Chapter 31
Orthopaedic Manifestations of Hematologic Disorders: Sickle Cell Disease and Hemophilia

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Sickle Cell Disease

Sickle cell disease (SCD) can manifest in many different ways. Even patients with the same genotype exhibit vast differences in clinical presentation. All forms of SCD involve abnormalities in the beta-globin gene. Red blood cells with abnormal hemoglobin (hemoglobin S) form an abnormal "sickle" shape in response to hypoxia. The sickled cells cause vaso occlusion and subsequent ischemia and tissue damage. Red blood cells with hemoglobin S have a reduced life span, leading to increased turnover and subsequent anemia.

Orthopedic Manifestations of Sickle Cell Disease

Vaso-occlusive Crisis ("Pain Crisis")

Relative hypoxia or inflammation due to factors such as cold, infection, and dehydration leads to sickling of the red blood cells. The sickled cells have a rigid structure and are more likely to stick to the endothelial cells lining blood vessels. The end result of sickling is obstruction of small blood vessels leading to ischemia with tissue damage and pain. In very young infants, the presence of fetal hemoglobin is protective against vaso occlusion. Pain crises typically begin to occur after 6 months of age [1].

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J. F. Sarwark, R. L. Carl (eds.), *Orthopaedics for the Newborn and Young Child*,
https://doi.org/10.1007/978-3-031-11136-5_31

In the first years of life, vaso-occlusive crises often involve the hands and feet. This form of pain crisis, known as dactylitis, leads to pain and fusiform swelling of digits. Radiographs show cortical damage and eventual periosteal reaction as new bone forms [2].

Avascular Necrosis (AVN)

Vaso occlusion involving bone leads to avascular necrosis (osteonecrosis). Subchondral avascular necrosis of the epiphysis can cause joint damage and early arthritis. The hip is the most commonly affected joint. Osteonecrosis of the femoral head causes flattening of the femoral head and poor congruence with the acetabulum. Bony infarction in the long bones can also lead to growth disturbances. Avascular necrosis is rare before school-age [1].

Osteomyelitis and Septic Arthritis

Children with SCD have an increased risk of osteomyelitis and septic arthritis. Because children with SCD have splenic infarcts leading to asplenia, they have an increased risk of infection with particular pathogens, including streptococcus pneumoniae, Hemophilus influenza, salmonella, and staphylococcus aureus [3]. Staphylococcus aureus and salmonella strains are the most common causative organisms for osteomyelitis and septic arthritis in individuals with SCD [1].

Because the bone and joint infections can present in a similar manner to pain crises, medical providers need to consider the possibility of infection in infants in children who present with pain involving the extremities. Patients with infection are more likely to have systemic symptoms including lethargy and fever though these features are not specific. With vaso-occlusive crisis, the onset of pain tends to be subtle, while children with osteomyelitis often have a more gradual onset of pain.

In the United States, infants are screened for sickle cell disease as part of the newborn screening program in each state. Early identification of infants with sickle cell allows for antibiotic prophylaxis with penicillin and increased vigilance for infection and appears to lower the risk of infection and morbidity associated with infection.

Hemophilia A and B

Hemophilia A is a genetic disorder that leads to deficiency in factor VIII. Hemophilia B (Christmas disease) involves deficiency of factor IX. Hemophilia A and B occur via an x-linked inheritance pattern. Deficiency of factor VIII or IX leads to

disruption of the clotting cascade and resultant bleeding episodes. The clinical presentation varies based on the levels of factor produced. The practice of prophylactically treating individuals with hemophilia with factor infusions has led to a decrease in the complications associated with these disorders and increase in life expectancy [4, 5]. Factor made with recombinant DNA techniques has attenuated the risk of infection transmission from factor infusion [6].

Children with hemophilia generally have their first bleeding episode before age 2; those with severe hemophilia typically experience bleeding before age 1 [7].

With mild forms of hemophilia, children tend to develop bleeding after moderate to severe trauma. Children with more severe hemophilia may have spontaneous bleeding episodes.

Orthopedic Manifestations of Hemophilia

Hemarthrosis (Joint Bleeding)

Approximately one-quarter of children who present with bleeding episodes in the first 1–2 years of life will have an episode of joint bleeding [7]. Bleeding into the joint space causes expansion of the joint capsule. Infants with hemarthrosis exhibit fussiness and pseudoparalysis as they seek to avoid use of the affected limb. Older children often have some stiffness initially and subsequently develop pain, joint swelling, and limp or refusal to bear weight (when a lower extremity joint is involved). In ambulatory children, the knees and ankles are most likely to be affected. Hemarthrosis involving the elbow is also common.

Muscle Hematoma

Bleeding can also occur in the muscles leading to pain and dysfunction [4, 7]. Severe bleeding can put children at risk for compartment syndrome. Therefore, a child with hemophilia who exhibits signs and symptoms of muscle hematoma, including increasing pain and decreased use of the affected limb, should be evaluated promptly. The classic "P" signs of paresthesia, paralysis, pallor, and pulselessness may be late findings of compartment syndrome; the absence of these features should not be used to rule out possible compartment syndrome.

Hemophilic Arthropathy

Frequent bleeding into the joint can cause chronic damage to the joint. This condition is referred to as hemophilic arthropathy. Hemophilic arthropathy is a late finding, typically seen in adolescence or adulthood. As prophylactic treatment with

recombinant factor has become the standard of care, the rates of hemophilic arthropathy have started to decline [6, 8].

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