



Osteopenia among Preterm Newborns and Nursing Care

Öznur Tosun*, Yağmur Sezer Efe, Emine Erdem and Meral Bayat

Department of Nursing, Faculty of Health Sciences, Erciyes University, Kayseri, Turkey

*Corresponding author: Öznur Tosun, Assistant Professor, PhD, Department of Nursing, Faculty of Health Sciences, Erciyes University, Kayseri, Turkey, Tel: 90 352 437 49 37/28568; Fax: 90 352 437 92 81; E-mail: obasdas@erciyes.edu.tr

Abstract

Incidence of preterm birth has been increasing since 1980s. Despite this increase in the incidence, survival rate of preterm newborns has been going up although it changes depending on gestational age. It is stated that such critical diseases that progress slowly as sensory losses, neurological disorders, developmental deficits, respiratory failures, bone mineral problems occur despite decreasing number of health problems that develop rapidly thanks to the increasing rate of preterm survival rate. One of the bone mineralization problems seen in preterm newborns is osteopenia. Because osteopenia, described as poor bone mineralization, occurs during the last trimester of pregnancy and bone development period, it is often seen among preterm newborns and is thus termed as preterm osteopenia. As birth weight and gestation age of newborns reduce, incidence of preterm osteopenia increases. In diagnosing preterm osteopenia, biochemical parameters and radiological tests are used. Preterm osteopenia may lead to fractures in long bones, respiratory insufficiency due to softening or fractures of ribs, inability to leave ventilator during newborn period as well as retardation of tooth development and short stature in future. Therefore, it is highly important to prevent preterm osteopenia. First intervention against preterm osteopenia is to prevent disease progress. Enabling preterm newborns to be fed with fortified breast milk or formula with calcium and phosphorous supplements may fail in preventing preterm osteopenia. Besides; osteopenia and osteopenia-related complications may be prevented by offering daily physical activities that have no adverse effects to preterm newborns who suffer from movement restrictions. It is suggested that nurses who are responsible for the protection, maintenance and development of health can make contributions to prevent osteopenia by assessing behaviors of the newborns with the health care team and providing nutritional supplements, proper treatment modalities and physical activity programs. Thus, undesired results including long hospital stay and repeated hospitalizations that will worsen general physical status of preterm newborns and will increase cost of health care can be avoided.

Keywords

Nurse, Osteopenia, Preterm

Introduction

Incidence of preterm birth has been increasing since 1980s. Despite this increase in the incidence, survival rate of preterm newborns has been going up although it changes depending on gestational age [1,2]. Although survival rate of preterm newborns

aged 23 weeks has increased from 0% to 65% at some health institutions thanks to scientific and technological advancements over the last 20 years, the survival rate varies from institutions to institutions [3]. It is stated that such critical diseases that progress slowly as sensory losses, neurological disorders, developmental deficits, respiratory failures, bone mineral problems (osteopenia) occur despite decreasing number of health problems that develop rapidly thanks to the increasing rate of preterm survival rate [4,5].

One of the bone mineralization problems seen in preterm newborns is osteopenia. Because osteopenia, described as poor bone mineralization, occurs during the last trimester of pregnancy and bone development period, it is often seen among preterm newborns and is thus termed as preterm osteopenia [6-10]. As birth weight and gestation age of newborns reduce, incidence of preterm osteopenia increases [6,11-13].

The most prevalent chronic diseases in the newborns, pharmacological agents as corticosteroids and diuretics and long-term parenteral nutrition are some of the risk factors that increase the incidence of osteopenia [6,11,14]. A loss in mechanical stimulant is also an important risk factor for preterm osteopenia [6,10,15].

In diagnosing preterm osteopenia, biochemical parameters and radiological tests are used [11,13,16]. Of these biochemical parameters; particularly in case of low Ca-P (calcium phosphorous) and high ALP (alkaline phosphatase), osteopenia is suspected. Serious osteopenia is diagnosed if ALP > 800 IU/L or P < 3.5 mg/dl is present. However; because specificity and sensitivity of biochemical parameters is not high, these parameters are only indicative for detailed examination in suspicious cases of osteopenia [11].

Biochemical Parameters used Diagnosis of Preterm Osteopenia

Diagnosis of osteopenia can be done more accurately with the measurement of bone mineral content (BMC) or histological examination (Table 1). Various screening methods have been developed in order to detect changes in bone mass because histological examination is not suitable for newborns [11,17]. Of these screening methods; SPA (Single Photon Absorptiometry) and DPA (Dual Photon Absorptiometry) perform measurements with radioactive isotopes while QCT (Quantitative Computed Tomography) and DEXA (Dual energy X-ray absorptiometry) perform measurements with X-rays. Apart from SPA, DPA, QCT and DEXA techniques; QUS

Citation: Tosun O, Efe YS, Erdem E, Bayat M (2016) Osteopenia among Preterm Newborns and Nursing Care. Int Arch Nurs Health Care 2:039

Received: December 03, 2015; **Accepted:** February 26, 2016; **Published:** February 29, 2016

Copyright: © 2016 Tosun O, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Table 1: Biochemical Parameters used Diagnosis of Preterm Osteopenia

Calcium	Normal, decreased or increased
Phosphorous	Normal or decreased
Alkaline Phosphatase	Normal or increased
Osteocalcin	Increased
PTH	Normal, increased
1,25(OH) ₂ vitamin D	Increased
Calcitonin	Normal
Fractional excretion of Ca	Increased
Tubular reabsorption of P	Increased
Urine deoxyprydolin	Collagen breakdown product, decreased
Pyridoxine in urine	Collagen breakdown product, decreased
PICP	Collagen breakdown product, decreased
ICTP	Collagen breakdown product, decreased
B-ALP	No superiority of total ALP, increased

(Quantitative Ultrasound) uses frequencies of sound waves. Today; QUS technique is preferred because it has a reference database for preterm newborns, it enables examination of newborn in incubator and it is a radiation-free technique [11,13,15,16].

Preterm osteopenia may lead to fractures in long bones, respiratory insufficiency due to softening or fractures of ribs, inability to leave ventilator during newborn period as well as retardation of tooth development and short stature in future [18,19]. Therefore, it is highly important to prevent preterm osteopenia. Studies on preterm osteopenia have generally focused on nutritional variables [1,20-22]. Today's commercial preparates can probably meet the needs of term newborns but fail in providing enough mineral support for extra needs of preterm newborns [6,23]. Mineral support can be made by using formula or breast milk fortifiers among preterm newborns and by adding calcium and phosphorus in total parenteral nutrition solutions among newborns that are unable to be fed [14,24]. Also; it is thought that postnatal estrogen and progesterone replacement therapy may help prevent osteopenia [6]. The relevant studies done by Trotter et al. reported that bone mineralization was not affected in the control group in which only mineral support was provided but hormone replacement therapy given together with mineral support helped increase bone mineral [25-27]. Some studies demonstrated that inactivity may cause poor bone mineral density [28-30]. Inactivity increases risk of osteopenia development more and more among preterm newborns who receive long hospital stay and standard care with minimal stimulus. It was detected that daily physical activities reduce the weakening of bone strength among preterm newborn and increase body weight [31-34].

First intervention against preterm osteopenia is to prevent disease progress. Enabling preterm newborns to be fed with only fortified breast milk or only formula with calcium and phosphorous supplements may fail in preventing preterm osteopenia. Particularly; if there are more than one risk factors for preterm osteopenia; phosphorous, calcium and D vitamin supplements may be needed. Besides; osteopenia and osteopenia-related complications may be prevented by offering daily physical activities that have no adverse effects to preterm newborns who suffer from movement restrictions. It is suggested that nurses who are responsible for the protection, maintenance and development of health can make contributions to prevent osteopenia by assessing behaviors of the newborns with the health care team and providing nutritional supplements, proper treatment modalities and physical activity programs. Thus, undesired results including long hospital stay and rehospitalizations that will worsen general physical status of preterm newborns and increased cost of health care can be avoided.

References

- Piellain C, de Halleux V, Senterre T, Rigo J (2013) Prematurity and bone health. *World Rev Nutr Diet* 106: 181-188.
- Dağoğlu T (2002) Yenidoğanın gelişimi ve çevresel faktörler. Dağoğlu T, Görak G, Eds. *Temel Neonatoloji ve Hemşirelik İlkeleri*, Nobel Tıp Kitabevleri, İstanbul 729-738.

- Ward RM, Beachy JC (2003) Neonatal complications following preterm birth. *BJOG* 110 Suppl 20: 8-16.
- Kocsis I, Kis E, Szabó A, Vásárhelyi B, Machay T, et al. (2005) [Osteopenia of prematurity]. *Orv Hetil* 146: 2491-2497.
- Preyde M, Ardal F (2003) Effectiveness of a parent "buddy" program for mothers of very preterm infants in a neonatal intensive care unit. *CMAJ* 168: 969-973.
- So K-W, Ng P-C (2005) Treatment and Prevention of Neonatal Osteopenia. *Current Paediatrics* 15: 106-113.
- Koo WWK, Tsang RC (1987) Calcium and Magnesium Homeostasis in the Newborn. In: Avery G.B. (eds), *Neonatology: Pathophysiology and Management of the Newborn* (3.ed.), JB Lippincot Company, Philadelphia 710-723.
- Miller ME (2003) The bone disease of preterm birth: a biomechanical perspective. *Pediatr Res* 53: 10-15.
- Beyers N, Hough FS (1986) Metabolic bone disease in preterm infants. *S Afr Med J* 70: 407-413.
- Rauch F, Schoenau E (2002) Skeletal development in premature infants: a review of bone physiology beyond nutritional aspects. *Arch Dis Child Fetal Neonatal Ed* 86: F82-85.
- Kızılateş SÜ (2002) Preterm Osteopenisi, Ankara Üniversitesi Tıp Fakültesi Mecmuası 55: 217-222.
- Nemet D, Dolfin T, Wolach B, Eliakim A (2001) Quantitative ultrasound measurements of bone speed of sound in premature infants. *Eur J Pediatr* 160: 736-740.
- Gürsoy T, Yurdakök M (2005) Prematüre Osteopenisi ve Kantitatif Ultrasonografi Cihazı İle Kemik Ses Hızının (SOS) Değerlendirilmesi. *Türk Neonatoloji Derneği Bülteni* 11: 26-33.
- Rigo J, de Curtis M, Piellain C (2001) Nutritional assessment in preterm infants with special reference to body composition. *Semin Neonatol* 6: 383-391.
- Schulzke SM, Kaempfen S, Trachsel D, Patole SK (2014) Physical activity programs for promoting bone mineralization and growth in preterm infants. *Cochrane Database of Systematic Reviews* 4: 1-44.
- Eliakim A, Nemet D (2005) Osteopenia of prematurity - the role of exercise in prevention and treatment. *Pediatr Endocrinol Rev* 2: 675-682.
- Altan L, Bingöl Ü, Kumaş FF, Ercan İ, Yurtkuran M (2004) Kemik Mineral Yoğunluğunun Değerlendirilmesinde Kantitatif Ultrasonografi ve Dual Enerji X-ışını Absorbsiyometrinin Karşılaştırılması. *Fiziksel Tıp ve Rehabilitasyon Dergisi* 50.
- Çetin H, Türedi A, Öktem F, Dündar B (2007) Çok düşük doğum ağırlıklı yenidoğanda osteopeni ve femur kırığı: Bir olgu sunumu. *Süleyman Demirel Üniversitesi Tıp Fakültesi Dergisi* 14: 37-40.
- Sharp M (2007) Bone disease of prematurity. *Early Hum Dev* 83: 653-658.
- Wauben IP, Atkinson SA, Grad TL, Shah JK, Paes B (1998) Moderatenutrientsupplementation of mother's milk for preterm infants supports adequate bone mass and short-term growth: A randomized controlled trial. *Am J Clin Nutr* 67: 465-472.
- Specker BL, Beck A, Kalkwarf H, Ho M (1997) Randomized trial of varying mineral intake on total body bone mineral accretion during the first year of life. *Pediatrics* 99: E12.
- Bozzetti V, Tagliabue P (2009) Metabolic Bone Disease in preterm newborn: an update on nutritional issues. *Ital J Pediatr* 35: 20.
- Salle BL, David L, Chopard JP, Grafmeyer DC, Renaud H (1997) Prevention of early neonatal hypocalcaemia in low birth weight infants with continuous calcium infusion: Effect on serum calcium, phosphorus, magnesium, and circulating immunoreactive parathyroid hormone and calcitonin. *Pediatr Res* 11: 1180-1185.
- Gürsoy T, Yurdakök M (2008) Prematüre bebeklerin beslenmesi. *Çocuk Sağlığı ve Hastalıkları Dergisi* 51: 240-251.
- Trotter A, Maier L, Grill HJ, Kohn T, Heckmann M, et al. (1999) Effects of postnatal estradiol and progesterone replacement in extremely preterm infants. *J Clin Endocrinol Metab* 84: 4531-4535.
- Trotter A, Bokelmann B, Sorgo W, Bechinger-Kornhuber D, Heinemann H et al. (2001) Follow-up examination at the age of 15 months of extremely preterm infants after postnatal estradiol and progesterone replacement. *J Clin Endocrinol Metab* 86: 601-603.
- Trotter A, Maier L, Pohlandt F (2001) Management of the extremely preterm infant: is the replacement of estradiol and progesterone beneficial? *Paediatr Drugs* 3: 629-637.
- Leblanc AD, Schneider VS, Evans HJ, Engelbretson DA, Krebs JM (1990) Bone mineral loss and recovery after 17 weeks of bed rest. *J Bone Miner Res* 5: 843-850.

29. Eliakim A, Raisz LG, Brasel JA, Cooper DM (1997) Evidence for increased bone formation following a brief endurance-type training intervention in adolescent males. *J Bone Miner Res* 12: 1708-1713.
30. Slemenda CW, Miller JZ, Hui SL, Reister TK, Johnston CC Jr (1991) Role of physical activity in the development of skeletal mass in children. *J Bone Miner Res* 6: 1227-1233.
31. Nemet D, Dolfin T, Litmanowitz I, Shainkin-Kestenbaum R, Lis M, et al. (2002) Evidence for exercise-induced bone formation in premature infants. *Int J Sports Med* 23: 82-85.
32. Litmanovitz I, Dolfin T, Friedland O, Arnon S, Regev R, et al. (2003) Early physical activity intervention prevents decrease of bone strength in very low birth weight infants. *Pediatrics* 112: 15-19.
33. Moyer-Mileur LJ, Brunstetter V, McNaught TP, Gill G, Chan GM (2000) Daily physical activity program increases bone mineralization and growth in preterm very low birth weight infants. *Pediatrics* 106:1088-1092.
34. Tosun Ö, Bayat M, Güneş T, Erdem E (2011) Daily physical activity in low-risk pre-term infants: positive impact on bone strength and mid-upper arm circumference. *Ann Hum Biol* 38: 635-639.