Annals of Medical Research

DOI: 10.5455/annalsmedres.2019.10.623 2020;27(1):411-4

Case Report

Evaluation of femoral shaft fractures in the neonatal intensive care unit

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Abstract

The first of the patients presented in this article was born in the 36th week with a weight of 2100 grams and was admitted to the neonatal intensive care unit due to neonatal pneumonia. The second patient was born at the 33rd week and 1830 grams. The patient was hospitalized with the diagnosis of prematurity. On postnatal 5th day, newborn pneumonia developed and treatment was started. The last patient was born with a cesarean section weighing 2300 grams at 37th week. She was hospitalized in the neonatal intensive care unit with the preliminary diagnosis of neonatal transient tachypnea and neonatal pneumonia due to respiratory distress. The femur shaft fracture occurred in these 3 patients during long follow-up intensive care. The splint was applied and healing was achieved. This study was aimed that being affected by families psychologically, socially and financially and also it was thought that healthcare workers could shed light on similar cases that might occur upon medical problems.

Keywords: Femur; fracture; medicolegal; neonatal; intensive care unit

INTRODUCTION

Unlike adults, the whole family is affected by pediatric fractures and therefore in the study written informed consent was obtained from the families of babies. After birth, there is an adaptation in the skeletal system in the form of decreased physical density (expansion of bone marrow cavity, thinning of cortical bone, increase in bone diameter) (1). The reasons for this postnatal adaptation are unclear, but it is caused by some factors that occur before and after birth. The long-term follow-up in the neonatal intensive care unit on this physiological picture poses a high risk for limb fractures, especially in low-birth-weight term neonates and preterm infants. However, especially in pre-gait children, abuse and predisposing diseases (neurological diseases, tumor ...) should be considered and excluded (2). In this study, the clinical features and treatment results of three patients were evaluated in İstanbul and Şanlıurfa-based hospitals between October 2017 and July 2018. The authors have no ethical conflicts to disclose.

CASE REPORTS

Case 1

A male infant born at 36 weeks of gestation with cesarean section and with a birth weight of 2100 grams was admitted to the neonatal intensive care unit (NICU) due to neonatal pneumonia and respiratory distress on post-natal day 27 (corrected age, 5 days). Treatment with ampicillin and amikacin was initiated and continued for 18 days. Treatment with nebulized budesonide, a bronchodilator, was administered for 12 days. A nasogastric catheter was used for feeding the patient with breast milk and infant formula. Radiographs were obtained due to complaints such as unrest, crying and inability to move the lower extremities during interventions. A right femoral shaft fracture was detected on radiography on post-natal day 34. Then, on the consultation of an orthopaedist, conservative treatment was initiated with transport splint, and sufficient union was achieved and recovery was observed in the follow-up period. The family history was not remarkable for consanguineous marriage,

Received: 27.09.2019 **Accepted:** 11.12.2019 **Available online:** 18.02.2020
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hereditary disease or bone disease. There was no evidence of neurological disease, metabolic bone disease or neoplasia on physical, radiological and biochemical evaluations. Medical history, physical examination findings, and radiological and biochemical evaluation results were consistent with osteopenia of prematurity (serum phosphorus level 3.28 mmol/L; serum alkaline phosphatase level 1096 mg/dL, serum calcium levels were 6.09 mg/dL and serum vitamin D levels were 13,3 ng/mL). Biochemical parameters also supported the diagnosis of osteopenia, and supportive therapy was initiated. Dual-energy X-ray absorptiometry could not be performed because the patient was mechanically ventilated. On the family's request for identifying the responsible persons due to medico-legal concerns, information was obtained from the responsible doctor and nurses in NICU, and camera records were investigated. No suspicious findings were noted (Figure 1).

Figure 1. (1A) Lateral radiograph showing long oblique fracture of the femoral shaft (lower extremity), (1B) Control radiograph after long leg casting

Case 2

A female infant born at 33 weeks of gestation with cesarean section and with a birth weight of 1830 grams was admitted to NICU due to premature birth. On post-natal day 5, mechanical ventilation was performed due to the development of neonatal pneumonia, and treatment with nebulized salbutamol and budesonide (bronchodilators) was initiated. Additionally, aminoglycoside and imipenem therapy were initiated. The nasogastric catheter was used for feeding the patient with breast milk and premature formula. At post-natal week 5, radiographs were obtained due to complaints of unrest, excessive crying, inability to move the lower right extremities and swelling; right femoral shaft fracture was detected on radiography. Then, an orthopaedist was consulted, and conservative therapy was initiated, with long leg splinting, and sufficient union was achieved and recovery was observed in the follow-up period. The serum phosphorus and alkaline phosphatase levels were 4.06 mmol/L and 575 mg/dL, respectively. Serum calcium levels were 8.76 mg/dL, and serum vitamin D levels were 28.2 ng/mL. Biochemical parameters were normal. On the family's request for identifying the responsible persons due to medico-legal concerns, information was obtained from the responsible doctor and nurses in NICU, and camera records were investigated to exclude the possibility of child abuse. No suspicious findings were noted (Figure 2).

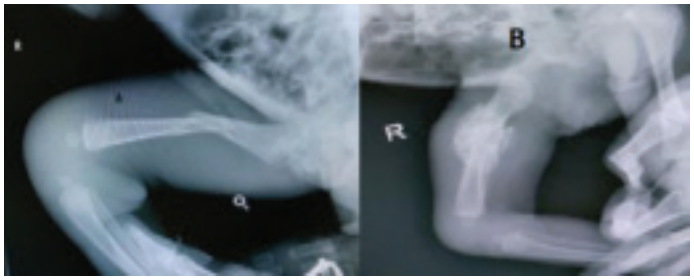

Figure 2. (2A) Lateral radiograph showing oblique fracture of the right femoral shaft (lower extremity), (2B) Control radiograph at 6 weeks; adequate callus tissue is visible

Case 3

A female infant who was born to a 34-year-old mother (5th gestation) by cesarean section and with a birth weight of 2300 grams at 37 weeks was admitted to NICU due to respiratory distress with the preliminary diagnosis of transient tachypnea of the newborn and neonatal pneumonia. The patient was followed up with nasal continuous positive airway pressure (CPAP). A combination of ampicillin 500 mg and aminoglycoside 20 mg was administered for 10 days. The patient was intubated due to tachypnea and increased need for oxygen during the follow-up period and extubated on day 4 when her demand for oxygen decreased. Follow-up treatment continued first with nasal CPAP and then with oxygen and nebulized salbutamol and budesonide in the incubator (16 days).

Figure 3. (3A) Lateral radiograph showing right femoral shaft fracture (lower extremity), (3B) Control radiograph at 7 weeks; adequate callus tissue is visible

Enteral feeding was used the patient with breast milk and infant formula. Serum alkaline phosphatase levels were 488 mg/dL, serum calcium levels were 9.46 mg/dL, serum phosphorus levels were 4.54 mmol/L and serum vitamin D levels were 21 ng/mL; furthermore, supportive treatment was initiated. There was no evidence of neurological disease, hereditary metabolic bone disease or neoplasia

on physical, radiological and biochemical evaluations. At 7 weeks post-NICU, swelling, and deformation were observed in her right leg. Biochemical parameters didn't support the diagnosis of osteoporosis of the infancy. Radiographs were obtained due to unrest and inability to move the right side, and the right femoral shaft fracture was detected. Conservative therapy was initiated with long leg splinting, and sufficient union was achieved and recovery was observed during the follow-up period (Figure 3).

DISCUSSION

In this study, fractures occurred during the treatment in NICU. Two cases were premature and one was a term infant, and they had low birth weights. All the three infants were under long-term treatment in NICU with the diagnosis of bronchopneumonia and remained immobile for prolonged periods. Nebulised budesonide was used in all three cases. In two cases, aminoglycoside was used as an antibiotic. They were fed orally (breast milk and formula) and were also exposed to recurrent invasive procedures for therapeutic and clinical follow-up, which may have caused trauma. In two of the three cases, the families requested to investigate the cause of the fractures and to identify medicolegally responsible individuals. There was no suspicion of child abuse on physical and radiographic examinations and camera recordings. At the interrogation, it was detected that vascular accesses were made from the foot on the fracture site all of the babies. However, the nurses stated that there were no problems during these procedures.

After birth, calcium and phosphorus transfer from the placenta ceases, increasing parathyroid hormone (PTH) release. This, in turn, increases bone destruction as well as calcium reabsorption and phosphorus excretion through the kidneys. Besides, the mechanical stimulation for bone formation originating from the uterine wall is no longer available after birth and the ratio of bone formation and destruction changes in favor of destruction. Furthermore, the increase in the bone marrow cavity results in a relative decrease in the bone cortex fraction in the cross-sectional parts of the bones. These changes in term infants are called osteoporosis of the infancy (3–7).

Premature infants are at a risk for the disorders of bone mineralization (osteopenia) because most calcium and phosphorus accumulation occur during the last trimester of the pregnancy. There are additional factors that contribute to the risk of decreased bone mineralization following premature birth, the most important ones being the failure to provide adequate levels of calcium and phosphorus required by the baby, prolonged parenteral nutrition, certain medications, and prolonged immobilization. To date, the diagnosis of osteopenia of prematurity is based on the biochemical evaluation, including measurement of serum alkaline phosphatase levels, and radiological evidence of osteopenia and/or fracture. The prevention of osteopenia of prematurity should be targeted rather than its treatment, and this should include adequate levels of calcium and phosphorus supplementation in the early period (8–13).

A large proportion of femoral shaft fractures (approximately three-fourth) in children in the pre-toddler stage is related to child abuse. Therefore, child abuse should be considered in children aged <4 years, particularly <18 months, admitted to a health institution due to femoral shaft fracture, and investigation should be initiated from this perspective. The femur is the second most commonly fractured bone after humerus in cases of child abuse. There is no specific fracture pattern which is pathognomonic for child abuse. However, certain fractures have high specificity, including metaphyseal or epiphyseal (bucket handle or corner), posterior costal, multiple or large complex skull, scapular, and sternal, multiple and unreported fractures. Fractures with low specificity include single, linear, narrow parietal bone and clavicular fractures. While the most common fracture type associated with child abuse is a single, transverse long bone fracture, several series have reported spiral fractures as the most common type (14,15).

CONCLUSION

The changes in bone metabolism after birth, negative effects of premature birth on bone metabolism and prolonged follow-up in NICU can increase the risk of fractures in neonates. Bone fractures that occur during follow-up at the hospital without the presence of parents may lead to medico-legal problems. Despite the potential for rapid healing and reshaping of the bones, the investigation should be conducted in these cases, and the patients' families should be informed. The prevention of osteopenia should be targeted, particularly in infants who require prolonged hospitalization in NICU, and adequate supportive care (vitamin D, calcium and phosphorus supplementation) should be provided during the early period. In addition to the doctors and nurses who come into contact with these babies, the auxiliary personnel (such as body cleaning, blood collection, vascular access, squeezing the extremities to keep them in motion…) should be trained. We believe that this report will shed light on similar cases.

Competing interests: The authors declare that they have no competing interest.
Financial Disclosure: There are no financial supports.

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