

Too Cool?

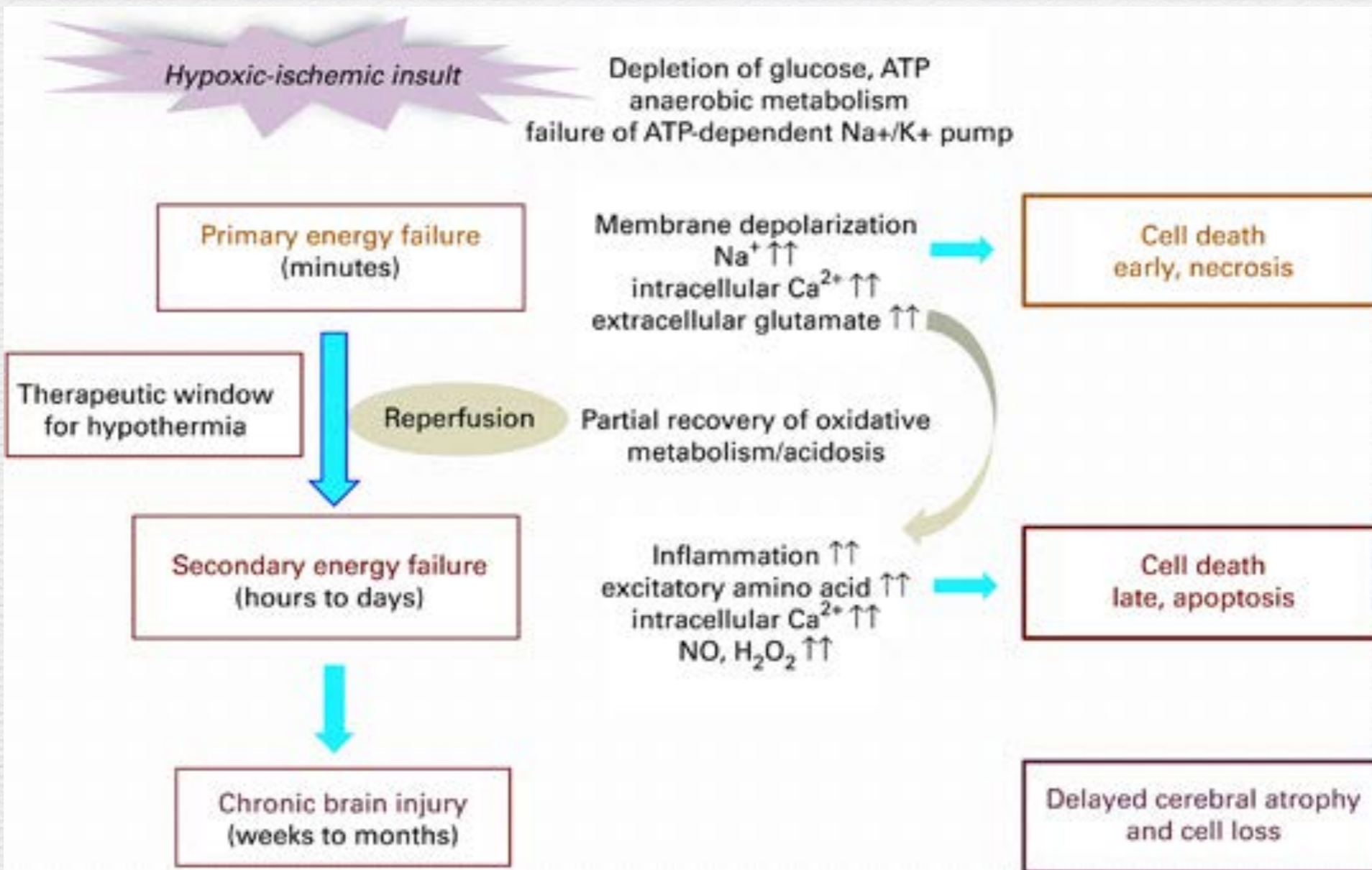
Hypoxic Ischemic Encephalopathy
and Therapeutic Hypothermia

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Pathophysiology of HIE

- Occurs in two energy failure phases:
 - First phase happens during the initial insult
 - sympathetic nervous system stimulation
 - movement of blood to vital organs: brain, heart, lungs
 - begin with aerobic metabolism, but as stores are depleted, anaerobic metabolism occurs
 - this leads to depletion of ATP, cytotoxic edema, acidosis, cell death, and accumulation of free radicals and free fatty acids in the brain and eventually organ failure

- second phase: occurs when cerebral circulation and oxygenation are reestablished following resuscitation
- during this phase brain injury occurs as a result of mitochondrial dysfunction, increased calcium inside the cells of the brain, oxygen free-radicals, and nitric oxide formation, which is similar to the first phase however damage is not repairable by the body



Pathophysiology of Therapeutic Hypothermia

- Total body & head cooling
- Both thought to reduce neuronal metabolic demand, cytotoxin accumulation, and prevent apoptosis during the second energy failure
- Decreases the brains glucose and oxygen metabolic rate
- Decreases loss of phosphates during ischemia
- Decreases free radical production
- Decreases nitric oxide production
- Suppresses inflammation

Therapeutic Hypothermia

- window of 6 hours to initiate cooling
- Head cooling and total body cooling
 - total body cooling demonstrated better control of core temperature
- Reduce brain temperature 2-3 degrees, cool to 33-35 degrees
- rewarm over 12-24 hours
- Potential adverse effects
- Two major studies conducted to determine efficacy and outcomes: CoolCap and NICHD
- Other studies include: TOBY, Neo.nEURO.network, ICE

Entry Criteria

- Cool Cap:
 - pH <7.0 or base deficit
 - or APGAR score
 - or need for resuscitation at 10 mi
 - Moderate to severe clinical encephalopathy
 - Abnormal aEEG trace or seizure
- NICHD:
 - pH <7.0 or base deficit
 - if blood gas not available or pH 7.01-7.15 or base deficit 10-15.9; need for history of acute perinatal event and APGARs \leq
 - Moderate to severe clinical encephalopathy or seizures
 - Signs of fetal distress

Modified Sarnat Score

Category	Moderate Encephalopathy	Severe Encephalopathy
level of consciousness	lethargic	stupor or coma
spontaneous activity	decreased activity	no activity
posture	distal flexion, complete extension	deceberate
tone	hypotonia	flaccid
primitive reflexes suck moro	weak incomplete	absent absent
autonomic system pupils heart rate respirations	constricted bradycardia periodic breathing	deviated, dilated, or nonreactive to light variable apnea

Shankaran, S., Laptook, A. R., Ehrenkranz, R. A., Tyson, J. E., McDonald, S. A., Donovan, E. F., Fanaroff, A. A., ... Jobe, A. H. (October 13, 2005). Whole-Body Hypothermia for Neonates with Hypoxic-Ischemic Encephalopathy. *New England Journal of Medicine*, 353, 15, 1574-1584.

Case Reviews

- 2 cases
- Discuss labor, delivery, resuscitation, admit information, and initial course in the NICU
- Then well go over the entry criteria for cooling

Baby I

- Labor

A 39 0/7 gestation mother presented with spontaneous onset of labor at 0930. History of SAB, ectopic pregnancy, and C/S for fetal distress. Decision for TOLAC prenatally. FHT WNL until following morning at 0245, when they became significant for prolonged late decelerations. Mother also complained of severe abdominal pain. Fluids clear.

What findings are concerning?

Baby I

- Delivery

Stat C/S ordered, during delivery uterine rupture noted. NICU RN at delivery who received severely depressed infant.

What findings are concerning?

Baby I

- Resuscitation

Infant dried, positioned, and NRP initiated with PPV
ARNP at bedside at 3:15 seconds of life

PPV continued to be provided at 20/5 with a rate of
40-50, 21% FiO₂

Spontaneous respirations noted at 4.5 minutes, infant
remains floppy, poorly perfused in significant
respiratory distress, PPV continued for unspecified
amount of time

Baby I

- Admit Information

Term infant at 39 0/7 weeks

APGARS: 1, 4, 8

BW: 3825g

Cord gases: (A) 6.86/134/<10/23/-14

(V) 6.9/115/13/22/-15

Baby I

- Initial NICU course by 1 hour of age

ABG: 7.27/45/82/20/-7

Intubated for respiratory support

Neuro exam significant for extreme agitation and hypertonicity at 15 minutes of life. Exam at 1 hour reveals lethargy, decreased muscle tone, and diminished primitive reflexes

WORK THROUGH ALGORITHM

Baby I

- Depressed at birth AND PPV given
- Cord gases and ABG obtained at 1 hour
- > 36 weeks and > 1800g and < 6 hours old
- pH <7
- Seizures not present
- Moderate to severe encephalopathy
- Eligible for cooling

Baby W

- Labor

A 37 3/7 gestation mother who received initial prenatal care from Hospital Midwifery Group, transferred care to lay midwife for home delivery. Presented to triage with decreased fetal movement, non-reassuring FHT, BPP 4/8. Parents reluctant to sign consent for C/S.

What findings are concerning?

Baby W

- Delivery

Stat C/S ordered following several hours of discussion with provider team. Membranes ruptured at delivery, fluids clear. NICU RN & ARNP at delivery, received non-vigorous infant.

What findings are concerning?

Baby W

- Resuscitation

Infant dried, positioned, suctioned, apneic, HR 60 bpm
PPV initiated at 21% FiO₂

Intermittent respiratory effort, floppy
minutes of life

Some gagging reflexes noted at 5 minutes of life

At 9 minutes of life, remained intubated with PPV given at 60%
FiO₂

Baby W

- Admit Information

Term infant at 37 3/7 weeks

APGARS: 1, 4, 6

BW: 2200g

Cord Gases: (A) 6.95/73/<10/15/-18

(V) 7.09/52/27/16/-14

Baby W

- Initial NICU course by 1 hour of age

ABG: 7.11/33/61/10/-18

Intubated on CMV, consistent spontaneous respirations by 1 hour of age

Neuro exam WNL at 1 hour of age

WORK THROUGH ALGORITHM

Baby W

- Depressed at birth AND PPV given
- Cord gas and ABG obtained at 1 hour
- > 36 weeks and > 1800g and < 6 hours old
- pH < 7 and BD >16
- Seizures not present
- No moderate to severe encephalopathy
- Not eligible for cooling at this time. Continue to reassess

Overview of Equipment

Outcomes

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