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Fracture Risk, Prevention and Care, 11168

Guideline of Care

I. Description:

- A. A fragility fracture is a fracture unrelated to significant trauma.
- B. Some children are at risk for reduced bone mineral density (BMD).
- C. Children with decreased BMD are at risk for fragility fractures.
- D. Birth to adolescence is a critical period of skeletal growth and bone maturation. Bone mass accumulates until a child reaches their late teens or early twenties when they reach their peak bone mass.
- E. Osteopenia is a moderate decrease in bone mass.
- F. The term osteoporosis is used in children only when there is a significant decrease in bone mass and fractures occurring unrelated to trauma (reference)

II. Important Considerations:

- A. While rare, fractures can occur when a patient is being repositioned in bed, transferred to and from a bed or wheelchair, receiving diaper changes and during other routine handling of the patient that occurs in the hospital.
- B. Possible complications associated with hospital acquired fractures include:
 - 1. Pain or discomfort
 - 2. Missed school
 - 3. Development of pressure sores due to a cast
 - 4. Difficulty positioning the child in their wheelchair or car seat due to a cast or splint
 - 5. Increased healthcare costs
- C. Families should be educated if their child is at risk for fractures.

III. Assessment:

- A. General Risk Factors:
 - 1. History of fragility fracture

2. Limited ambulation/prolonged immobilization

- a. The lack of weight-bearing activity seriously hinders the formation of normal structures and long-term immobilization contributes greatly to the development of secondary osteoporosis.
- b. Cerebral palsy (CP)
 - i. The most common physical disability of childhood.
 - ii. 70-80% of fractures occur in the legs with the femur being the most common site of fracture.
 - iii. Risk factors
 - Immobility
 - Past history of fracture
 - Presence of a feeding tube due to possible marker of a worsened state or decreased functional ability.
 - Use of seizure medications (see explanation under seizure medications)
 - Poor nutrition and dietary intake of calcium and vitamin D due to esophageal reflux, difficulty swallowing and other gastric disorders can lead to low BMD.
 - Older age
 - iv. Osteopenia can result from a decreased bone mineral growth rate compared with healthy children.
- c. Myelomeningocele (MMC)
 - i. The second most common physical disability of childhood after CP.
 - ii. Osteoporosis and osteopenia are major complications of MMC. Most fractures in this population occur in the lower extremities due to immobility with the distal femur as the most common site of fracture.
 - iii. Risk factors
 - Motor and sensory deficits
 - Disuse of lower limbs compared to able-bodied peers
 - Decreased functional ambulation
 - High level of paralysis or higher neurological lesion
- d. For similar reasons stated for CP and MMC, Duchenne Muscular Dystrophy and developmental delay in the setting of limited ambulation may also put children at risk for fractures.

3. Bone diseases

- a. Osteopenia of prematurity
 - i. Premature infants are at high risk for reduced BMD and subsequent bone disease.
 - The majority of bone mineralization and calcium and phosphate accretion occurs during the third trimester. Premature infants born before this time have depleted stores of these minerals.
 - ii. Clinical onset is between 6 and 16 weeks postnatally.
 - iii. Typically undetectable until severe demineralization occurs.

- iv. Risk factors
 - Weight less than 1500 g
 - 28 weeks gestation or less
 - Total parenteral nutrition (TPN) for greater than 4 weeks
 - Use of diuretics
 - Use of steroids
 - If results in prolonged periods of immobilization:
 1. Sepsis
 2. encephalopathy
 3. Muscular disorders
 4. Paralysis
 - v. BMD may remain low in very low birth weight (VLBW) and preterm infants until after one year of life.
- b. Rickets
- i. Rickets is the failure of mineralization of growing bone and cartilage, most recognizable at the growth plate.
 - ii. Children with deficient vitamin D levels have decreased intestinal absorption of calcium. This stimulates parathyroid hormone (PTH) which releases calcium and phosphorous from bone to attempt to maintain normal calcium levels. Increased PTH levels also lead to increased urinary phosphorous excretion. These decreased levels of serum calcium and phosphorous result in decreased bone mineralization.
 - iii. Types of rickets:
 - Congenital
 - Nutritional
 - iv. Symptoms can range from none to varying degrees of bone pain and delay in gross motor development.
 - v. Causes of vitamin D deficiency:
 - Decreased vitamin D synthesis with skin pigmentation
 - Physical agents blocking sun exposure (sunscreens or clothing)
 - Geography related to air pollution or cloud cover
 - Decreased nutritional intake
 - Malabsorption
 - vi. Supplementation with calcium and/or vitamin D after birth should be considered because even human breast milk does not have enough to meet the needs of the infant
 - vii. Vitamin D levels in infants correlate with vitamin D levels in their mothers during the first 2 months of life. Diet and sunlight determine the levels in the later months and years of life.
- c. Osteogenesis Imperfecta (OI)

- i. OI is a genetic disorder characterized by increased bone fragility leading to fracture and bone deformity, chronic bone pain, low bone mass, other connective tissue manifestations and reduced mobility.
 - ii. The most common cause of primary osteoporosis.
 - iii. The bone material of children with OI is stiffer and more brittle, not absorbing energy as well before breaking.
 - iv. Assess and document
 - Any limb or spinal deformity
 - Size of anterior fontanelle
 - Hypotonia
 - Decreased limb movement
4. Chronic steroid use (excluding inhaled corticosteroids)
 - a. Corticosteroids interfere with bone metabolism at multiple levels,
 - b. Patients on long-term steroids or patients who are treated with greater than 4 courses of high dose steroids in one year have decreased BMD.
 - c. The most common location of fractures is the humerus.
5. Chronic kidney disease (CKD)
 - a. Mineral bone disorder is common in children with CKD
 - b. The deleterious effect of CKD on bone results from a combination of factors such as vitamin D deficiency, hyperparathyroidism, hypogonadism, malnutrition, resistance to growth hormone and use of chronic corticosteroids.
6. Crohn's disease and ulcerative colitis
 - a. Crohn's disease and ulcerative colitis are collectively known as inflammatory bowel diseases (IBD).
 - b. Risk factors
 - i. Malnutrition
 - ii. Malabsorption
 - iii. Delayed puberty
 - iv. Reduced physical activity
 - v. Glucocorticoid use
 - vi. Vitamin D deficiency
 - c. There is a known decrease in bone mass and density in children with IBD even before glucocorticoid treatment is started. Delayed diagnosis may further decrease BMD. This etiology is not completely understood.
7. Acute lymphoblastic leukemia (ALL)
 - a. Decreased BMD occurs at the time of diagnosis through chemotherapy and may persist after treatment is completed and the disease is in remission.

- b. The majority of skeletal complications occur in the lower extremities during the first two years after diagnosis. During this time frame, the developing skeleton is very vulnerable.
 - i. Skeletal complications
 - Bone pain
 - Osteonecroses
 - Fractures
 - Loss of mobility
 - Bone deformation
 - Osteopenia
 - c. Vertebral fractures are common and may occur as early as two weeks into the first treatment. Many children with vertebral fractures may be asymptomatic or will present with back pain.
 - i. Spine BMD is affected in **all** children with newly diagnosed ALL.
 - d. The mechanism of decreased BMD in patients with ALL at the time of diagnosis is not fully understood.
 - e. Risk factors
 - i. Use of high dose corticosteroids
 - ii. Use of cytotoxic drugs in chemotherapy (methotrexate)
 - iii. Decreased physical activity during therapy
 - f. Bone growth may occur after treatment is completed and help to decrease the fracture risk.
8. Bone marrow transplant (BMT)
- a. Diminished BMD is a known complication after BMT.
 - b. In preparation for BMT, total body irradiation is common.
 - i. Risk factors associated with CNS radiation
 - Immobility
 - Seizure medications
 - Radiation directly to the lumbar spine
 - Pituitary dysfunction
 - c. After transplantation, bone loss is most rapid during the first 3-12 months.
9. Liver transplant
- a. End-stage liver failure affects growth plates (bone length) and bone strength, causing short stature and hepatic osteodystrophy, respectively.
 - i. Hepatic osteodystrophy is bone disease associated with chronic liver failure.
 - b. Decreased BMD remains post transplant due to the use of high-dose immunosuppressive medication and potent glucocorticoids.
 - c. Vertebral fractures usually occur asymptotically and are related to low spine BMD.
 - d. Risk factors

- i. Age greater than ten years at the time of transplantation
 - ii. Lower BMI
 - iii. Shorter duration since transplantation, within a few years
- 10. Kidney Transplant
 - a. The disease process leading to kidney transplant may cause hypogonadism and the patient may have been exposed to medications that can affect bone and mineral metabolism.
 - b. Hyperparathyroidism persists even after renal transplant and correlates with transplant calcification.
 - c. Vertebral fractures are common post transplant.
- 11. Total parenteral nutrition (TPN)
 - a. Decreased BMD may be related to the disease process and not TPN itself.
 - b. Aluminum is contained in the solutions used in TPN and can be accumulated in the skeleton leading to decreased BMD.
 - c. Excessive intake in amino acids can induce hypercalciuria, which is a common finding in patients receiving long-term TPN.
 - d. The overall mechanism of TPN and decreased BMD is still not fully understood.
 - e. Long-term TPN use is one of the main factors involved with osteopenia in neonates.
- 12. Anti-seizure medications
 - a. Higher risk of vitamin D deficiency due to effect on bone metabolism.
 - b. Increased risk for osteopenia and osteoporosis.
 - i. Patients receiving long-term therapy are at higher risk for osteoporosis.
 - c. The exact mechanism of decreased BMD and fracture risk associated with anti-seizure drugs is not completely understood.
 - d. Risk factors
 - i. Increased length of time receiving antiepileptic therapy
 - ii. Receiving multiple anti-seizure medications at the same time
 - iii. Comorbid conditions
 - Developmental or cognitive delay
 - Decreased functional ambulation
 - Cerebral palsy
- 13. Lasix
 - a. Results in an increase of calcium and sodium in the urine
 - b. Inhibits the pump that aids in the tubular reabsorption of calcium
- 14. Identification of a fracture
 - a. Not all children will demonstrate pain if they have a fracture. Some symptoms triggering suspicion of a fracture include:
 - i. Swelling in the area of the suspected fracture

- ii. Warmth in the area of the suspected fracture
- iii. Redness around the area of the suspected fracture
- iv. Some children may exhibit fevers

IV. Interventions:

- A. If a patient is identified at risk for fractures:
 - 1. Place the appropriate "at risk" sign in a location visible to all team members.
 - 2. Provide and review with parents the one page information sheet describing why the child is considered at risk.
- B. Handling patients at risk for fractures
 - 1. Maintain the child's natural body position.
 - 2. Handle the child gently with slow, careful movements.
 - 3. Avoid bumping the child against solid objects.
 - 4. Do not let the child's limbs dangle when you lift them.
 - 5. Do not force arms or legs into positions that are resisted.
 - 6. Do not pull or twist limbs.
 - 7. Support the entire limb when repositioning and hold close to joints (like elbows, hips or knees) when moving arms and legs.
 - 8. Avoid performing diaper changes by lifting the child by the feet in a child with muscle weakness, low muscle tone, or paralysis.
 - 9. Use lift systems for larger children.
 - 10. Do not secure straps and belts too tightly.
 - 11. Ask for help when needed.
- C. Discuss the use of dietary supplements such as vitamin D with the child's care provider.
- D. Discuss the risk factors for each patient (e.g. TPN or high risk medications) with the care team.
- E. If concern for a fracture exists:
 - 1. Notify the child's care provider to have the appropriate imaging completed.
- F. If a fracture is confirmed:
 - 1. Notify the child's care provider
 - a. The attending physician is responsible for reporting the fracture and can delegate this to a resident or fellow.
 - b. The provider should discuss the fracture with the parent(s) or caregiver(s).
 - c. Child Protective Services and the SCAN team may be notified at the discretion of the attending physician.
 - 2. Notify the charge nurse who will notify unit leadership.
 - 3. File an eFeedbackNOW report.

V. Outcomes:

- A. Reduce/eliminate the patient's risk of fractures.

VI. Patient/Family Education:

- A. Parent/caregiver awareness of common causes of fracture in their child.
- B. Reminder to keep crib and bed side rails up as developmentally appropriate.
- C. Careful repositioning, diaper changes and transfers as described in interventions above.
- D. Deliver and explain parent education handout.

See also: **Clinical P&P**, [Reducing Hospital Acquired Fractures](#)

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Attachments:

No Attachments