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Research Article

Peculiarities of Bone Mineral Metabolism at Osteoarthritis and Exocrine Pancreatic Insufficiency

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Abstract

Introduction: Analysis of bone density speed loss shows the difference of bone density in patient without chronic disorder and person with some chronic disease. It could be making the conclusion that chronic homeostasis imbalance due to any etiology has negative influence on bone tissue state.

The Goal of Research: Make complex study of bone density in patients with primary osteoarthritis and exocrine pancreatic insufficiency and patients with primary osteoarthritis without exocrine pancreatic insufficiency, analyze possible correlations between them.

Methods: There were examined 112 patients with primary osteoarthritis without exocrine pancreatic insufficiency and combination osteoarthritis and exocrine pancreatic insufficiency.

Diagnosis of osteoarthritis was based on diagnostic X-Ray criteria - according J.H. Kellgren and J.S. Lawrence. The level of exocrine pancreatic insufficiency was based on result of Elisa test. State of mineral bone density was examined by using dual-photon densitometry. Serum calcium was determined in the reaction of Ca^{2+} formation with a neutral pH of the arsenase (III) color complex. Serum inorganic phosphorus was determined using a LACHEMA bioassay in the reaction of phosphoric acid with vanadate and ammonium molybdate. Serum magnesium was determined by reaction with calmagite. The level of 25-OH vitamin D was determined using enzyme-linked immunosorbent kits "25-OHD" from the commercial firm Immundiagnostic (Germany).

Results: It was established the progressive, statistically significant increasing of mineral density of bone tissue in the 1st group patients with osteoarthritis. Patients in the 2nd group, with osteoarthritis in the comorbidity with exocrine pancreatic insufficiency, the densitogram rates were statistically significantly lower than in patients 1st group. Hypoelementosis and hypovitaminosis often develop in patients with primary osteoarthritis and it depends on the depth of exocrine pancreatic insufficiency.

Conclusion: The changes of bone tissue can be explained by the formation of trophological insufficiency as a result of exocrine pancreatic insufficiency. One of the symptoms of trophic failure is bone and mineral changes, in particular, the decrease of bone density.

Keywords: *Osteoarthritis; Exocrine Pancreatic Insufficiency; Trophological Insufficiency; Mineral Density of Bone Tissue*

Introduction

It is known that the osteoporosis is systemic disorder of skeleton, which is characterized by decreased bone density, micro-architectonic changes of bone tissue, which leads to bone fragility and increased risk of bone fracture and is typical and very often the only symptom

of this disease. Analysis of bone density speed loss, inducted by age and gender (in case of primary osteoporosis) shows the difference of bone density in patient who were undiagnosed with any other chronic disorder and person with some chronic disease. It could be making the conclusion that chronic homeostasis imbalance due to any etiology has negative influence on bone tissue state.

Study of bone tissue state is very topical in case of combination of osteoarthritis and osteoporosis. These two disorders are very common, with leading prevalence. Each of them has negative influence on ability to work and may lead to long-term disability. Concomitant exocrine pancreatic insufficiency as the result of chronic pancreatitis, diabetes mellitus type 2, chronic gastrointestinal disorder (even in stable remission phase) worsen course of these diseases and bone tissue state [1-3].

The Goal of Research

Make complex study of bone density in patients with primary osteoarthritis and exocrine pancreatic insufficiency and patients with primary osteoarthritis without exocrine pancreatic insufficiency, analyze possible correlations between them.

Materials and Methods

There were examined 52 ambulatory patients with primary osteoarthritis (1st group) and 60 patients with osteoarthritis in the comorbidity with exocrine pancreatic insufficiency (2nd group). Average age was (51.3 ± 3.5) year old (from 29 to 74), 68 (60.7%) women and 44 men (39.3%). Control group consisted of 30 healthy people.

Excluding criteria: Oncological diseases, acute and exacerbation of chronic disease of vital organs, severe diabetes mellitus type 2, diabetes mellitus type 1, gastric and duodenal ulcers, viral hepatitis and cirrhosis, Crohn's disease, ulcerative colitis, cystic fibrosis.

Diagnosis of primary osteoarthritis was determined based on diagnostic criteria, X-Ray stage - according J.H. Kellgren and J.S. Lawrence.

Degree of exocrine pancreatic insufficiency was verified based on result of fecal elastase-1, which was done by Elisa test.

State of mineral bone density was examined by using dual-photon densitometry. Measured values were analyzed according to the age, gender by densitometer «Lunar» and reflect the healthy population of men and women in Ukraine.

Serum calcium was determined in the reaction of Ca^{2+} formation with a neutral pH of the arsenase (III) color complex. Serum inorganic phosphorus was determined using a LACHEMA bioassay in the reaction of phosphoric acid with vanadate and ammonium molybdate. Serum magnesium was determined by reaction with calmagite. The level of 25-OH vitamin D was determined using enzyme-linked immunosorbent kits "25-OHD" from the commercial firm Immundiagnostic (Germany).

Results of Research and their Discussion

Analysis of obtained fecal elastase-1 values has shown the presence of exocrine pancreatic dysfunction in both investigated groups - (153.83 ± 5.34) mkg/g and (58.65 ± 4.73) mkg/g respectively in comparison with control group (213 ± 6.29) mkg/g as well as statistically accurate lower level of fecal elastase in second group compared to the first one ($p < 0.05$).

It has proved the presence of deeper exocrine pancreatic dysfunction in osteoarthritis with concomitant gastrointestinal disorders and exocrine pancreatic dysfunction as well as presence of mild exocrine pancreatic dysfunction in 1st group of people diagnosed with isolated osteoarthritis without gastrointestinal disorders ($p < 0.05$).

It supports the idea about necessity and importance of this problem investigation and taking into account the presence of exocrine pancreatic dysfunction in both groups for effective complex of patients rehabilitation who were diagnosed with osteoarthritis and concomitant gastrointestinal disorders and osteoarthritis without concomitant gastrointestinal disorders.

Table 1 shows obtained results of our investigated densitometric values of bones in patients with primary osteoarthritis without gastrointestinal disorders and in patients with primary osteoarthritis with gastrointestinal disorders. Investigated area - lumbar spine.

Comparison group	The zone of CT indicators determination	CT scan				
		BMD, g/cm^2 (n = 115)	T, standard unit (n = 115)	T, % (n = 115)	Z, standard unit (n = 115)	Z, % (n = 115)
I group (n = 52)	L1-L4 of spine	1,19 ± 0,01*	-0,06 ± 0,09*	99,26 ± 0,96*	0,23 ± 0,24*	102,84 ± 1,99*
II group (n = 60)	L1-L4 of spine	0.98 ± 0,01*p_{1-2} < 0,05	-1,69 ± 0,02* p_{1-2} < 0,05	86,45 ± 0,26* p_{1-2} < 0,05	-1,41 ± 0,11* p_{1-2} < 0,05	82,67 ± 1,04* p_{1-2} < 0,05

Table 1: *Densitometric values in patients with primary osteoarthritis of lumbar spine.*
*Note: *: All indicators are statistically significant in relation to the reference database Lunar;*
p_{1-2}*- statistically significant differences in the data between the study groups.*

Obtained densitometrical values showed that the patients with primary osteoarthritis without gastrointestinal disorders (1st group) are more likely to develop of mineral density of bone tissue, densitometrical values were statistically more significant in comparison with referent base of Lunar ($p < 0.05$) however were in normal reference range according to the age.

In the 2nd group which the patients had primary osteoarthritis with gastrointestinal disorders the values of densitometry were statistically significantly lower compared to referent base of Lunar and reflected Osteopenia, stage 2 ($p < 0.05$).

Bone metabolism was evaluated according to the following biochemical parameters (Table 1). Analyzing the data, we found a statistically significant decrease in calcium level in 1st group compared with the control group, also in the studied patients there was a statistically significant decrease in the levels of phosphorus and magnesium in 1st group, respectively ($p < 0.05$). It should be noted that the levels of the trace elements studied were within the age norm in 1st group in patients with primary osteoarthritis without concomitant gastrointestinal disorders, but their level was statistically significantly lower compared to the control group. Statistically significant hypovitaminosis was found at 25-OH vitamin D level, which was reduced compared to the control group ($p < 0.05$). In the 2nd group which the patients had primary osteoarthritis with gastrointestinal disorders the values of biochemical parameters were statistically significantly lower compared to 1st group and control group ($p < 0.05$) (Table 1).

Indicator of mineral-vitamin metabolism	Comparison group		
	Control group (n = 30)	I group (n = 52)	II group (n = 60)
Calcium, mmol/l	2.41 ± 0.02	2.09 ± 0.02*	2.01 ± 0.01** < 0.05
Phosphorus, mmol/l	1.45 ± 0.03	1.05 ± 0.02*	0.96 ± 0.02** < 0.05
Magnesium, mmol/l	1.08 ± 0.04	0.83 ± 0.02*	0.76 ± 0.02** < 0.05
25-OH vitamin D, nmol/l	52.48 ± 0.26	32.27 ± 0.01*	30.47 ± 0.02** < 0.05

Table 2: *Indicators of mineral and vitamin status in patients with primary osteoarthritis.*
*Note: 1. * - (<0.05); 2. ** - (<0.05).*

Important characteristic of concomitant gastrointestinal disorder in patients with osteoarthritis is severity of exocrine pancreatic dysfunction according to fecal elastase, which is objective, available and non-invasive standard test.

In figure 1 it is showing the regression and correlation analysis between mineral density of bone tissue and indicator T in patients with concomitant exocrine pancreatic dysfunction and fecal elastase level.

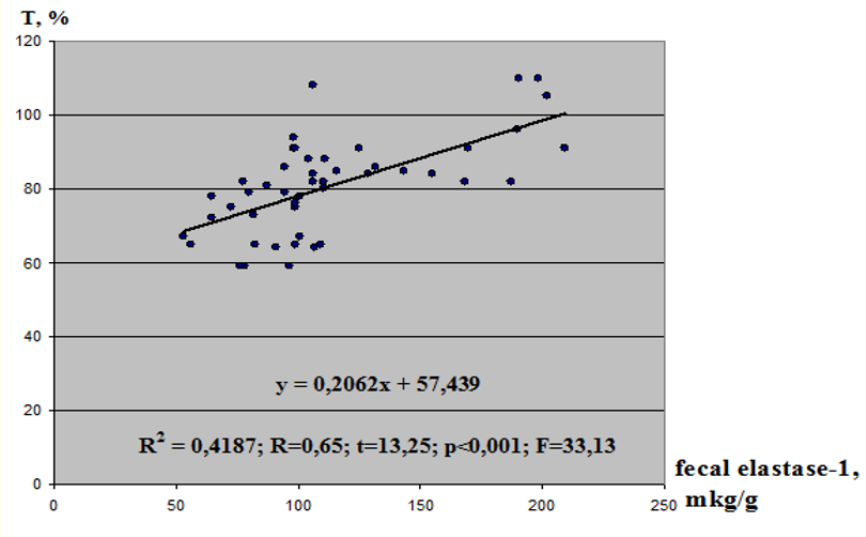

Figure 1: *The dependence of the BMD of patients with osteoporosis from exocrine pancreatic dysfunction by the indicator T (%) on the level of fecal α-elastase.*

Completed analysis established the significant correlation between mentioned above indicators and has proved important role of pancreas function in trophic insufficiency development especially in osteopenia for people diagnosed with osteoarthritis. Linear trend and formula reflect direct correlation and give us an ability to predict the decrease of bones mineral density according to fecal elastase level.

It shows the necessity to include pancreatic functional state in development of complex therapy for patients with combination of osteoarthritis and concomitant gastrointestinal disorders too.

Discussion

Sum up the results of research, we can talk about the negative influence of exocrine pancreatic insufficiency to the of bone mass.

Densitogram in 1st group patients shows the tendency of patients with primary osteoarthritis to increase mineral density of bone tissue. The results were statistically significantly higher in relation to the referent base Lunar ($p < 0,05$), but were within the age range.

Patients in 2nd group, with primary osteoarthritis with gastrointestinal disorders, the densitogram rates were statistically significantly lower than in patients 1st group, and lower in relation to the reference base of Lunar and were at the 2nd level of osteopenia ($p < 0.05$).

Hypoelementosis and hypovitaminosis often develop in patients with primary osteoarthritis and it depends on the depth of exocrine pancreatic insufficiency.

These changes can be explained by the formation of trophological insufficiency as a result of exocrine pancreatic insufficiency. One of the symptoms of trophic failure is bone and mineral changes, in particular, the decrease of bone density.

Thus, the comorbidity of the primary osteoarthritis with diseases of the gastrointestinal tract with exocrine insufficiency of pancreas leads to the loss of bone mass and the forming of osteopenia in the category of such patients.

Conclusion

1. More sever exocrine pancreatic dysfunction in case of osteoarthritis and concomitant gastrointestinal disorder and mild exocrine insufficiency of pancreas in patient with osteoarthritis without gastrointestinal disorder were proved.

2. In patients with primary isolated osteoarthritis mineral bone density has been improving densitometrical values were statistically significantly higher than Lunar reference values.

3. Patients with primary osteoarthritis and gastrointestinal diseases characterized by severe exocrine pancreatic dysfunction were diagnosed with 2-rd stage of osteopenia. Completed correlation and regression analysis established significant correlation between bone mineral density and fecal elastase value and also has proved importance of functional state of pancreas in trophic insufficiency development and osteopenia for patients with osteoarthritis.

4. Patients with primary osteoarthritis and gastrointestinal diseases have hypoelementosis and hypovitaminosis and it depends on the depth of exocrine pancreatic insufficiency.

The next step of our research we be making special correction program of bone mineral density in patient with osteoarthritis and exocrine pancreatic dysfunction.

Compliance with Ethics Requirements

The authors declare no conflict of interest regarding this article.

The authors declare that all the procedures and experiments of this research respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law.

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