The effect of serum 25-hydroxycholekalciferol levels on musculoskeletal system in children with inflammatory bowel disease

Background: Low bone mineral density and osteoporosis represent severe secondary complications that can be a result of childhood chronic disease. According to Frost's mechanostat theory impaired muscle functions may contribute to the changes observed on the skeleton.

Aims: The aim of this study was to: 1) evaluate parameters of bone mineral density, bone geometry and dynamic muscle functions in children and adolescent with chronic disease – inflammatory bowel disease (IBD) and type 1 diabetes (T1D); 2) evaluate a possible effect of vitamin D deficiency and vitamin D supplementation or duration of the disease on the musculoskeletal unit; 3) determine clinical or laboratory predictors of muscle and bone parameters.

Methods: The study was divided into two substudies according to the diagnosis. Seventy patients with IBD (median age 13.8 years) were included in one study, fifty-five of which completed all of the planned procedures. During the study, IBD patients were supplemented with 2000 IU/d of vitamin D. In the second study 95 patients with T1D were included (median age 16.4 years). BMD and bone geometry of non-dominant tibia was evaluated using peripheral quantitative computed tomography (pQCT), dynamic muscle functions were evaluated using jumping mechanography. Prevalence of asymptomatic vertebral fractures in patients with IBD was evaluated using standardized semiquantitative assessment according to Genant.

Results: While relative dynamic muscle functions (P_{max}/mass a F_{max}/BW) in patients with IBD did not differ from the reference population, in patients with T1D were significantly decreased (median Z-score -0.4; $p<0.001$ resp. -0.3; $p<0.01$). T1D duration negatively affected P_{max}/mass ($p<0.01$), but not F_{max}/BW ($p=0.54$). Alteration of densitometric parameters was observed both in patients with IBD and T1D (median Z-score trabecular BMD -1.6; resp. -0.9; cortical BMD +1.1; resp. +1.4; cortical thickness -0.7; resp. -1.1; $p<0.001$ for all; SSI 0.2; $p<0.01$ resp. -0.4; $p<0.001$). No association was observed between vitamin D serum levels and muscle or bone parameters in IBD or T1D patients. However, vitamin D supplementation was positively associated with trabecular BMD and maximal muscle power P_{max} (estimates 0.26, 95% confidence interval [CI] 0.14-0.37, $p<0.0001$ and 0.60, 95% CI 0.32-0.85, $p<0.0001$, respectively).

Conclusion: While the decrease of bone mineral density and alteration of bone geometry in patients with IBD is rather a result of the disease itself and not due to insufficient stimulation by skeletal muscle, alteration of the musculoskeletal system in patients with T1D occurs already in adolescence. Longer disease duration leads to decreased muscle function, which may contribute to the development of osteoporosis reported in adulthood.

Key words: inflammatory bowel disease, type 1 diabetes, bone density, dynamic muscle function, vitamin D, fracture