

Physiologic Anemia and the Anemia of Prematurity

Risk

- Physiologic anemia, occurring 6–8 wk after birth, is a normal process in term infants.
- Anemia of prematurity is a pathologic anemia occurring in preterm infants. Extent of prematurity and comorbidities correlate with extent of anemia.

Perioperative Risks

- Term infants with physiologic anemia tolerate minor surgery well.
- Premature infants must be evaluated for symptoms due to anemia that may contribute to increased risk of preop events.

Worry About

- Major surgery occurring at the physiologic nadir of anemia may require blood transfusion.
- Preterm infants with anemia undergoing physiologic stress due to surgery are at risk for tachycardia, tachypnea, lactic acidosis, and periop apnea and bradycardia.

Overview

- Physiologic anemia is normal response to extrauterine life. Nadir at 9th–12th wk of life, Hgb level varies 9–11 g/dL.

- In preterm infants, nadir occurs at 4–8 wk of life and may decrease to 8 g/dL.
- Anemia of prematurity may be asymptomatic or give rise to nonspecific symptoms such as tachycardia, tachypnea, lethargy, pallor, apnea and bradycardia, poor feeding, poor growth, and lactic acidosis.

Etiology

- Transition to extrauterine life includes requirement for increased oxygen to bind to hemoglobin (HbO₂ saturation 50% in utero, 95% ex utero). Fetal hemoglobin with high oxygen affinity starts to be replaced with low-oxygen-affinity adult hemoglobin.
- Survival of neonatal erythrocytes is shorter than that of adult erythrocytes. Hemoglobin decreases until oxygen needs are greater than supply. Production of EPO is triggered and erythropoiesis increases.
- Rapid growth in infants causes a rapid increase in blood volume, resulting in hemodilution. Growth is more rapid in preterm than term infants.
- Preterm infants have more severe anemia because the less sensitive hepatic oxygen sensor triggers EPO production until 40 wk PCA. After 40 wk PCA, an

extremely sensitive renal oxygen sensor takes over triggering and production of EPO.

- Iron storage occurs in the last trimester; therefore, premature infants are relatively iron deficient and have difficulty increasing iron stores by feeding.
- Extent of prematurity correlates with the amount of blood loss due to blood sampling.

Usual Treatment

- No treatment required in term infants.
- Preterm infants benefit from prevention: Reduction of blood draws, appropriate dietary supplementation, and erythropoietin therapy.
- Treatment of anemia of prematurity with blood transfusion occurs when symptoms of reduced O₂ supply are present. Symptoms include continued need for mechanical ventilation, apnea and bradycardia, tachycardia (>180 bpm for 24 h), inadequate weight gain, metabolic acidosis, or anticipation of major surgery.

Assessment Points (Apply to Preterm Infants Only)

System	Effect	Assessment by Hx	PE	Test
CV	Tachycardia	Review of VS trends	Tachycardia	± ECG
RESP	Apnea/bradycardia	Number of episodes; treatment required or spontaneous resolution		

Key References: Aher S, Malwatkar K, Kadam S: Neonatal anemia, *Semin Fetal Neonatal Med* 13(4):239–247, 2008; Bishara N, Ohls R: Current controversies in the management of the anemia of prematurity, *Semin Perinatal* 33(1):29–34, 2009.

Perioperative Implications

Preoperative Preparation

- Timing of elective blood-losing surgery depends on Hgb levels.

Monitoring

- Routine

Airway

- None

Preinduction/Induction

- Routine

Extubation

- Recent Hx of apnea and bradycardia: Consider delaying extubation to allow metabolism of anesthetic agents and sedatives.

Adjuvants

- Spinal anesthesia, when appropriate, may be beneficial in preterm infant.

Postoperative Care

- Consider monitoring preterm infant for apnea and bradycardia for 24 h.

Anticipated Problems/Concerns

- Anemia is a significant risk factor for postop apnea in preterm infant undergoing surgery and anesthesia.

Pickwickian Syndrome

Aaron M. Fields | Ryan E. Rubin

Risk

- Affects 5–10% of morbidly obese pts
- Usually associated with long-standing obesity

Perioperative Risks

- Markedly greater risk among the morbidly obese vs. pts with normal BMI.
- With intraabdominal or intrathoracic procedures lasting more than 2 h, there is approximately 40% of serious morbidity.

Worry About

- Hypoventilation
- Hypercarbia
- Hypoxemia
- Polycythemia, thrombophlebitis, and subsequent pulm embolism
- Pulm Htn
- Hypersomnolence
- Biventricular cardiac failure

Overview

- Pickwickian syndrome, or OHS, is defined as the combination of obesity (BMI above 30 kg/m²), hypoxia during sleep, and hypercapnia.
- Morbidly obese pts who hypoventilate due to sleep apnea and severe restrictive ventilatory disorder have permanent pulm Htn, acidosis, and polycythemia because of their chronic hypoxemia and CO₂ retention.
- OHS is usually associated with systemic Htn and compensatory increase in circulating blood volume, leading to right and left ventricular failure.
- Two subtypes are recognized, depending on the nature of the disordered breathing detected on further investigation. The first is OHS in the context of obstructive sleep apnea; this is confirmed by the occurrence of five or more episodes of apnea, hypopnea, or respiration-related arousals per h (high apnea-hypopnea index) during sleep. The second is OHS primarily due to “sleep hypoventilation syndrome;”

this requires a rise of CO₂ levels by 10 mm Hg (1.3 kPa) after sleep compared to awake measurements and overnight drops in O₂ levels without simultaneous apnea or hypopnea. Overall, 90% of all people with OHS fall into the first category and 10% in the second.

- On physical exam, characteristic findings are the presence of a raised jugular venous pressure, a palpable parasternal heave, a heart murmur due to tricuspid regurgitation, hepatomegaly, ascites, and leg edema.

Etiology

- Work of breathing is increased as adipose tissue restricts the normal movement of the chest muscles and makes the chest wall less compliant, causing the diaphragm to move less effectively. Respiratory muscles are fatigued more easily, and airflow is impaired by excessive tissue in the head and neck area.