UC DAVIS HEALTH | CHILDREN'S HOSPITAL

Echocardiography Screening in Neonates with Hypoxic-Ischemic Encephalopathy (HIE) and Hemodynamic Instability

NICU Clinical Guideline – Neonatal Hemodynamics

Background

Hypoxic-ischemic encephalopathy (HIE) occurs in approximately 1 to 3 per 1,000 live births in high-income countries, and therapeutic hypothermia (TH) remains the standard of care [1]. Cooling reduces the composite outcome of death or major neurodevelopmental disability but HIE is increasingly recognized as a multi-organ disease in which cardiac dysfunction is frequently under-recognized [2-4].

Hemodynamic instability is common during TH and is associated with increased mortality and brain injury on MRI. Reported prevalence in moderate-to-severe HIE is summarized below.

Parameter	Prevalence	Population / notes
Hemodynamic impairment	Up to 80%	Moderate-severe HIE
Pulmonary hypertension (PPHN)	17-25%	Moderate-severe HIE
Hypotension requiring inotropes	30-65%	Higher with PPHN (65% vs 30%)
Inhaled nitric oxide (iNO)	64%	HIE with PPHN
ECMO	12%	HIE with PPHN

Cited prevalence figures are drawn from published HIE studies [3-6].

Purpose

To standardize early, targeted echocardiographic assessment in neonates with HIE and hemodynamic instability, so that hemodynamic management is guided by the underlying physiology rather than by blood pressure alone.

Why Blood Pressure (BP) Alone Is Insufficient

Mean arterial pressure (MAP) is the product of cardiac output (CO) and systemic vascular resistance (SVR). In HIE, CO and SVR often change, so BP can appear normal while systemic perfusion is poor (low CO with compensatory high SVR) [7].

- Neonatal BP thresholds are imperfect and are not validated for HIE physiology; the "MAP ≈ gestational age" rule is a rough estimate only.
- Therapeutic hypothermia lowers heart rate and cardiac output without a proportionate change in BP. Sedation, ventilation, acid-base status, and PPHN further distort BP interpretation [8].
- A mean BP of at least 40-50 mmHg best preserves cerebral autoregulation; longer time spent outside this range is associated with more severe brain injury on MRI [9, 10].
- BP also does not identify which therapy is required. Surrogate markers of perfusion are unreliable during TH: lactate does not reliably reflect real-time cardiac output, capillary refill time is influenced by cooling, and urine output is confounded by perinatal renal injury [11, 12].

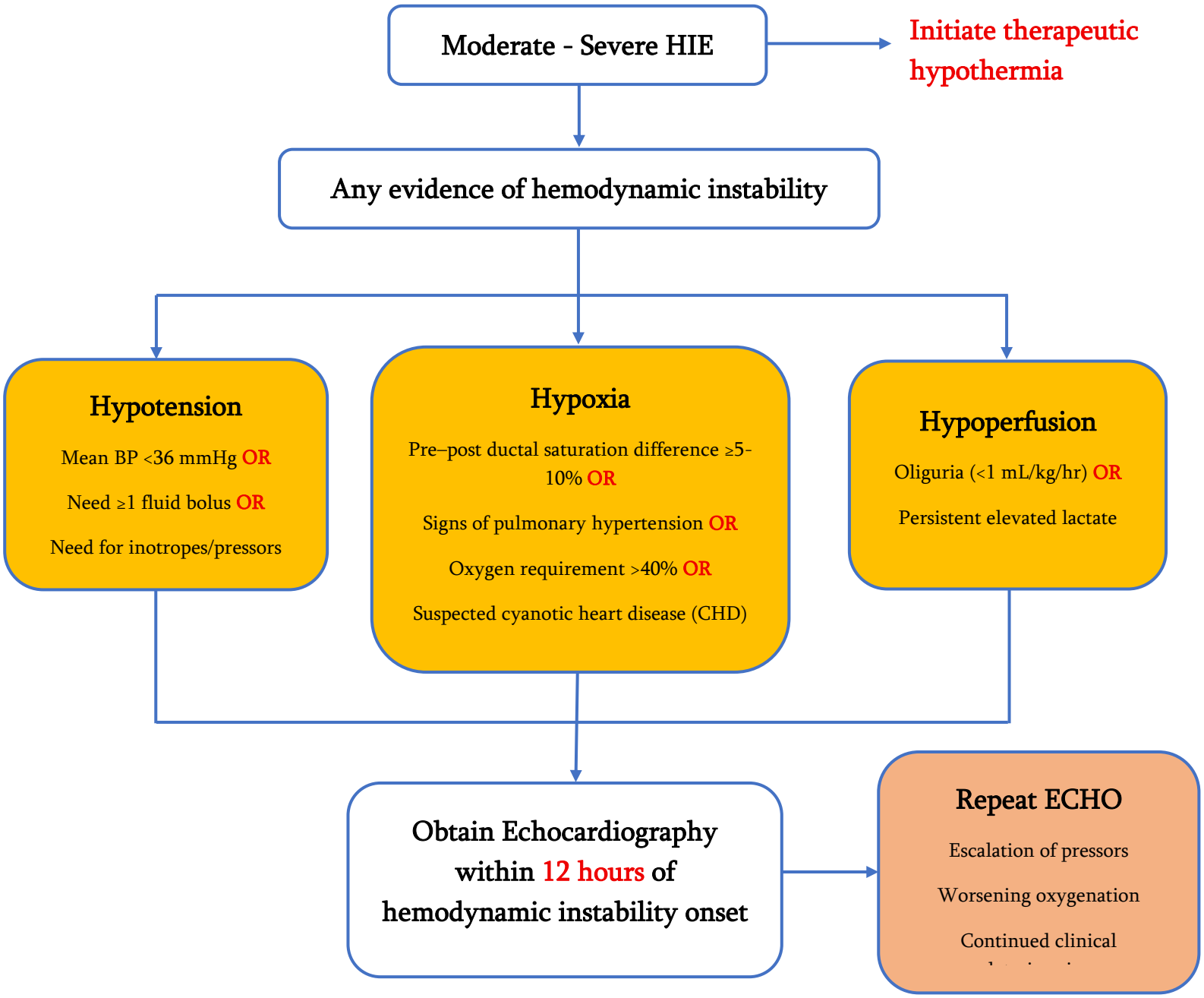
Role of Targeted Echocardiography

Targeted neonatal echocardiography characterizes the physiology that drives instability and allows therapy to be matched to the underlying lesion. Echocardiography can assess:

- Fluid status and ventricular filling
- Left ventricular systolic and diastolic function
- Right ventricular function
- PPHN severity and shunt direction
- Ductal and atrial shunting and PDA physiology
- Estimates of filling pressures (left atrial size, Doppler patterns)

Echocardiography-guided management aids inotrope and vasopressor selection, identifies the need for pulmonary vasodilators, avoids inappropriate fluid loading, and helps identify high-risk neonates associated with poorer outcomes.

Echocardiography screening guideline in neonates with HIE & Hemodynamic Instability



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