Case Study #1: Normocytic Anemia

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You are the surrogate for one of your vacationing co-workers. Kai-Lan, a 2-month female, recently came in to see your co-worker for a well child exam. Your co-worker ordered a CBC at that time. Nothing significant is uncovered when reviewing notes from that visit. When checking her labs, you note that Kai-Lan has the following results:

CBC:
WBC 15.9
Hgb 9.5
Hct 28
MCV 90
MCHC 28.3
PLT 310

1. What can you determine from these lab values?

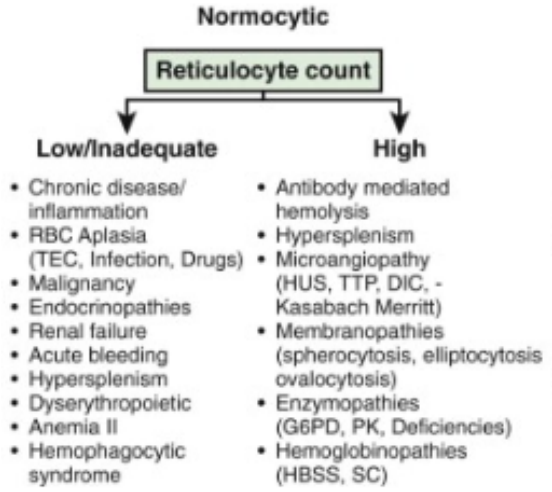
Analysis of these lab values indicates a mild normocytic anemia. Anemia is defined as having a hemoglobin (Hgb) value less than the 5th percentile for age (Janus & Moerschel, 2010). The mean corpuscular volume (MCV) is used to categorize whether the anemia is normocytic, macrocytic, or microcytic based on RBC size; further tests may need to be ordered to determine the possible causes (Janus & Moerschel, 2010). Each lab value was assessed using the Age Specific Blood Cell Indices (Table 14-1) from *Harriet Lane* (Ahsan & Noether, 2012). The WBC of 15.9 is within normal limits. The Hgb of 9.5 is just above the 2 SD below the mean mark (9.4) and is less than 5th percentile for age based on the hemoglobin percentile curve for age and sex (Figure 14-1) indicating anemia (Ahsan & Noether, 2012). The Hct is also borderline at the two standard deviation below the mean mark. The MCV of 90 is within normal range (Mean 95), and the MCHC is borderline at the two standard deviation below the mean mark. The platelet count of 310 is within the normal range (150-350), indicating no

thrombocytopenia. The following values are not available to assess: Total RBC's (cannot determine the Mentzer Index without it), RDW value, Retic Count, and Differential.

2. What is your differential diagnosis?

As outlined, Kai-Lan's CBC results appear to reveal a normocytic anemia, with many of her lab values in the low normal range. Her MCV, however, is entirely normal, removing micro- and macrocytic causes of anemia from list of possible differential diagnoses. This eliminates some of the most common causes of anemia such as iron deficiency, but also some of the more worrisome ones like thalassemia or congenital aplastic anemia.

Follow up and additional testing will be required to differentiate some of the many causes of normocytic anemia, including the following:



(Kliegman, Stanton, St. Geme, Schor, & Behrman, 2011, p. 1649)

Once narrowed down to a normocytic anemia, there are a number of differentials to consider. Since we do not have a retic count, we cannot use that to narrow our diagnosis until it is obtained. A reticulocyte count is important to differentiate decreased production of RBC's (as in bone marrow dysfunction) from increased destruction of RBC's (as in hemolysis). An elevated retic count can indicate hemolytic disease, whereas a decreased retic count can indicate bone

marrow dysfunction. Leukemia and aplastic anemia would also be in the differential. Normocytic anemia can be the result of chronic disease. However, it sounds like this patient does not have any significant past history based on her record. Blood loss is an unlikely cause in this case. At two months old, transient erythroblastopenia of childhood is less likely, as it typically occurs in children 6 months-3 years old after recovering from viral infection (Janus & Moerschel, 2010; Ahsan & Noether, 2012).

Perhaps the most important first step is to determine if Kai Lan's lab values could represent the physiologic anemia of infancy, part of the normal physiologic adaptations that occur as an infant's body transitions to extrauterine life (Kliegman et al., 2011, p. 1654). At birth, the infant is immediately exposed to an environment that is much more oxygen rich than the uterus, and the production of erythropoietin is down-regulated, concurrently down-regulating red blood cell (RBC) production (Kliegman et al., 2011). Existing RBCs continue to age out and are removed from circulation, and RBCs and hemoglobin (Hgb) levels continue to fall until tissue needs become greater than what the available RBCs can supply. This shortfall "jumpstarts" RBC production and the anemia will resolve. In premature infants, this process is exaggerated and may require treatment, but healthy term babies do not (Kliegman et al., 2011). Physiologic anemia typically occurs between 8 and 12 weeks of age, when the Hgb concentration is between 9-11 g/dL (Ahsan, S., & Noether, 2012). Birth trauma or repeated lab draws can also aggravate physiologic anemia (Kliegman et al., 2011). In Kai Lan's case, she is at the low end of the age range, but her hemoglobin levels may indicate physiologic anemia.

Knowing more about Kai Lan's birth history could also help to differentiate some other likely causes of anemia. Anything related to increased hemolysis at birth, such as infection or jaundice, could also worsen physiologic anemia. Her newborn screening results could also help,

as both enzyme disorders glucose-6-phosphate dehydrogenase deficiency (G6PD) and pyruvate kinase (PK) deficiency can appear as normocytic anemia (Kliegman et al., 2011). Ultimately, further investigation is needed.

3. Is additional testing needed? If so, what and when?

This child's lab result is normal, but her H& H is normocytic within low normal limit. Anemia causes vary by age and it is defined when the hemoglobin level is less than the 5th percentile for age (Janus & Moerschel, 2010). There is no clear reason why she needed CBC, so it will be important to do a good physical exam and review of the medical and surgical history including her birth history. Most anemias in children can be diagnosed with a basic work-up that includes a complete blood cell count (CBC), a corrected reticulocyte index, and a peripheral blood smear (Brill & Baumgardner, 2000). Childhood normocytic anemias are the result of acute bleeding, sickle cell anemia, red blood cell membrane disorders and current or recent infections (Brill & Baumgardner, 2000), and also may be caused by "chronic disease, hemolysis, or bone marrow disorder" (Janus & Moerschel, 2010, p. 1462).

We would order a reticulocyte count to check if there is any bone marrow disorder and a peripheral smear to evaluate for spherocytosis or other RBC issues. The peripheral blood smear often yields diagnostic clues or confirmatory evidence by hemoglobin shapes (Brill & Baumgardner, 2000). Depending on the results, further investigation would include G6PD deficiency, sickle cell, etc. Full-term infants are born with iron stores that can last four to six months, and for two months in premature babies, so I am not going to do a work up for iron deficiency in this case.

4. What is your plan of care?

We would start by reviewing Kai-Lan's prenatal screening tests for hemoglobinopathies that might have been missed at her initial appointments. We would conduct a complete history and physical to include a thorough family history to assess for further anemia risk factors. It would be important to understand the reason the CBC was ordered at the previous visit, as this is not a universal screening test for a 2-month old. The first step in evaluation of normocytic anemia is determining whether the reticulocyte count is elevated or depressed (Janus & Moerschel, 2010). If the reticulocyte count is elevated, it suggests high RBC turnaround that would lead to further testing for hemolysis. If the reticulocyte count is depressed it would suggest bone marrow hypofunction. Because the reticulocyte count is a critical decision point in correctly diagnosing her anemia and providing appropriate referrals, we would emphasize the importance of going to the lab immediately after this appointment. We would provide parents with educational resources regarding anemia, answer any additional questions, and ask them to follow up with their primary care provider in two weeks.

PICOT Questions

Beatty: P) In children with anemia I) how sensitive is the reticulocyte hemoglobin content (RHC) C) compared to the Hemoglobin level (Hgb) O) in identifying early anemia, and differentiating iron deficiency anemia from other forms of anemia?

Corey: P: How do **term infants**, I: who received **delayed umbilical cord cutting** at birth, C: **standard practice** (immediate cut), O: **hemodynamic status** (HCT, Hgb, Retic, MCV, etc), **T:** at **8 weeks of life**?

Kim: Do children with anemia compared to those without anemia have an increased risk of neurologic impairments in the future?

Negard: For children at risk for lead exposure, will routine screening for chronic lead poisoning aide in diagnosing unexplained microcytic and normocytic anemia?

Torres: In children less than one-year-old with suspected anemia, how does early diagnosis predict future health outcomes over five years?

References

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