

Neonatal Anemia

Dr. Ranan Kardagh, FICP
Department of Pathology/Hematology
Hawler Medical University
College of Medicine
2011

Neonatal Hemopoiesis

- Yolk sac 3rd wk of gestation
- Liver by 6–8 wk of gestation
- BM around 11th wk of gestation
- Crenated RBC are seen
- Life span 35–50 days in preterm 60–70 days in term
- Susceptibility to oxidant induced injury is increased.
- Epo. response to anemia is blunted

Specific embryonic and fetal globin chains are synthesized

Table 61.1 Composition of haemoglobins in the human embryo, fetus and neonate.

<i>Haemoglobin</i>	<i>Globin chains</i> <i>α-Globin gene cluster</i>	<i>β-Globin gene cluster*</i>	<i>Gestation</i>
<i>Embryonic</i>			
Hb Gower 1	ξ_2	ϵ_2	From 3–4 weeks
Hb Gower 2	α_2	ϵ_2	
Hb Portland	ξ_2	γ_2	From 4 weeks
<i>Fetal</i>			
HbF	α_2	γ_2	From 4 weeks
<i>Adult</i>			
HbA	α_2	β_2	From 6–8 weeks
HbA2	α_2	δ_2	From 30 weeks

*The α -globin gene cluster is situated on chromosome 16 and the β -globin gene cluster on chromosome 11. Note that fetuses and neonates with α -thalassaemia major, who are unable to synthesize α -globin chains, will have Hb Portland as well as Hb Barts (β_4), detectable by haemoglobin electrophoresis or HPLC.

At birth

Hb F	70–80%
Hb A	25–30%
Hb A ₂	small amount
Hb bart	trace amount

Definition of anemia

- ▶ Reduction of RBC volume, or hemoglobin concentration below the normal ranges of values of the same age and weight
- ▶ At term, Cord Hb (14-20 g/dl)
- ▶ LBW, Hb (12-18 g/dl)
- ▶ Hb of term infant at 12 weeks (12 g/dl)
- ▶ Hb of preterm at 6 weeks (7-10 g/dl)

Differences in premature infants

- ▶ At birth they have slightly lower hemoglobin levels, and higher MCV and retic counts
- ▶ The nadir is lower and is reached sooner
 - Average nadir is 7–9 g/dL and is reached at 4–8 weeks of age
 - Related to a combination of decreased RBC mass at birth, increased iatrogenic losses from lab draws, shorter RBC life span, inadequate erythropoietin production, and rapid body growth

Clinical picture of anemia

- ▶ Regardless of the etiology, anemia presents with:
- ▶ **Symptoms:**
 - Dyspnea on feeding or poor feeding
- ▶ **Signs:**
 - Pallor, tachycardia, short soft systolic murmur (haemic murmur)
 - Cardiomegaly
 - High COP failure, generalized edema (Hydrops fetalis)

Pathophysiology

- ▶ Anemia in the newborn results from three processes
 - Loss of RBCs: hemorrhagic anemia
 - Increased destruction: hemolytic anemia
 - Underproduction of RBCs: hypoplastic anemia

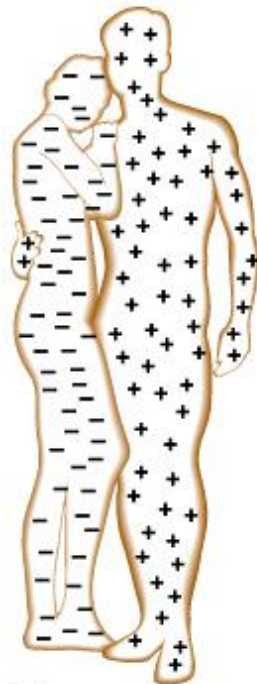
Hemorrhagic anemia

- Twin–twin transfusion syndrome
 - Only in monozygotic multiple births
 - Difference in hemoglobin usually > 5 g/dL
 - Congestive heart disease common in anemic twin and hyperviscosity common in plethoric twin.
- Fetomaternal hemorrhage (30–50% of pregnancies)
 - Increased risk with preeclampsia–eclampsia, need for instrumentation.
- Traumatic rupture of the cord
- Failure of placental transfusion due to cord occlusion (nuchal or prolapsed cord)
- Obstetric trauma causing occult visceral or intracranial hemorrhage.
- Iatrogenic blood loss due to blood draws

Hemolytic anemia

- ▶ Immune hemolysis: Rh incompatibility or autoimmune hemolysis
- ▶ Non-immune: sepsis, TORCH infection
- ▶ Congenital erythrocyte defect
 - G6PD, thalassemia, unstable hemoglobins, membrane defects (hereditary spherocytosis, elliptocytosis)
- ▶ Systemic diseases: galactosemia, osteopetrosis

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Rh-negative woman and Rh-positive man conceive a child



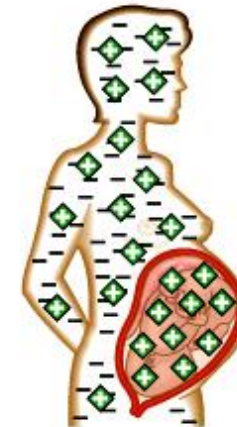
Rh-negative woman with Rh-positive fetus



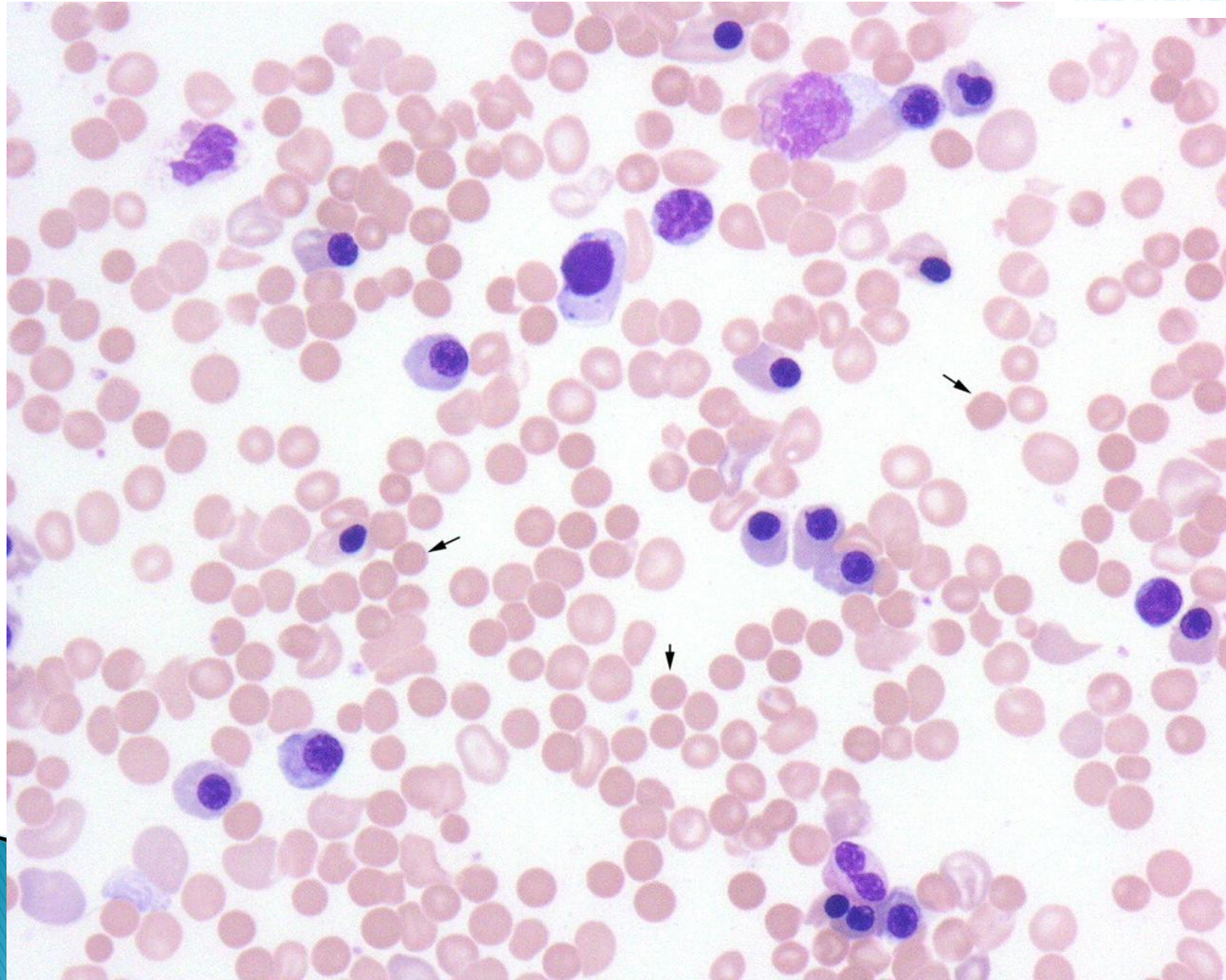
Cells from Rh-positive fetus enter woman's bloodstream



Woman becomes sensitized—antibodies (◊) form to fight Rh-positive blood cells

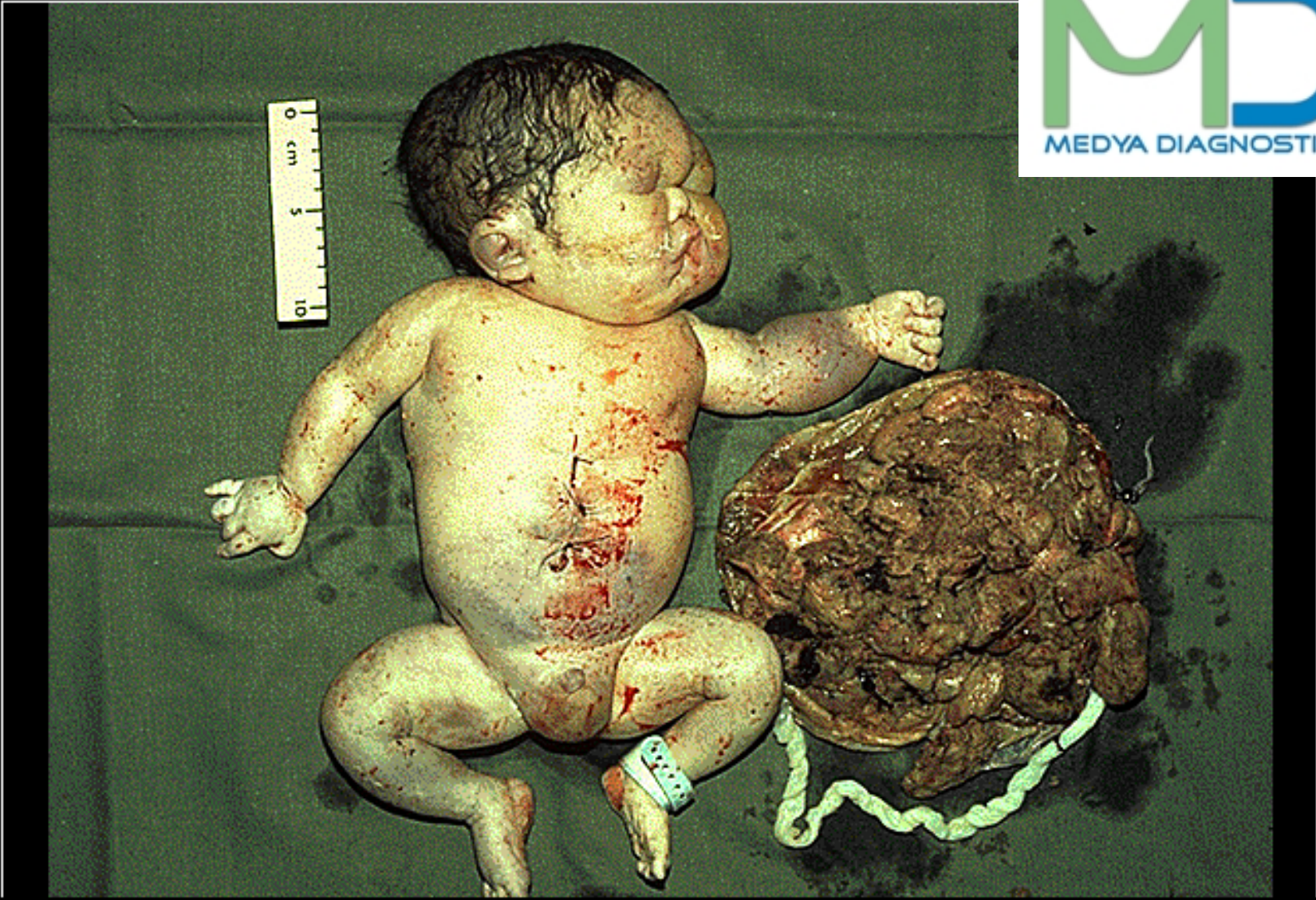


In the next Rh-positive pregnancy, maternal antibodies attack fetal red blood cells



1. Hb Bart's Hydrops Fetalis

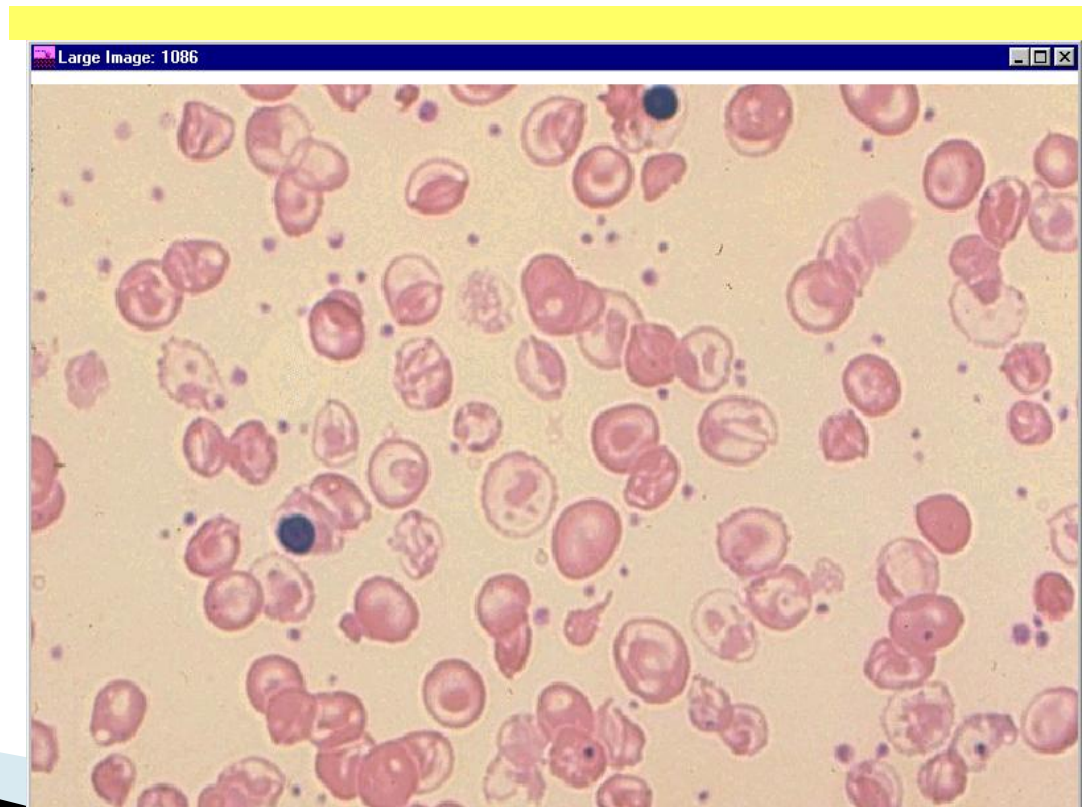
- ▶ Common only in SEA.
- ▶ Genetics :
Due to inheritance of α^0 defect from both parents, so (---/---). So no Hb F but γ_4 (Hb Barts) which is ineffective as an Oxygen carrier.
- ▶ Clinical :
Death inutero, or within hours of birth.



Hb Bart's Hydrops Fetalis

Blood picture in Hb Barts Hdrops fetalis

- ▶ Severe anaemia Hb 3-10g/dl.
- ▶ Hypochromia, microcytosis, target and NRC.
- ▶ Heinz bodies.
- ▶ Negative Coomb's test.



Hb Studies in Hb Bart's Hydrops Fetalis

- ▶ Electrophoresis :
 - ~ 80% Hb Barts (γ_4),
 - ~ 20 % Hb portland ($\xi_2\gamma_2$)
 - and a small amount of Hb H (β_4).
 - No Hb F, No Hb A, or A2.

Hypoplastic anemia

- ▶ Congenital
 - Diamond–Blackfan syndrome, congenital leukemia, sideroblastic anemia
- ▶ Acquired
 - Infection: Rubella and syphilis are the most common

Diagnosis



▶ Initial studies

- Hemoglobin
- RBC indices
 - Microcytic or hypochromic suggest fetomaternal or twin-twin hemorrhage, or α -thalassemia
 - Normocytic or normochromic suggest acute hemorrhage, systemic disease, intrinsic RBC defect, or hypoplastic anemia
- Reticulocyte count
 - elevation suggests hemolytic anemia while low count is seen with hypoplastic anemia

Diagnosis



- ▶ Initial studies continued
 - Blood smear looking for
 - spherocytes (ABO incompatibility or hereditary spherocytosis)
 - elliptocytes (hereditary elliptocytosis)
 - pyknocytes (G6PD)
 - schistocytes (consumption coagulopathy)
 - Direct Coombs test: positive in AIH0-immune or autoimmune hemolysis

Other diagnostic studies

- ▶ Blood type and Rh in isoimmune hemolysis
- ▶ Kleihauer–Betke test on maternal blood looking for fetomaternal hemorrhage
- ▶ Bone marrow aspiration for congenital hypoplastic or aplastic anemia
- ▶ DIC panel, platelets looking for consumption
- ▶ Intrinsic RBC defects: enzyme studies, globin chain ratios, membrane studies



THANK YOU