

Study Of The Influence Of The Effectiveness Of Calcium Compounds In Experimental Osteoporosis, Taking Into Account Individual-Typological Characteristics

Ziyaeva Sh.T.

Tashkent State Medical University, Tashkent, Republic of Uzbekistan

Received: 26 December 2025; **Accepted:** 16 January 2026; **Published:** 22 February 2026

Abstract: Calcium plays a fundamental role in bone modeling, remodeling, and mineralization. Disorders of calcium metabolism are central to the development of osteoporosis, a systemic skeletal disease characterized by decreased bone mass and increased fracture risk. The effectiveness of calcium-containing preparations may depend not only on their pharmacological properties but also on individual typological characteristics, including psychobehavioral activity.

Keywords: Calcium, Calcium alginate, Calcium chloride, Experimental osteoporosis, Ovariectomy model, Bone mineral metabolism, Psychobehavioral activity, Open Field Test.

Introduction: Calcium is a vital mineral in the human body. This mineral is involved in over 300 biologically active reactions. Medications containing calcium salts have been used in medicine for many decades. This is explained by the important role of this element in bone modeling, remodeling, and mineralization. Depending on body type and gender, approximately 97-98% of calcium is found in the skeleton in the form of hydroxyapatite, and only 2-3% is found in other tissues (muscles, skin). In total, the adult body contains approximately 1000-1500 mg of Ca. Calcium exists in the body in two forms: ionized (free) and protein-bound Ca (mainly albumin). A decrease in the concentration of ionized calcium causes signs of hypocalcemia [13, 12].

Calcium ions perform the following functions [11]:

- activate the plastic function of osteoblasts and osteocytes;
- participate in the formation of bone and dental tissue;
- form the mineral basis of the skeleton, providing its strength and hardness;
- interacting with the intracellular protein calmodulin, calcium ions regulate many biochemical processes.

Calcium also plays a key role in a number of functions in the human body, including [11, 14]:

- cell division and differentiation;
- the release of neurotransmitters from the endings of efferent nerves into the synaptic cleft and the conduction of nerve impulses;
- the contraction-relaxation cycle (together with troponin) of striated and smooth muscles;
- the activity of neurosecretory organs;
- blood clotting;
- transmembrane ion reactions involving selective calcium channels;
- the regulation of cell membrane permeability and the activity of many enzymes and other protein and non-protein biologically active substances.

The primary route of calcium intake is through the diet. By consuming milk, dairy products, fish, meat, fruits, vegetables, and greens, we meet our daily calcium intake. According to WHO recommendations, the daily calcium requirement varies by age and gender. An unbalanced diet and inadequate consumption of foods containing phosphorus and calcium inevitably leads to

a deficiency of these nutrients.

Vitamin D is the primary bioregulator of calcium absorption, increasing calcium absorption from the gastrointestinal tract. Calcium absorption is directly dependent on vitamin D3 levels; when taken in combination with calcium, absorption efficiency reaches 80%. With reduced dietary calcium intake but adequate vitamin D3 intake, the body adapts to fluctuations in calcium intake by increasing passive diffusion in the distal intestine. Abroad, in Russia, and also in Uzbekistan, calcium metabolism disorders in children over 3 years of age are commonly referred to as "osteopenia," "osteomalacia," and "osteoporosis" [7]. Osteopenia is a decrease in bone mass. Osteomalacia is an osteopenic condition associated with impaired bone mineralization. Osteoporosis is a systemic skeletal disease characterized by decreased bone mass and microstructural remodeling of bone tissue, leading to increased bone fragility and fracture risk [7].

Osteoporosis (OP) is one of the most common pathologies among older adults, especially the elderly. The most significant and well-known consequence of OP is hip fracture, the mortality rate of which can be significant, often exceeding global averages, and the cost of inpatient treatment and rehabilitation can be quite expensive. Prevention of OP using traditional methods is not always effective. A personalized approach that takes into account the pharmacokinetics and pharmacodynamics of a particular drug used in the prevention and treatment of AP can significantly improve its effectiveness and reduce the incidence and severity of its consequences and complications. This necessitates experimental comparative studies of the absorption of various calcium compounds, taking into account individual typological characteristics and, in particular, existing psychobehavioral activity (PBA).

As is known, the characteristics of osteoporosis can determine the intensity and type of metabolic activity, which in turn can influence both the course of osteoporosis and its treatment [1]. Experimental modeling of pathological processes plays a major role in studying the pathogenesis of diseases and developing new treatments. Experimental models of osteoporosis have been performed on monkeys, dogs, cats, rodents, rabbits, guinea pigs, and sheep, each with its own advantages and disadvantages. Many

factors must be considered when choosing an osteoporosis model. The choice of an experimental animal must be scientifically and ethically sound, and the model must provide comprehensive data on the research questions. Therefore, there is a need to characterize available experimental models of osteoporosis [3, 4]. Another aspect of this approach is improving the effectiveness of therapy and prevention of osteoporosis, as well as the development of highly effective domestic drugs containing natural calcium compounds. Such drugs include calcium alginate, a natural compound widely used in the food and confectionery industries. Purpose of the study. A comparative study of the efficacy of calcium alginate and calcium chloride in experimental osteoporosis, taking into account individual typological characteristics.

METHODS

Experiments were performed on 100 white rats. The experimental osteoporosis model was reproduced using ovariectomy. After ovariectomy, 33 animals were administered calcium chloride (comparison group) for 90 days at a dose of 2 ml/kg (2.5% solution at a rate of 18 mg/kg pure Ca). 33 animals were given calcium alginate, also administered for 90 days at a dose of 2 ml/kg (8.5% solution at a rate of 18 mg/kg pure Ca) (experimental group). 34 animals received no treatment. Each of these groups was divided into subgroups depending on their activity type (active, normal, and passive animals). All experimental rats were divided into groups with active, normal, and passive psychobehavioral activity based on individual typological characteristics using a standard behavioral test. The type of psychobehavioral activity was determined using the standard Open Field Test, according to the method of Buresh Ya. I. and Lomteva N. A. (6). Total calcium and alkaline phosphatase (ALP) levels in the blood serum were determined by biochemical analysis using the HUMAM test systems (Germany); measurements were performed on a VAZA semiautomated biochemical analyzer (Mindray, China). Statistical processing of the study results was performed using Excel and Biostat software. The criterion for statistical significance was $p < 0.05$.

RESULTS

A comparative analysis of groups with varying levels of

activity revealed certain differences. Thus, the highest calcium levels in the first group were recorded among active animals, while in the group with normal activity, calcium levels were, on average, one-third lower in passive animals. In animals with experimental OP, the highest serum calcium levels were found among animals with increased activity, which were one-fifth and one-quarter higher than in animals with normal and reduced PPA, which in turn may be associated with a higher intensity of calcium leaching from bone tissue with a high degree of metabolic processes in the body of the experimental animals. In rats with experimental OP, a decrease in calcium concentration was noted, and if in animals with increased activity, the value of this indicator was reduced by 13.5% ($p < 0.05$) compared to the baseline data, then in animals with intermediate (normal) PPA, an insignificant downward trend was observed, in the absence of statistically significant changes, and in rats with reduced activity or a "passive" type of behavior, the calcium content decreased by 9.0% ($p < 0.05$). Moreover, the most pronounced increase in serum calcium, relative to its content in untreated animals and compared to animals treated with calcium chloride, was observed after administration of calcium alginate in "passive" animals with reduced PPA, and a slightly less significant increase among "normal" animals with intermediate PPA.

CONCLUSION

The results of the study showed that the use of calcium alginate in experimental osteoporosis resulted in the greatest increase in serum calcium levels in animals with reduced PPA ("passive" animals).

REFERENCES

1. Асилова С.У., и др. Морфологические исследования при остеопорозе костей в экспериментальных условиях. // Образование и наука без границ - Мат. 10 науч. практ. конф. Пшеть, 2014. С. 19-32.
2. Будзинский Н.Э., Сирак С.В., Максимова Е.М., Сирак А.Г. Определение антимикробной активности мирамистина, иммобилизованного на композиционном полисорбе, на микрофлору корневых каналов при остром и обострившемся хроническом периодонтите и процесс остеофикации в эксперименте на животных. //

Фундаментальные исследования. 2013; 7(3): 518-22. 52

3. Сирак С.В., Щетинин Е.В., Слетов А.А. Субантральная аугментация пористым титаном в эксперименте и клинике. // Стоматология. 2016; 95 (1): 55-4.
4. Слетов А.А., Переверзев Р.В., Ибрагимов И.М., Кодзоков Б.А., Сирак С.В. Экспериментальное определение регенераторного потенциала клеток костного мозга. // Стоматология для всех. 2012; 2: 29-31.
5. Котельников Г.П., Булгакова С.В. Остеопороз: // Руководство. М.: ГЭОТАР Медиа, 2010. 512 с.
6. Нетилько Г.И., Наконечный Д.Г., Румакин В.П., Зайцева М.Ю., Божко АМ., Конев В.А. Способ создания остеопороза у кролика в эксперименте. /Патент России м 2480843. 2013.
7. Komori T. Animal models for osteoporosis. //European Journal of Pharmacology - 2015. №759. P. 287-294.
8. Беспалов В.Г. Альгинат кальция. Источник растворимых пищевых волокон и кальция. - М., 2010 - 26 с.
9. Гурин А.Н., Федотов А.Ю., Деев Р.В., Комлев В.С. Направленная регенерация костной ткани с использованием барьерной мембраны на основе альгината натрия и октакальциевого фосфата // Клеточная трансплантология и тканевая инженерия Том VIII, № 4, 2013.
10. Дедух Н. В., Побел Е. А. Костная ткань в норме и при остеопорозе: препараты кальция и витамина D (обзор литературы) // Ортопедия, травматология и протезирование. 2013. № 3: 92–98.
11. Клиническая фармакология по Гудману и Гилману.// Практика. – Москва. –2006.–С.1316–1340.
12. Костылева М.Н. Место препаратов, содержащих кальций в профилактике гипокальциемии у детей.// РМЖ. Педиатрия – 2008. - №25. – С.1629-1637.
13. Спиричев В.Б. Роль витаминов и минеральных веществ в остеогенезе и профилактике остеопатий у детей.//Вопросы детской диетологии.–2003.–Т.1,№1.–С.40–49.

- 14.** Стенникова О.В., Санникова Н.Е.
Патофизиологические и клинические аспекты дефицита кальция у детей. Принципы его профилактики.//Вопр. Совр.педиатр.–2007. – Т.6. – №4. – С.58–65.