ADVANCED NICU CARES AND PROCEDURES

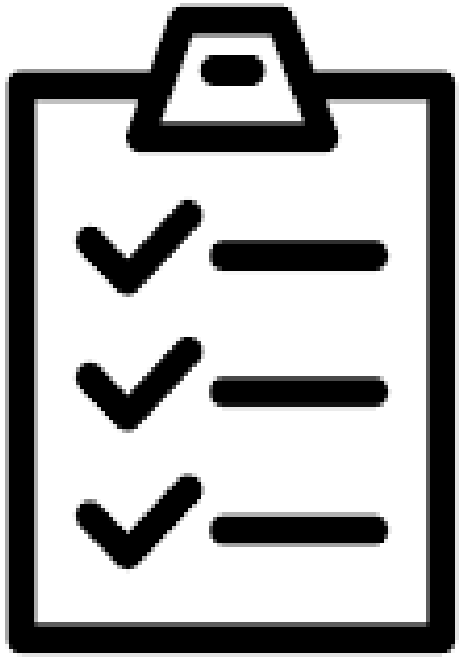
Pam Jacobsen, MSN, RNC-NIC

TOPICS

Hyperbilirubinemia

Head Injuries

Whole Body Cooling



NEONATAL HYPERBILIRUBINEMIA

Types:

- Physiological jaundice
- Breast milk jaundice
- Breastfeeding jaundice
- Pathologic jaundice
- Hemolytic jaundice
- Unconjugated (indirect) vs. Conjugated (direct)

PHYSIOLOGIC VS PATHOLOGIC

Physiologic:

- Does not present in the first 24 hours of life
- Usually peaks on day 3-4
- Contributing Factors: polycythemia, shortened erythrocyte life span, immature hepatic uptake and conjugation process, and higher entrohepatic circulation
- Risk factors: sibling with jaundice, AMA, cephalohematoma or bruising, isoimmune, or other hemolytic anemia, ethnicity

Pathologic:

- Dx if presents in first 24 hours of life, after the first week of life, or last > 2 weeks
- Babe's blood type and Coombs test done at birth if mom Rh – or O blood type
- Rh incompatibility
- ABO incompatibility
- Glucose-6-phosphate dehydrogenase (G6PD) deficiency

Kenner et al, 2020

	Characteristics	Found	Phototherapy	Effects
Indirect (unconjugated bilirubin)	Lipid soluble, unbound or bound to albumin	• Free bilirubin (unbound) circulating in blood stream • Needs to be bound to albumin to get to liver (where the enzymes are)	Yes	• Free bilirubin can cause kernicterus or brain staining • Deposits in fatty tissues (sclera & skin) • **JAUNDICE**
Direct (conjugated bilirubin)	Water soluble	• Found in the liver • If not water soluble, cannot be excreted without enzyme help	No	Build up in the liver and can cause gallbladder sludge

TABLE 2 Hyperbilirubinemia Neurotoxicity Risk Factors

Risk Factors
• Gestational age <38 wk and this risk increases with the degree of prematurity[a]
• Albumin <3.0 g/dL
• Isoimmune hemolytic disease (ie, positive direct antiglobulin test), G6PD deficiency, or other hemolytic conditions
• Sepsis
• Significant clinical instability in the previous 24 h

[a]Gestational age is required to identify the phototherapy thresholds (Figs 2 and 3; Supplemental Tables 1 and 2, and Supplemental Figs 1 and 2) and the exchange transfusion thresholds (Figs 5 and 6; Supplemental Tables 3 and 4, and Supplemental Figs 3 and 4).

HYPERBILIRUBINEMIA NEUROTOXICITY RISK FACTORS

(AAP, 2022)

COMPLICATIONS

- Acute Bilirubin Encephalopathy
- Kernicterus
- Hydrops Fetalis
- Glucose-6-phosphate dehydrogenase (G6PD) deficiency

HYDROPS FETALIS

Abnormal accumulation of fluid in 2 or more fetal compartments

10% complication from severe form of Rh incapability

90% disease or medical condition affects the babe's ability to manage fluid.

Can present with:

Ascites, pleural effusion, pericardial effusion and skin edema

ESCALATION OF CARE FOR THE INFANT WITH HYPERBILIRUBINEMIA

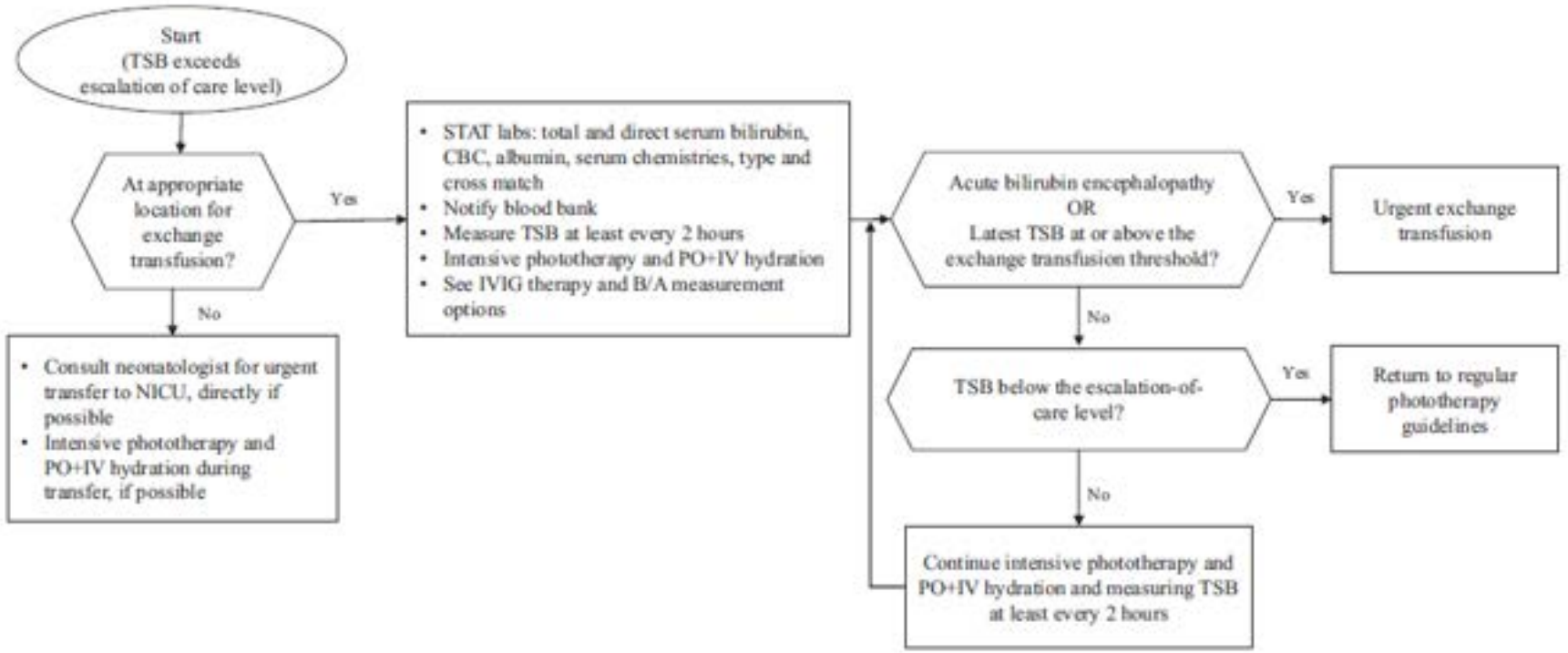


FIGURE 4
Approach to escalation of care. The escalation-of-care threshold is 2 mg/dL below the exchange transfusion threshold. IVIG, intravenous immune globulin; B/A, bilirubin to albumin ratio.

(AAP, 2022)

PHOTOTHERAPY & EXCHANGE TRANSFUSION NOMOGRAM FOR PREEMIES

Guidelines for hospitalized infants less than 35 weeks' gestation:

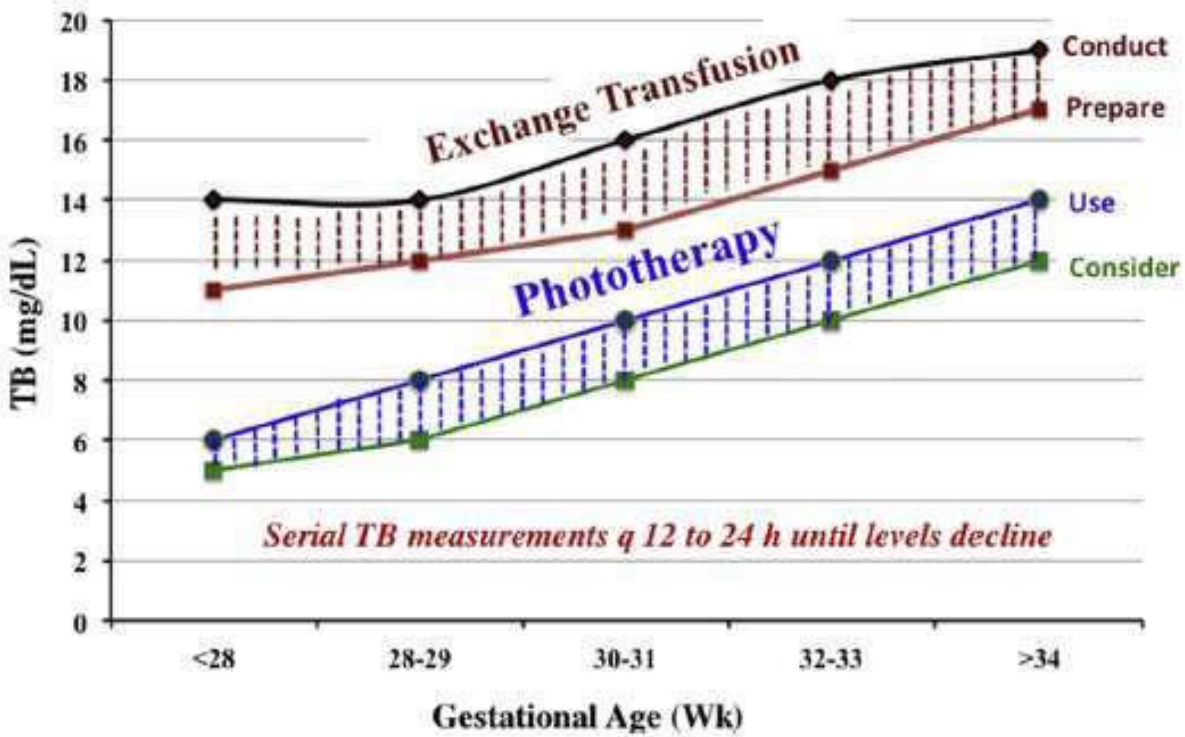


Fig. 1. Suggested use of phototherapy and exchange transfusion in preterm infants less than 35 weeks GA. The operational thresholds have been demarcated by recommendations of an expert panel. The shaded bands represent the degree of uncertainty. Recommended thresholds to prepare for exchange transfusion assume that these infants are already being managed by effective phototherapy. Increase in exposure of body surface area to phototherapy may inform the decision to conduct an exchange transfusion based on patient response to phototherapy. (*Adapted from* Maisels MJ, Watchko JF, Bhutani VK, et al. An approach to the management of hyperbilirubinemia in the preterm infant less than 35 weeks of gestation. J Perinatol 2012;32:660–4; with permission.)

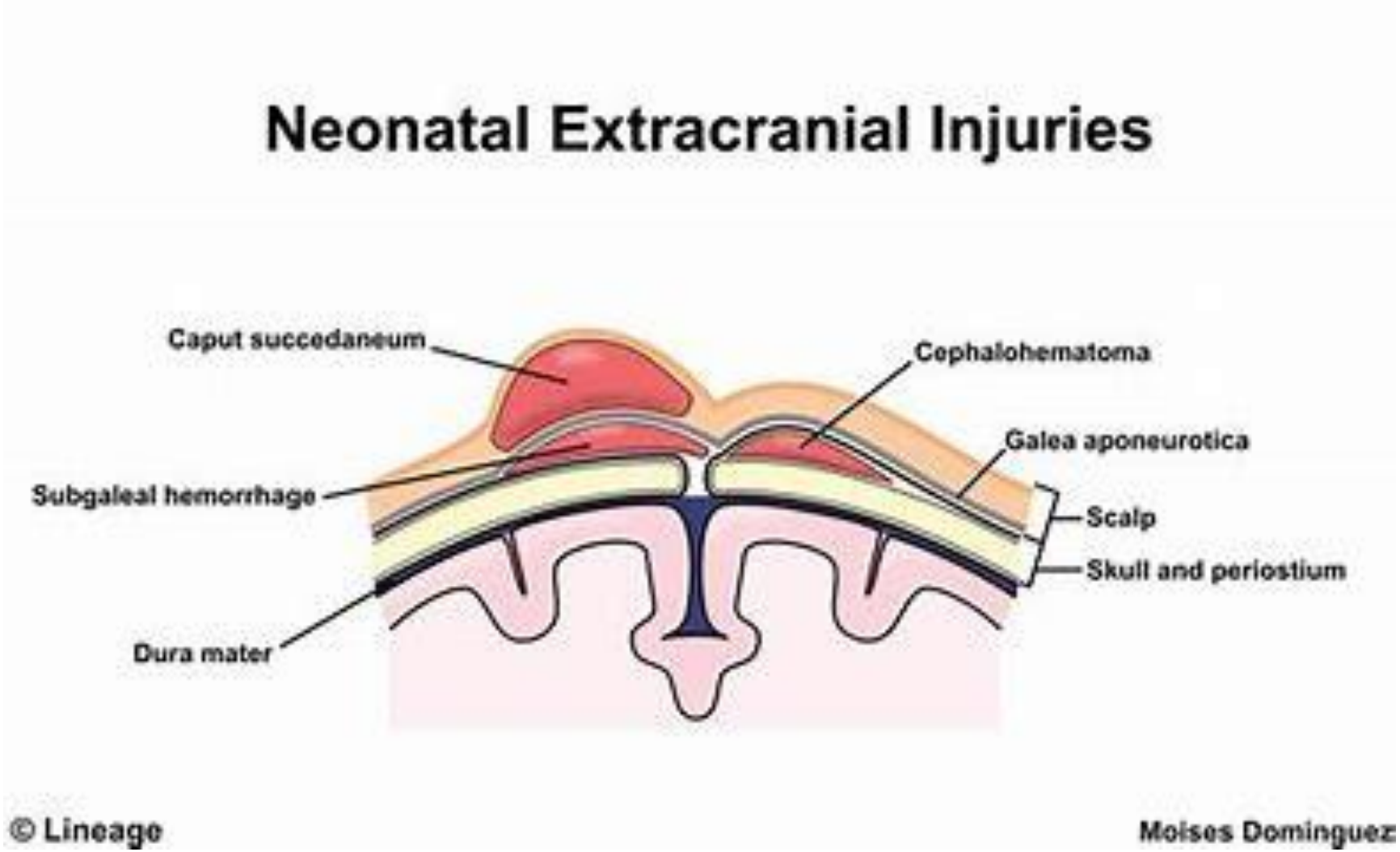
(AAP, 2004)

TREATMENTS

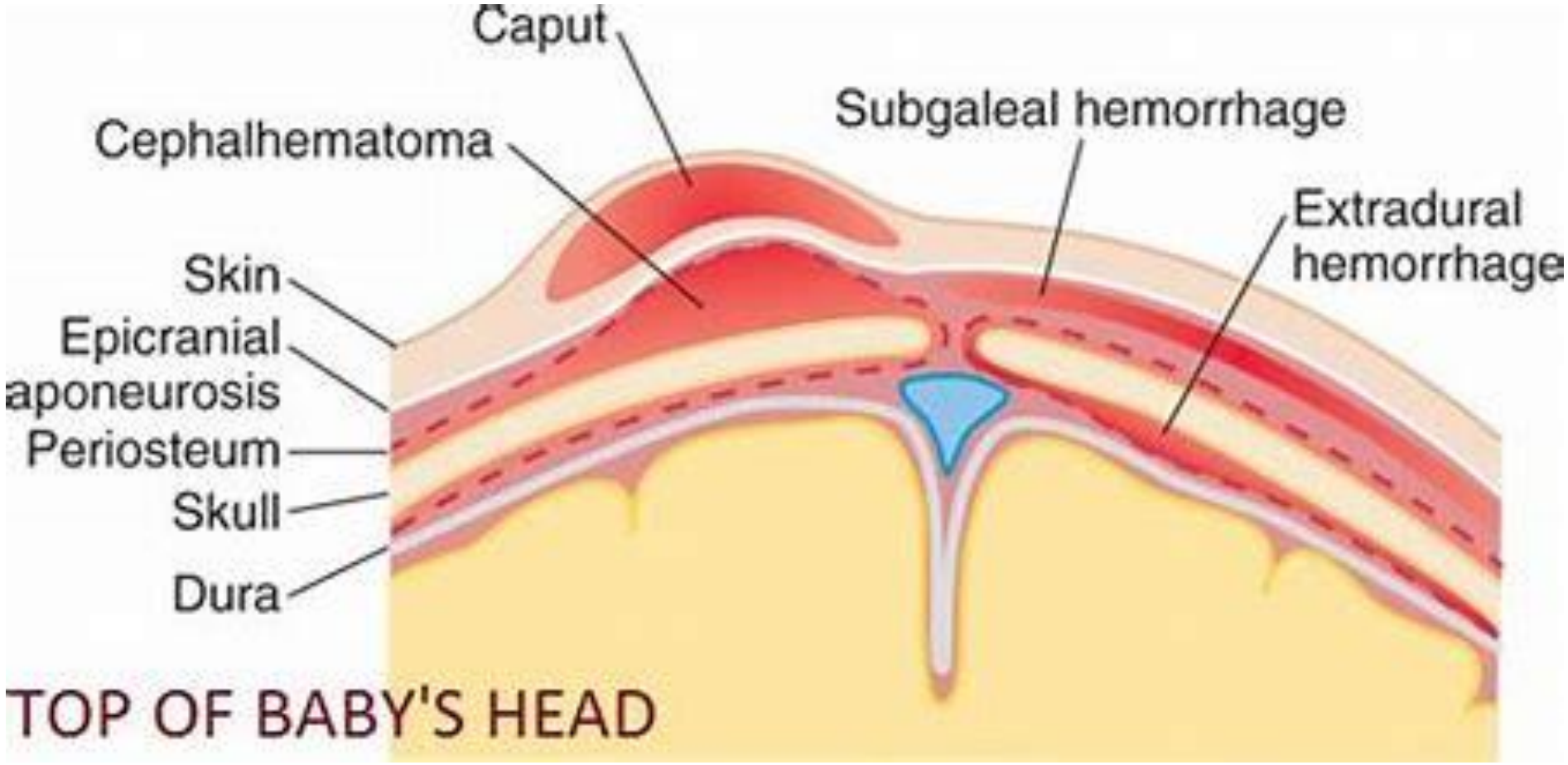
- Phototherapy
  - Facilitates biliary excretion of unconjugated bilirubin
- Intravenous Immunoglobulin (IVIG)
  - Used with newborns diagnosed with Rh incompatibility hemolytic disease
- Exchange Transfusion
  - Withdrawal and replacement of newborn's blood with donor
  - Used to treat infants
    - Whose serum bilirubin continues to rise despite phototherapy
    - With severe hyperbilirubinemia (i.e. hemolytic disease)
    - Diagnosed with acute bilirubin encephalopathy

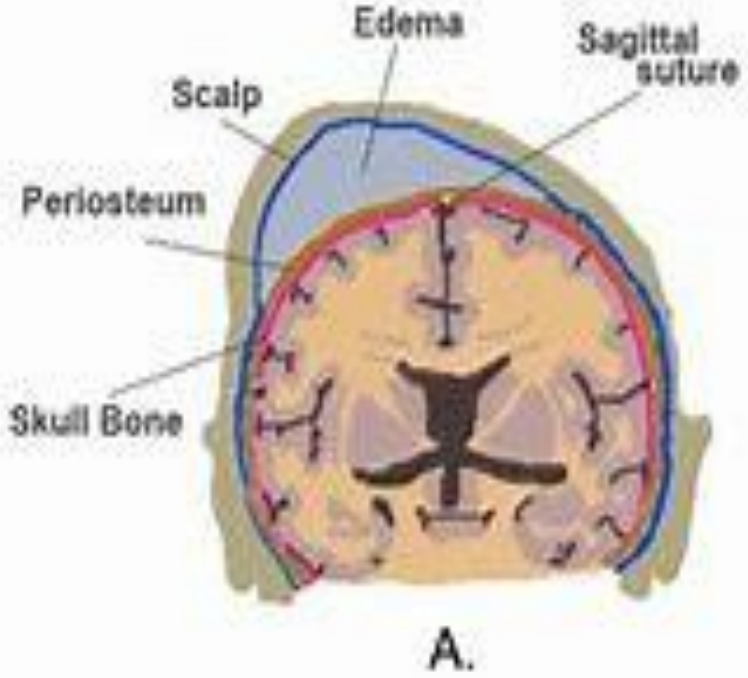
HEAD INJURIES

NEONATAL EXTRACRANIAL INJURIES

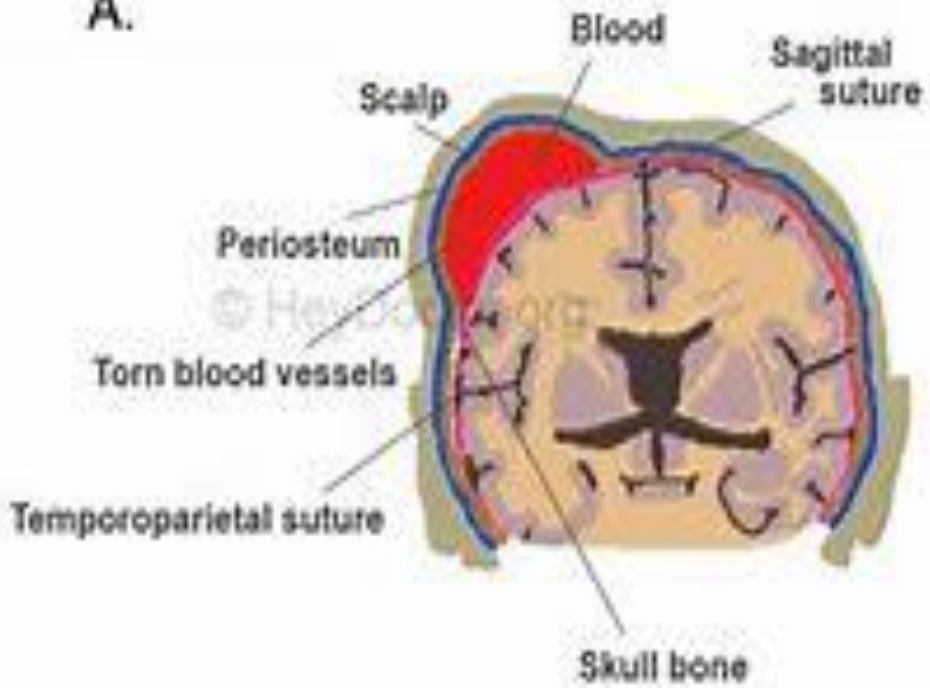


SCALP SWELLING





CAPUT



CEPHALOHEMATOMA

SUBGALEAL HEMORRHAGE

HTTPS://WWW.YOUTUBE.COM/SHORTS/MNEUT8CLMSY

- Rupture of emissary veins
- Can occur during vacuum delivery
- Subaponeurotic space located above periosteum
- No barrier to stop bleeding
- Subgaleal space can hold up to 240 – 260 ml of blood
- Entire blood volume of a 3 kg infant
- Extends from eyebrow to nape of neck

RISK FACTORS

- Nulliparous mother
- Failed vacuum extraction
- Sequential use of vacuum and forceps
- Apgar score less then 8 at 5 minutes following vacuum assist delivery

MONITORING SUBGALEAL HEMORRHAGE

Close monitoring of vital signs

Physical assessment of scalp, neck and face

Head circumference

Lab work

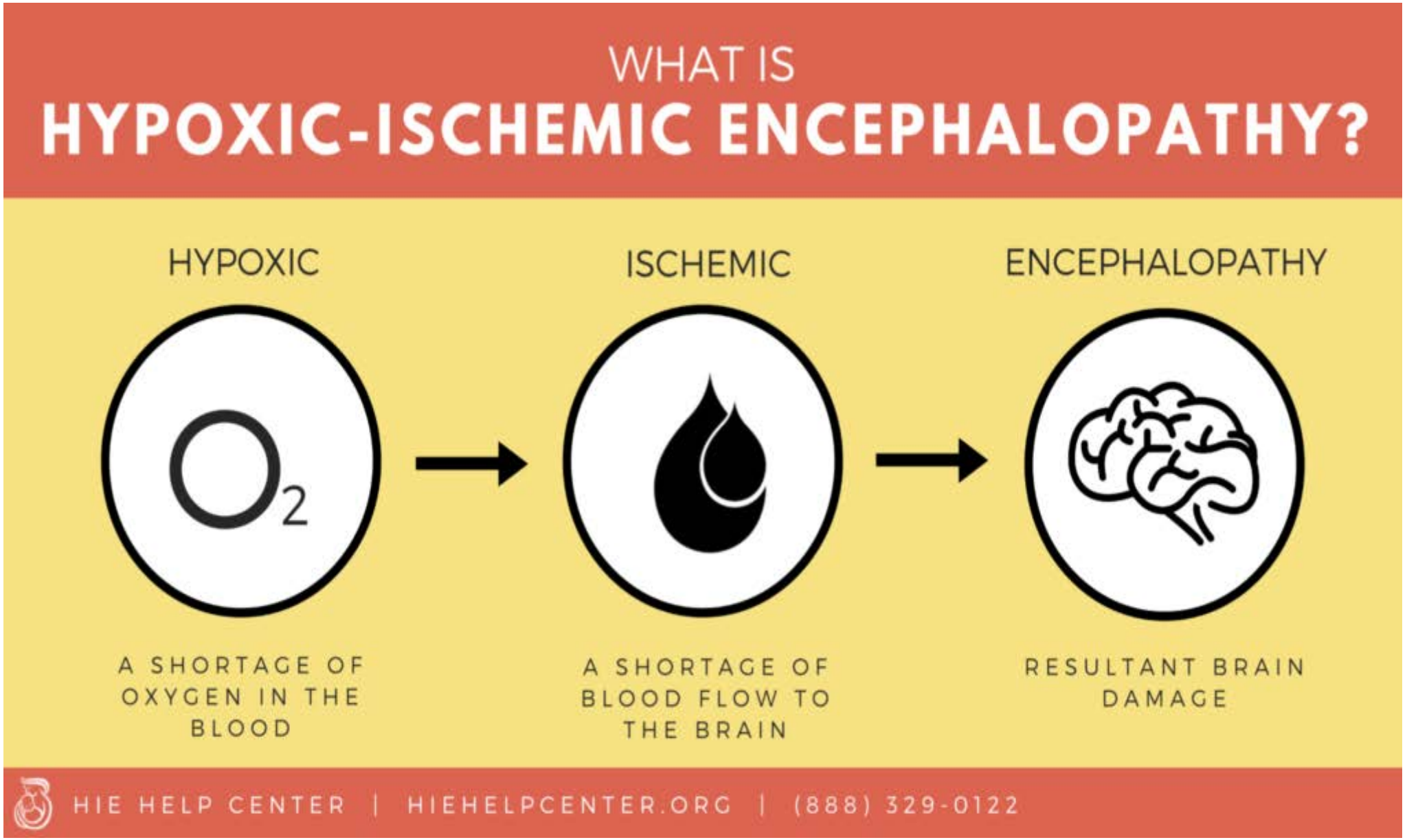
- CBC
- Blood gasses

Treatment

- Close monitoring
- Treat hypotension

WHY DO WE DO WHOLE BODY COOLING?

https://www.youtube.com/watch?v=Tbsa-OPMni4


WHAT IS
HYPOXIC-ISCHEMIC ENCEPHALOPATHY?
HYPOXIC
ISCHEMIC
ENCEPHALOPATHY
O2
A SHORTAGE OF OXYGEN IN THE BLOOD
A SHORTAGE OF BLOOD FLOW TO THE BRAIN
RESULTANT BRAIN DAMAGE
HIE HELP CENTER | HIEHELPCENTER.ORG | (888) 329-0122

CANDIDATES FOR WHOLE BODY COOLING

- ≥ 36 0/7 weeks gestational age
- ≥ 1,800 grams at birth
- Less than 6 hours of age (preferred)
- No severe congenital anomaly or known major chromosomal abnormalities

TO COOL OR NOT TO COOL

Candidacy for Cooling (Neuroprotective Hypothermia)

TIME of birth: _____ a.m./p.m. **CURRENT AGE in hours/minutes:** _____ h. _____ min.
If current age is > 6 hours, but less than 24 hours, contact your tertiary center to discuss candidacy for cooling.

Clinical information	Criteria	Instructions
Gestation	**1** ≥ 36 weeks gestation ☐	Go to ➡ **2** *Weight*
	< 36 weeks gestation ☐	Ask tertiary center
Weight	**2** ≥ 1800 grams ☐	Go to ➡ **3** *Blood gas*
	< 1800 grams ☐	Ask tertiary center
Blood gas pH = _____ Base deficit = _____ Source: Cord A ☐ or V ☐ *Enter the worst blood gas results from the cord or the 1 hour of age gas* __ __ __ __ __ __ __ __ ***Or 1st baby blood gas at < 1 hour of age.*** Time obtained: _____ : _____ ☐ Arterial ☐ Capillary ☐ Venous	**3** pH ≤ 7.0 ☐ *or* Base deficit ≥ −16 ☐	Criteria met thus far. Go to **EXAM***
	No gas obtained ☐ *Or* pH 7.01 to 7.15 ☐ *Or* Base deficit −10 to −15.9 ☐	Go to ➡ **4** *History of acute perinatal event*
	pH > 7.15 or Base deficit < −10 ☐	May not be eligible; Go to ➡ **4** *History of acute perinatal event*
Acute perinatal event *(check all that apply)*	**4** Variable/late fetal HR decelerations ☐ Severe fetal bradycardia ☐ Prolapsed/ruptured or tight nuchal cord ☐ Prolonged shoulder dystocia ☐ Uterine rupture ☐ Maternal hemorrhage/placental abruption ☐ Maternal trauma (e.g. vehicle accident) ☐ Mother received CPR/cardiovascular collapse ☐	Any checked, Go to ➡ **5** *Apgar score*
	No perinatal event *Or* Indeterminate what the event was because of home birth or missing information	May not be eligible; Go to ➡ **5** *Apgar score*
Apgar score at 1 minute _____ 5 minutes _____ 10 minutes _____	**5** Apgar ≤ 5 at 10 minutes **(yes)** ☐	Criteria met thus far. Go to **EXAM***
	Apgar ≥ 6 at 10 minutes **(yes)** ☐	Go to ➡ **6** *Resuscitation after delivery*
Resuscitation after delivery *(check all that apply)* ___ PPV/intubated at 10 minutes ___ CPR ___ Epinephrine administered	**6** Continued need for PPV or intubated at 10 minutes? **(yes)** ☐	Criteria met thus far. Go to **EXAM***
	PPV/intubated at 10 minutes? **(no)** ☐	May not be eligible; Go to **EXAM***

***Seizures:** If infant is <6 hours old and meets the gestation, weight, and blood gas criteria, and has a clinically recognized and/or electrographic seizure, patient is eligible for hypothermia regardless of additional exam findings. However, complete the checklist so that complete information is provided. Consult the tertiary center where cooling is offered to discuss any questions or concerns.

NEUROLOGICAL EXAM

Neurological Exam To Evaluate Eligibility For Cooling

Time of Birth:		Current Age (in hours/minutes) Hours:		Minutes:	Determination (0, 1, 2, or 3)
Circle findings for each domain. Patient is eligible for cooling if 3 or more domains with findings in stages 2 or 3.					
Stage	**Normal (0)**	**Mild (1)**	**Moderate (2)**	**Severe (3)**	
Spontaneous Activity	Normal/active	Jittery/increased	Decreased	No activity	= _____
Posture	Normal (moves around and does not maintain only one position)	Slight extension of arms and legs, and/or slight flexion of wrists, ankles, fingers, or toes	Extension of arms and legs (including a "frog-legged" position) and/or strong flexion of the wrists, ankles, fingers or toes	Decerebrate (all extremities rigidly extended)	= _____
Level of Consciousness	Normal (arouses to an awake state and responds to external stimuli)	Hyperalert or inconsolable/irritable	***Lethargic*** Can elicit a response with stimulation, but may be delayed	***Stupor/Comatose*** Unresponsive or barely responsive to touch/ external stimuli	= _____
Tone	Normal (resists passive motion)	Slightly increased	Hypertonic or hypotonic/ floppy	Flaccid (like a rag doll)	= _____
Primitive Reflexes *(select the **worst** item for suck or moro)*	**Suck:** strong/rhythmic **Moro:** normal (extension of limbs, opening of hands, followed by adduction of upper extremities)	**Suck:** effective but uncoordinated **Moro:** hyperreactive (low threshold to elicit)	**Suck:** weak or biting **Moro:** incomplete	**Suck:** absent **Moro:** absent	**Select *highest* stage for primitive reflex for determination** = _____
Autonomic Nervous System [ANS] (vital signs) *Select the **worst** for the ANS findings. Ex: if infant is intubated, circle the severe respirations item (column 3)*	**Respirations:** regular respiratory rate and spontaneous breathing with no abnormal pauses **Heart rate:** normal range for age and variable with movement, crying	**Respirations:** tachypnea **Heart rate:** tachycardia	**Respirations:** periodic or irregular breathing **Heart rate:** <100 bpm, but variable up to 120 bpm	**Respirations:** intubated or receiving PPV via mask or laryngeal mask airway (LMA) **Heart rate:** little variability in rate, may be irregular, may be bradycardic	**Select *highest* stage of the 3 ANS for determination** = _____
ANS (pupils)	**Pupils:** normal size, reactive to light	**Pupils:** mild dilation, but reactive to light	**Pupils:** constricted, but reactive to light	**Pupils:** dilated and either fixed or sluggishly reactive; asymmetric	

Seizures: if the infant is <6 hours old and meets the gestation, weight, and blood gas criteria and has a clinically recognized and/or electrographic seizure, the patient is eligible for cooling regardless of the rest of the exam findings. However, complete the entire neurological exam to establish a baseline exam.

Observe infant first | Hands on exam

WARMING AFTER WBC

1

Rewarm after 72 hours of cooling

2

Increase by 0.5°C per hour

3

Avoid hypothermia for 24 hours

REWARMING

- Do not exceed 0.5°C per hour to avoid sudden vasodilation and hypotension
- Have volume expanders and blood pressure medications available
- Adjust rewarming speed to infant's stability and tolerance

REFERENCES

- Gardner, S. L., Carter, B. S., Hines, M. E., & Hernandez, J. A. (2021). *Merenstein & Gardner's handbook of neonatal intensive care* (9th ed.). Elsevier.
- Kenner, C., Altimier, L., & Boykova, M. V. (2020). Comprehensive neonatal nursing care.
- Lowdermilk, D., Perry, S., Cashion, K., & Alden, K. (2020). Maternity & Women's Health Care. (12th ed.). St. Louis: Mosby.
- Methodist Health System. (2024, January). *Whole body cooling for neonates with hypoxic ischemic encephalopathy*. http://mhsintranet/Main/Policies-and-Procedures/Whole-Body-Cooling-for-Neonates-with-Hypoxic-Ische-15116.aspx
- Verklan, M. T., & Walden, M. (2021). *Core curriculum for intensive care nursing* (6th ed.). Elsevier.