

Intensive Care Nursery House Staff Manual

Neonatal Anemia

BACKGROUND and PATHOPHYSIOLOGY: Normal erythropoiesis is influenced by several factors, especially erythropoietin (EPO), which stimulates maturation of red blood cell (RBC) precursors. Anemia, defined as hematocrit (Hct) or hemoglobin (Hgb) concentration >2 SD below mean for age, may be due to three general causes: blood loss, \uparrow RBC destruction or \downarrow RBC production. The major physiologic impact of anemia is \downarrow oxygen delivery to tissue, resulting in both compensatory responses (see “symptoms”) and acute or chronic consequences including poor growth, decreased activity and limited cardiovascular reserve. Anemia is defined as Hct $<45\%$ in a term infant. The table at the end of this section gives some normal hematological values for preterm and term newborn infants.

CAUSES OF NEONATAL ANEMIA:

1. Blood loss, the commonest cause of neonatal anemia, including:

- A. Obstetrical causes:** placental abruption, placenta previa, trauma to placenta or umbilical cord during delivery and rupture of anomalous placental vessels
- B. Feto-maternal transfusion:** 8% of normal pregnancies have some admixture.
- C. Feto-placental transfusion** due to positioning of infant above level of placenta after delivery, partial cord occlusion (*e.g.*, with nuchal or prolapsed cord).
- D. Twin-twin transfusion**(see section on Multiple Births, P. 170):
 - Occurs only with monochorionic (*i.e.*, monozygotic) twins and when there are placental vessels which allow shunting of blood from one twin to the other.
 - Donor will have anemia of variable severity.
 - Recipient will have polycythemia of variable severity.
- E. Internal hemorrhage** such as intracranial hemorrhage, subgaleal hemorrhage, cephalohematoma, adrenal hemorrhage, subcapsular hematoma of liver or ruptured viscus
- F. Iatrogenic blood loss** secondary to sampling of blood for laboratory tests. This is the commonest cause of anemia (and transfusion) in small preterm infants.

2. \uparrow RBC destruction:

A. Intrinsic causes: Hereditary RBC disorders (rare), including:

- RBC Enzyme defects (*e.g.*, G6PD deficiency)
- RBC membrane defects (*e.g.*, hereditary spherocytosis)
- Hemoglobinopathies (*e.g.*, α -thalassemia)

B. Extrinsic causes:

- Immune hemolysis
 - Rh incompatibility
 - ABO incompatibility
 - Minor blood group incompatibility (*e.g.*, Kell, Duffy)
 - Hemangiomas (Kasabach Merritt syndrome)
- Acquired hemolysis:
 - Infection
 - Vitamin E deficiency (of historical interest, now it is very rare)

-Drugs

3. ↓ RBC production:

- A. Anemia of prematurity due to transient deficiency of erythropoietin
- B. Aplastic or hypoplastic anemia (*e.g.*, Diamond-Blackfan)
- C. Bone marrow suppression (*e.g.*, with Rubella or Parvovirus B19 infection)
- D. Nutritional anemia (*e.g.*, iron deficiency), usually after neonatal period

CLINICAL FINDINGS vary with the severity of anemia and other associated conditions. There may be no signs with mild anemia. With more severe anemia, findings include:

- Pallor
- Tachypnea
- ↑ O₂ requirements
- Poor feeding
- Jaundice
- Hypotension
- ↓ tolerance of labor with fetal anemia
- Tachycardia
- Apnea
- Lethargy
- Hepatosplenomegaly (hemolytic disease)
- Wide pulse pressure
- Metabolic acidosis with severe anemia

DIAGNOSTIC EVALUATION of anemia:

1. History:

- Family: Anemia, ethnicity, jaundice
- Maternal and perinatal: Blood type and Rh; anemia; complications of labor or delivery
- Neonatal: Age of onset; presence of other physical findings

2. Laboratory Evaluation may include the following, depending history and physical findings:

- CBC with platelets, smear and reticulocyte count
- Blood group and type, Direct Antiglobulin test (Coombs Test)
- Bilirubin (total and direct)
- Kleihauer-Betke Test (on maternal blood to look for fetal red cells as evidence of fetomaternal hemorrhage)
- Ultrasonogram for internal bleeding (head, abdomen)
- Rarely, hemoglobin electrophoresis and RBC enzymes
- Bone marrow aspiration is almost never necessary to diagnose anemia in a newborn

MANAGEMENT will depend on cause and severity of anemia.

1. Prenatal: Diagnosis of significant fetal anemia is unusual except in hemolytic disease of the newborn (see P. 121) and Parvovirus B-19 infection. Fetal transfusion may be needed for severe anemia.

2. Postnatal:

A. Anemia of prematurity: The main methods of management are:

- Limit blood drawing for laboratory tests
- Treatment with recombinant human erythropoietin (r-Hu-EPO) (see Guidelines for Use of Erythropoietin, P. 111)

- Transfusion with packed red blood cells (PRBCs) for severe anemia (see guidelines on P. 40-41)

B. Other causes of anemia: Treat underlying cause when feasible. Transfusion guidelines for treatment of anemia in newborns are given in the section, Administration of Blood Products (P. 40).

C. Severe anemia: With severe, symptomatic anemia, the infant's cardiovascular system may not be able to tolerate the ↑ blood volume from simple transfusion of PRBCs. In such cases, perform a partial exchange transfusion with PRBCs. See sections on Exchange Transfusion (P. 42) and Polycythemia (P. 112) for the technique. To calculate the volume of PRBCs to exchange, use the following formula:

$$\text{Volume of PRBCs for exchange (cc)} = \frac{(\text{Desired Hct} - \text{Patient's Hct}) \times \text{weight (kg)} \times 90 \text{ cc/kg}}{(\text{PRBC Hct} - \text{Patient's Hct})}$$

Table. Average hematological values for term and preterm infants.

| <u>Gestation (weeks)</u> | <u>Hct (%)</u> | <u>Hgb (g/dL)</u> | <u>Retic (%)</u> |
|--------------------------|----------------|-------------------|------------------|
| 37-40 | 53 | 16.8 | 3-7 |
| 32 | 47 | 15.0 | 3-10 |
| 28 | 45 | 14.5 | 5-10 |
| 26-30 | 41 | 13.4 | — |
