

Bone Problems in Young Children-A Narrative Review

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Introduction

Bone disorders in children can be divided into problems of bone mineralization, density and bone matrix. It can present with problems in gaining height, fractures, bone deformities and biochemical disturbances in minerals such as calcium, phosphorus, and hormones -vitamin D and parathyroid hormone.

Methods

References for this review were identified through searches of PubMed, Medline, and Embase for articles published to July 2018 using the terms “osteoporosis, rickets and osteogenesis imperfecta” [MeSH Terms] OR “bone metabolic disorders” [All Fields] OR “bone disorders” [All Fields]. The reference lists of the articles thus identified were also searched. The search was not restricted to English-language literature.

Problems in Bone Density

Bone density is a dynamic state in children. It is continuously increasing as children are gaining height and weight. It is different in comparison to adults, as the peak bone mass is achieved between the second and third decade of life followed by gradual loss. This loss is more significant in females around menopause as they have lower bone mass in comparison of males due to decreased thickness of bones. It does not imply that boys and males do not get osteoporosis. Therefore, osteoporosis in children is more likely due to failure to gain bone mass. In adult osteoporosis, it is caused by age-related bone mass.

Table 1: *Pathophysiology*

Osteoporosis in children	Lack of osteoblastic activity
Osteoporosis in Adults	Increased osteoclastic activity

Risk factors for osteoporosis are the history of fractures in the past, use of glucocorticoids, and hyperthyroidism.

Bone density is measured with the help of machine known as Dual Energy X-ray absorptiometry(DXA) [1,2]. It provides a quick estimate of bone mineral density and is considered the gold standard for the assessment of osteoporosis in children as well as well as adults. It does not give any unnecessary radiation exposure to the patient and the technician who is performing it.

As far as interpretation is concerned, adult standard criterion, reported in T scores for diagnosing low bone density should not be used in children which is reported in Z scores. Using T scores in children will lead to underestimation of bone mineral density and hence over diagnosis of osteoporosis. National institute of Health in USA has developed free online pediatric bone density assessment calculator based on the age and height of child. It provides a handy tool for estimation of pediatric bone density as a Z scores which is standard deviation from the mean.

Table 2: *Definition of Adult osteoporosis [3]*

T scores	Definition
0 to -1	Normal
-1 to -2.5	Osteopenia
-2.5 or lower	Osteoporosis

Table 3: *Pediatric osteoporosis definition*

Criterion-1
One or more vertebral compression fractures, in absence of local disease or high energy trauma.
Criterion-2
If no vertebral compression fractures osteoporosis diagnosis requires both clinically significant fracture history which is 2 or more long bone fractures by age 10 years, or 3 or more bone fractures by age of 19 years and low bone mineral density Z score ³ .

The first step in the treatment of Osteoporosis in children is ensuring optimum calcium and Vitamin D levels, and adequate physical activity. The most widely used medication for the treatment of pediatric low bone density is an intravenous medication which falls under the category of bisphosphonates. It is a synthetic stable pyrophosphate analogue. Bisphosphonates work by decreasing the bone resorption by binding to the hydroxyapatite crystals of the bone. The two most commonly used medications under this category are pamidronate and zoledronic acid. Zoledronic is an upcoming medication, with less frequency but requires closer monitoring of calcium and phosphorus levels. It is a non FDA approved usage of the medication (off label). It is well tolerated medication but can be used associated with low calcium levels and flu like symptoms, when used first time [4]. Website for bone mineral density z scores in children with height consideration: <http://www.bmdcspublic.com>.

Bone Mineral Problems

The most common problem under this category is Rickets. It refers to the changes at the growth plate caused by deficient mineralization of bone and occurs before the closure of the growth plates. In adults it is known as osteomalacia [5,6]. Bone mineral problems are more common in children in comparison to bone density problems. Rickets occur due to deficiency of Vitamin D, the most common cause, phosphorus(phosphopenic) and or calcium(calcipenic). The evaluation of a child with clinical signs of rickets should include a dietary history with attention given to calcium and vitamin D intake, medication history specially the use of glucocorticoids and anticonvulsants, and a history of sun exposure. There are more clearly laid out recommendations in children by Institute of Medicine (last came in 2010) and American Academy of Pediatrics for recommended daily allowances (RDA) for vitamin D and calcium intake. It is diagnosed on the basis of biochemical finding of calcium, phosphorus, 25 hydroxy vitamin D levels, 1-25 hydroxy vitamin D levels, parathyroid hormone level, urinary calcium levels and alkaline phosphatase levels. The treatment is by replacing the calcium, phosphorus and Vitamin D. Oral method of replacement is preferred over intravenous method of replacement [7].

Bone Matrix Problems

Osteogenesis Imperfecta, is an inherited connective tissue disorder with varied presentations also known as brittle bone disease. It is caused by problems in the genes controlling the alpha-1 and alpha-2 chains of type I collagen or proteins involved in posttranslational modification of type I collagen [8]. It presents with increased bone fragility which presents with fractures, along with short stature, blue colored sclera and hearing problems. Family history of similar presentations is also important and helpful in making the diagnosis. If clinically significant, it is treated with bisphosphonates [9].

Conclusion

The most important question in the mind of the doctor ordering it, should be its clinical utility in the clinical management and need for further evaluation. Even the definition of osteoporosis in children gives more importance to the history of fractures and age of patient rather the absolute value of bone density.

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