

Case conference  
1/8/2008

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Stat c/section, thick meconium,  
fetal bradycardia !!!!!

# Maternal history

- 22 yo, G1: contractions.
- GA 39 w, AGA. Prenatal care (+)
- Labs: A (+), RPR NR, Hep B neg, Rubella immune, GBS : positive
- 11:00 : alternating episodes of severe and prolonged fetal bradycardia and tachycardia.
- Stat c/s for fetal distress

# Delivery room

- Stat C/S
- General anesthesia: induction with propofol.
- ROM @ 11:30 thick meconium
- Delivery @ 11:36. Umbilical cord OK
- At birth: apneic, pale, severe bradycardia (<60 x'), poor perfussion

# Delivery room

- Management: positioning, stimulation, endotracheal intubation, suctioning and PPV/oxygen
- Apgars 1/2/4
- Cord gas: 6.85/89/03 BE-17
- Transfer to NICU
- Wt 3.685
- Maternal fever 101 @ 20:45 pm. Antibiotics started. WBC 17 B 11 N 78

# Respiratory

- MAS
- SIMV/PC
- Extubated @ 18 hs  
to BIPAP, then  
CPAP then RA.

# Metabolic

- Initial ABG: 7.25/38/42 BE-9.9
- Hypoglycemia ( 27, 35 ) @ 1 hr
- D10 W bolus + glucose @ 8 mg/k/min
- Hypocalcemia (7.2, 6.9) @ 10-24 hs
- Ca gluconate

# Cardiovascular

- Initial VS normal
- @ 6 hs of life BP 50/28 : NS bolus
- Then BP : 33/17
- Dopamine started ( 5 mcg/kg/min ) with improvement
- On dopamine x 36 hs
- Echo : PFO, tiny PDA. Dyskinesia posterior LV wall. Adequate function
- CPK mb/CPK : 3.0→4.2→2.0

# FEN/GI/Heme

- Initially NPO, IVF, HAL
- Feeds @ 48 hs
- AST/ALT : 210/99
- Liver dysfunction ?
- Nucleated RBC > 15%

# Renal

- Decreased UO  
< 1ml/k/hr @ 24 hs
- BUN 7 → 16 → 9
- Creat 0.9 → 1.3 → 0.8
- Na: 139 → 130 → 128 → 134
- Renal US : negative

# ID

- CRP 4.2 Bands 23
- Cx's : negative
- Amp/cefotax x 7 d

# Neuro

- Tonic movements + lip smacking @ 4 hs of life
- Electrolyte correction + phenobarbital (bolus + maintenance)
- Neuro consult/evaluation : irritable, increased tone, + suck, - clonus, increased reflexes
- Initial EEG : “ some increased spike activity”
- F/U EEG : negative
- HUS / MRI @ 7 d : normal for age
- Neuro exam @ 8 d of life: Normal

# Summary

- Prenatal abnormal monitoring, maternal fever
- Fetal bradycardia
- Abnormal cord gas
- Meconium, low apgar scores
- Seizures
- Myocardial depression
- Renal dysfunction
- Liver dysfunction
- Metabolic dysfunction ( hypoglycemia-calcemia)

# What happened ??

- Placental pathology

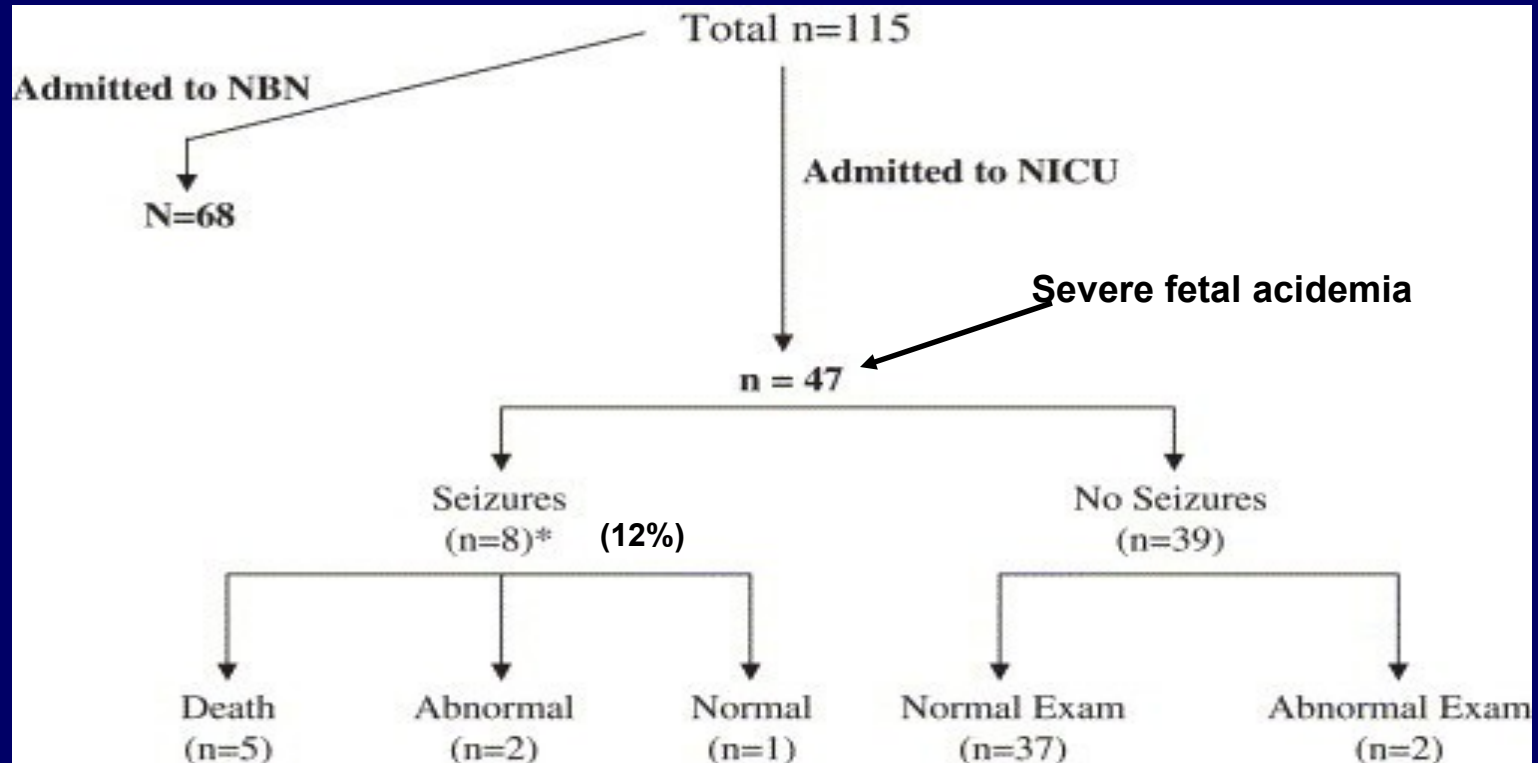
CHORIOAMNIONITIS

# PERINATAL ASPHYXIA

# PERINATAL ASPHYXIA

- Imprecise definition
- Interruption of placental blood flow
- Main concern: CP
- Impaired gas exchange: hypoxemia, hypercapnia
- Fetal acidosis
- Umbilical artery pH
  - $< 7.1$  : 2-8 %
  - $< 7.0$  : 2-8 % : severe acidemia: 0.3 % deliveries

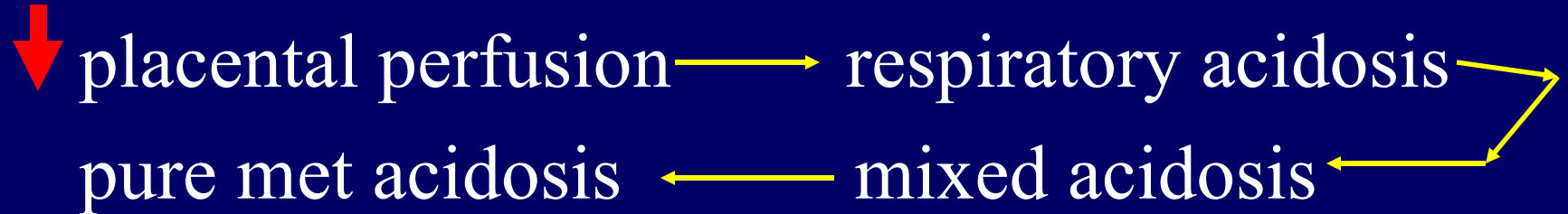
# PERINATAL ASPHYXIA



\* Six received CPR: the odds ratio estimate for developing seizures following CPR was 234

# Umbilical cord blood gases

- Sequence of events:



- Metab acidosis : timing insult ??
- Resp acid + : 20-30 min
- pH before insult can be calculated

# Umbilical cord blood gases

- Sampling both: artery and vein
- Sampling site nearest to the fetus
- Timing
- Cord clamping
- Temperature : room temp 30-60 min: OK
- Heparine

# ACOG criteria

- Arterial pH < 7.00
- Apgar score of up to 3 for longer than 5'
- Neonatal neurologic sequelae
- Multi-organ system dysfunction

# International Consensus criteria

## *ESSENTIAL CRITERIA*

- Evidence of metabolic acidosis (pH<7.00 and base deficit  $\geq$ 12 mmol/L)
- Early onset of severe or moderate encephalopathy
- Cerebral palsy of the spastic quadriplegic or dyskinetic type

## *NONESSENTIAL CRITERIA*

- A sentinel (signal) hypoxic event
- A sudden, rapid, and sustained deterioration of the fetal heart rate pattern, usually after the hypoxic sentinel event
- Apgar scores of 0 to 6 for longer than 5 minutes
- Early evidence of multi-system involvement.
- Early imaging evidence of acute cerebral edema

# The Neonatal Encephalopathy Committee Opinion

## *ESSENTIAL CRITERIA (MUST MEET ALL FOUR)*

- Evidence of a metabolic acidosis
- Early onset of severe or moderate neonatal encephalopathy
- Cerebral palsy of the spastic quadriplegic or dyskinetic type
- Exclusion of other identifiable etiologies( trauma, infectious, genetic)

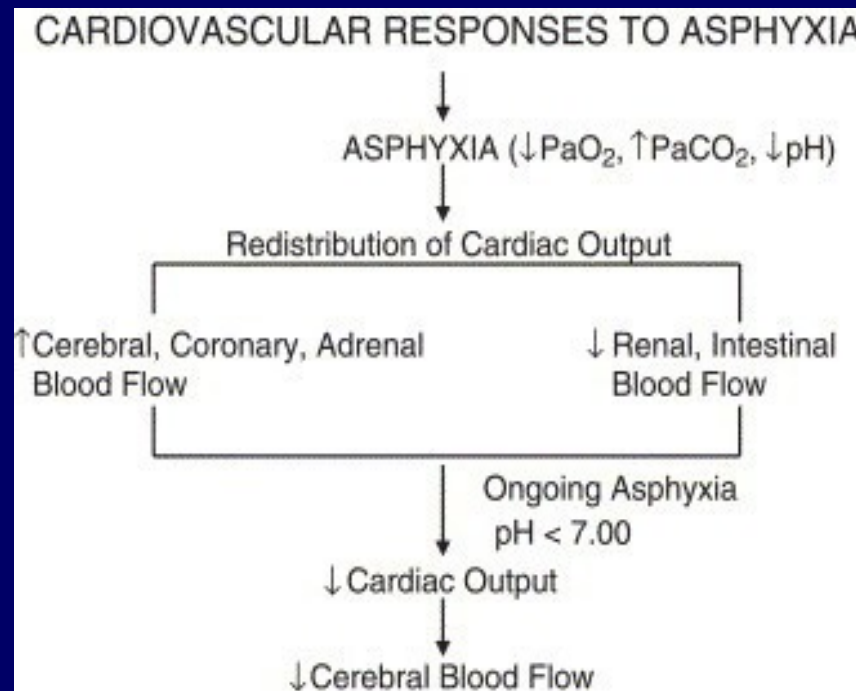
## *ADDITIONAL CRITERIA*

- A sentinel (signal) hypoxic event
- A sudden and sustained fetal bradycardia or the absence of FHR variability in the presence of persistent, late or variable decelerations, usually after a hypoxic sentinel event when the pattern was previously normal
- Apgar score of 0 to 3 beyond 5 minutes
- Onset of multi-system involvement within 72 hours of birth
- Early imaging study showing evidence of acute nonfocal cerebral abnormality

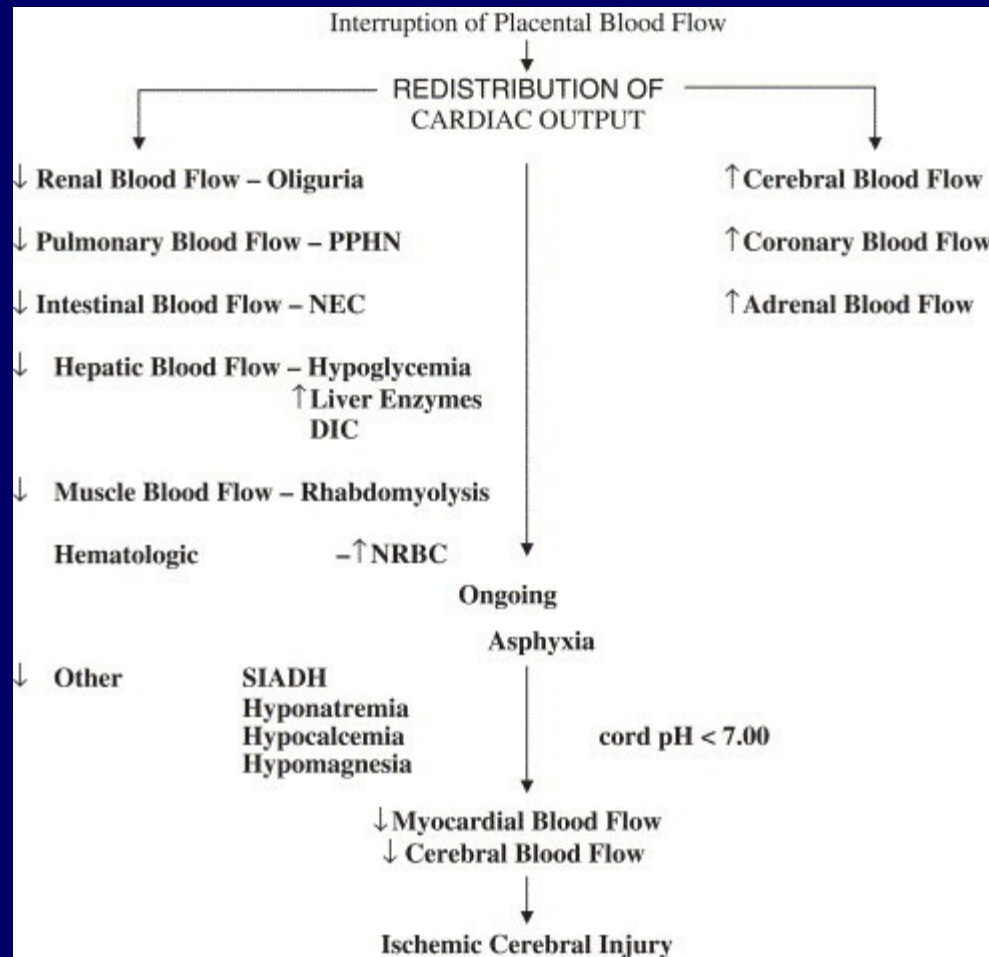
# Other possible predictors

- pH
- Nucleated RBC
- Platelets
- Neonatal organ dysfunction
- Liver function
- Renal function
- Neuroimaging

# CIRCULATORY FETAL ADAPTATIVE MECHANISMS I



# CIRCULATORY FETAL ADAPTATIVE MECHANISMS II



# NON-CIRCULATORY FACTORS

- Slower depletion of high-energy compounds during hypoxia-ischemia
- Use of alternate energy substrate ( lactate and ketone bodies for energy production )
- Relative resistance of myocardium to ischemia
- Fetal hemoglobin

# NEONATAL ENCEPHALOPATHY

- Frequently, H-I can not be proven
- *NE : “clinical syndrome of disturbed neurological function in the earliest days of life, manifested by difficulties with initiating and maintaining respiration, depression of tone and reflexes, subnormal level of consciousness and Sz”*
- Causes: pre-postpartum ischemia, genetic factors, metabolic diseases, maternal drug use, infection, vascular/heme/trauma

# HIE, events

**Interruption of placental blood flow/gas exchange**



**Hypoxia/ischemia**



**Necrosis**

**Brain oxygen deprivation**



**Apoptosis**

**Reperfusion**



# HIE, Sarnat

- Stage I : hyper-alertness and sympathetic activation, weak suck, normal tone, wide-open eyes, mydriasis. EEG normal
- Stage 2: obtundation, hypotonia, strong distal flexion, parasympathetic activation, slow HR, increased secretions, seizures, apnea
- Stage 3 : stupor or coma, response to intense stimulation, hypotonia, seizures

# NEUROPATHOLOGY

- Parasagittal cerebral injury
- Selective neuronal necrosis : more common
- Basal ganglia injury
- Periventricular leukomalacia
- Focal/multifocal ischemic injury

# MRI

- MRI
- MRS
- DWI
- Possible outcome predictor
- Becoming standard of care

# Therapeutic interventions

- Head cooling
- Magnesium
- Phenobarbital
- Melatonin
- Erythropoietin
- G-CSF
- Allopurinol

# Questions

- In your experience, has electronic fetal monitoring made a difference ?
- Is hypothermia going to become standard of care?



## Intrapartum Hypoxic-Ischemic Brain Injury

