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Features Of Reparative Regeneration Of Bone Tissue In Fractures In Children

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Abstract: The analysis of the results demonstrates that underweight, physical inactivity, and a high incidence of fractures among girls emphasize the need to introduce modern preventive methods into pediatric practice aimed at preventing pathological conditions that interfere with normal bone tissue formation. Timely and active implementation of preventive measures (both mass and individual) can improve the condition of bone tissue and reduce the incidence of fractures.

Keywords: Bone tissue regeneration; pediatric fractures; reparative osteogenesis; immobilization-induced osteoporosis; calcium deficiency; vitamin D deficiency; osteopenia; bone remodeling; Calcium D3 Nycomed; preventive measures in children.

Introduction: Calcium deficiency during periods of active growth and development in children negatively affects the formation of bone mass. Disorders in the functioning of organs responsible for regulating phosphorus–calcium metabolism often underlie various diseases in children. In particular, osteopenic conditions at an early age are frequently associated with disturbances in phosphorus and calcium metabolism, as well as vitamin D deficiency (vitamin D–deficient rickets), which may have long-term adverse effects on growth and development.

Aim

To study the causes of immobilization-induced osteoporosis and to investigate morphological changes in bone tissue in experimental studies on laboratory animals.

Objectives

To identify risk factors for osteoporosis associated with prolonged immobilization following bone fractures in children, as well as to analyze the influence of rachitic deformities that developed after rickets in early childhood.

METHODS

1. An analysis was conducted of the treatment outcomes of 68 children aged 3–14 years with fractures of long tubular bones who were treated at the clinic of the Tashkent Pediatric Medical Institute in recent years. The most frequent localization of fractures was the diaphysis of the forearm bones (70%). The majority of patients were girls (67%) aged 3–7 years.

2. The morphological features of bone tissue were studied in laboratory Wistar rats (12 rats up to 3 months of age and 10 rats aged 3 years). Samples were collected from diaphyseal and metaphyseal regions of long tubular bones and vertebral bodies. Histological examination was performed on semi-thin sections. The control group of animals was kept under standard conditions, while the experimental group received the preparation Calcium D3 Nycomed. Bone tissue studies were carried out on days 1, 7, and 14 of the experiment.

RESULTS

Histological examination of bone tissue in the control group of 3-month-old rats revealed a predominance of woven bone tissue in the metaphyseal region, which is characteristic of bone tissue in childhood. Collagen fibers were arranged in a disorganized manner. The diaphyseal region was composed of lamellar bone, in which collagen fibers had a strictly oriented arrangement, indicating high bone rigidity. Bone tissue was richly supplied with blood through numerous vessels.

In rats receiving Calcium D3 Nycomed (experimental group), the metaphyseal region of long tubular bones

demonstrated a combination of woven and lamellar bone tissue, indicating increased bone rigidity.

In children with forearm fractures, it was found that fractures occurred more frequently in underweight girls leading a sedentary lifestyle. Laboratory tests revealed a decrease in the level of ionized calcium in the blood (down to 1.7 mmol/L).

CONCLUSIONS

The analysis of the results shows that underweight, physical inactivity, and a high frequency of fractures in girls emphasize the necessity of implementing modern preventive methods in pediatric practice aimed at preventing pathological conditions that hinder normal bone tissue formation. Timely and active preventive measures (both mass and individual) can improve bone tissue quality and reduce the incidence of fractures.

Primary prevention of osteoporosis contributes to strengthening bone tissue during the formation of peak bone mass and periods of active growth. Secondary prevention is aimed at preventing fractures in patients with already developed osteoporosis.

Main Preventive Measures

- Rational nutrition with adequate calcium intake.
- Administration of calcium- and vitamin D–containing preparations when indicated.

The optimal choice includes combined calcium and vitamin D preparations such as Calcium D3 Nycomed (500 mg of elemental calcium and 200 IU of vitamin D3 per tablet) and Calcium D3 Nycomed Forte (500 mg of elemental calcium and 400 IU of vitamin D3 per tablet).

Recommended dosages:

- Children under 12 years: 1–2 tablets per day
- Adolescents: 2 tablets twice daily (morning and evening)

The duration of treatment depends on the severity of osteoporosis and the dynamics of bone tissue structural recovery.

The use of Calcium D3 Nycomed demonstrates high effectiveness in preventing calcium deficiency in children, which is manifested by stabilization or improvement of bone remodeling parameters, positive changes in bone mineral density, as well as a tendency toward increased linear growth rates and bone mass gain. The drug is characterized by good tolerability and a minimal risk of side effects. Its mechanism of action is aimed at regulating calcium homeostasis, suppressing bone resorption, slowing collagen degradation, increasing calcium and phosphorus deposition in bone tissue, and reducing the activity of proinflammatory cytokines, which leads to a decrease in pain syndrome, especially in patients with fractures.

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