develop proteinuria, it may be a delayed finding
- Renal lesion= *Glomeruloendotheliosis*
- Proteinuria and HTN together more significant markers for poor outcome than either alone
- Hypertension and Preeclampsia Risk(Nullipara):
  - DBP > 15 torr = Doubled Risk
  - SBP > 30 torr = Increased 2 1/2 Fold
  - SBP and DBP = Nearly 4 1/2 Fold Increase
- New onset seizure activity in a pregnant or early postpartum pregnant patient is ECLAMPSIA until proven otherwise

( Various Sources- Including Williams Obstetrics- 20th ed, 1997)

# Etiology of Eclampsia (EC)

- Etiology uncertain
- May be a manifestation of loss of cerebral autoregulation (hypertensive encephalopathy in a relatively normotensive person)\*
- Cerebral findings- Cortical petechiae

\*Does the physiologic hyperventilation of pregnancy alter cerebral autoregulation?)

# Treatment of Eclampsia

- **Mainstays of treatment are:**
  - Control of Seizure**
  - Correction of hypoxemia and acidosis**
  - Delivery (if undelivered)**
- **Consider the D/DX of Seizure**
  - Cavernous Sinus**
  - Local Anesthetic**
  - CVA**
  - Metabolic**
  - Amniotic Fluid Embolism**
  - Infection**
  - Substance Abuse**

# Eclampsia- Control of Seizure

- Magnesium sulfate most effective for treatment of seizure
- Magnesium sulfate most effective for prophylaxis (several regimens)
- Magnesium sulfate more effective than phenytoin
- Other agents useful for refractory seizure and/or non-availability of magnesium (example- non OB ER)

(Lucas et al, 1995; Eclampsia Collaborative Trial Group, 1995)

# Treatment of Eclampsia

**Airway Protection**

**Intravenous Magnesium=  
2-4 gm IV- depending on  
preexisting Mag tx.**

**Success =  
Continuous Magnesium**

**Failure= Consider**  
- Other Pharm tx  
- Complicating Causes

# Treatment of Eclampsia (2)

Treatment Failure?

Consider Other Causes!

Neuro Exam

Cerebral Edema?

Hypertensive Crisis?

Consider CT

Consider Mechanical Ventilation

Consider Cerebral Protective or Edema

Treatment

(Get Help!)

# Magnesium Sulfate

- After IV loading, infuse with 2.0-3.0 gm/hr
- 4.0 - 7.0 mEq/L = therapeutic range
- Overdose = Calcium gluconate
- Treatment Failure = Consider other cause of seizure or cerebral complication
- DTR's, Urine Output, Respiration, etc., etc.

# **Eclampsia- Airway/Metabolic**

- **Control of Airway During Seizure**
- **Evaluation and correction of hypoxemia**
- **Diagnosis of Aspiration**
- **Neurologic and Ophthalmologic Evaluation**
- **Treatment of Hypertensive Crisis**
- **Evaluation of electrolytes, other manifestations of severe EPH and blood gas**

# Hypertensive Crisis in PIH

Diagnosis- Fetal Sx, Maternal Sx, SBP > 160 torr, DBP > 110 torr

Hydralazine 5-10 mg IV- repeat x 2  
Eliminate false positives

Response- no further tx

No response or transient

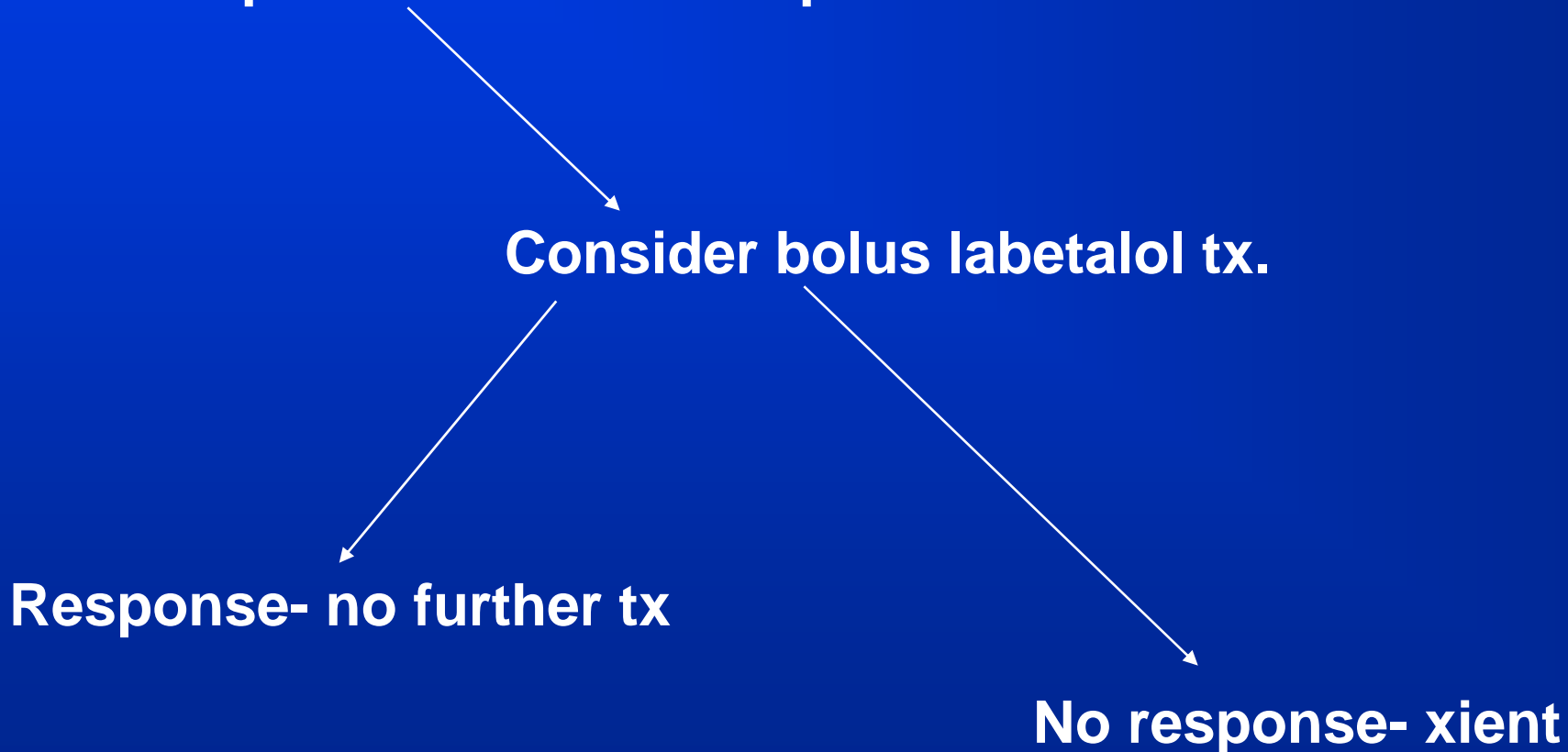
# Hypertensive Crisis in PIH Cont.(2)

No response/ transient response

Consider bolus labetalol tx.

Response- no further tx

No response- xient



# Hypertensive Crisis in PIH Cont (3):

Transient or No Response

Arterial Line  
Continue Fetal Monitoring  
Continuous Labetalol

Response = Continue  
or wean before/after delivery

Consider Invasive-  
Directed Tx

Failure, or fetal or maternal  
Symptoms despite tx

# Cardiopulmonary Resuscitation in Pregnancy

- If you don't think that this will never happen to you, you are wrong!
- Being an Obstetrics provider is no excuse not to be CPR literate.
- Non-Obstetrics providers may know more than you do about CPR, but they may know little or nothing about pregnancy, fetal evaluation, etc.
- Even if CPR by non-OB, OB endeavored to function as an advocate ombudsman or resource person for the OB patient and her fetus!

# Issues Specific to CPR in Pregnancy

- **Pregnancy is a state of increased metabolic demands**
- **The placenta comprises a 20-30% shunt**
- **Buffering capacity is diminished during pregnancy**
- **Functional Residual Volume (FRC) is decreased in pregnancy- predisposing gravida to supine hypoxemia**

## Issues Specific to CPR in Pregnancy (2)

- Aortocaval Compression- occurs during second 1/2 of pregnancy. Compression may significantly reduce effectiveness of CPR during second 1/2 of pregnancy
- Aspiration risk
- Pregnancy-associated causes of cardiopulmonary arrest

# Use of Medications During CPR of Pregnant Person

- When the alternative is death, very few things are absolutely contraindicated
- Most inotrope/vasopressors are either poorly studied or can cause reductions in uteroplacental blood flow
- Thrombolytics are relatively contraindicated if delivery imminent

## Fetal Outcome in CPR

- Limited data suggest intact fetal salvage if delivery afforded by 5 minutes of unsuccessful CPR
- Neonatal neurologic impairment increases significantly after 8-10 minutes of CPR
- CPR does NOT adequately perfuse the uterus

(Katz, 1986; ACOG, and others)

# IMPORTANT CAVEATS FOR CPR IN PREGNANCY

- If CPR can be anticipated (sick gravida at risk), pre-arrest planning and counseling vital!
- In CPR during pregnancy, in addition to ABC's, immediate fetal evaluation should not delay primary maternal evaluation

## **IMPORTANT CAVEATS FOR CPR IN PREGNANCY (2)**

- **Early Intubation recommended success (>20-25 weeks gestation)**
- **Thoracostomy tubes, if placed, should be placed with consideration of the fact that the diaphragm is elevated in pregnancy**
- **Pregnancy causes of arrest need to be considered**

# Treatment of CPR in Pregnancy

ABC's

Early Intubation

Gestational age?

< 20-25 weeks

Continue CPR  
Evaluate fetus when  
able

> 20-25 weeks

Lateral tilt  
Fetus alive?  
Gest. age viable?

# Treatment of CPR in Pregnancy (2)

Lateral tilt

Fetus alive?

Gest. age viable?

Alive/Viable

C/S by 5 min.  
if CPR not working

Pre-viable/Demise

C/S by 5-10 min.  
if CPR not working