The results of noninvasive bone mineral density studies in children and adults with end-stage renal failure on hemodialysis

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Objectives:

Chronic kidney disease (CKD) is common and life-threatening condition in children and adults due to the development of end-stage renal disease (ESRD) and increased rate of cardiovascular mortality as well. The processes that cause disturbances of mineral bone metabolism and lead to bone diseases develop already in the early stages of CKD. These disorders correlate with CKD progression and they require special methods of examination.

Methods:

We report a prospective study examining the prevalence of reduced bone mineral density (BMD) in children and adults on hemodialysis. BMD was measured by dual-energy X-ray absorptiometry (DEXA) and quantitative ultrasound (QUS) in 33 children (4-18y.o.) and 28 adults (19-70y.o.) with ESRD. The duration of chronic hemodialysis (cHD) in children ranged from 1 to 74 months. Most of adult patients (86.4%) received cHD more than 12 months. The control group included 11 children with dialysis free CKD stage 3-4 (GFR - 15-29 ml / min). BMD of the hip (femoral neck) and lumbar spine (L2-L4) were investigated. Z-scores (number of standard deviations below the BMD) were reported in children. In adults along with Z-score, T-score (a deviation of peak bone mass) was reported as well and mean scores were calculated (0-1 intact; -1 - -2,5 osteopenia; -2,5 or less severe osteoporosis according to WHO osteoporotic range).

Results:

Lumbar spine was the most reduced zone of BMD in children. Even in control group a significant osteopenia and osteoporosis was revealed with minimal Z-score rate -2,95±0,26. Children on hemodialysis also had less BMD rate in the study of the lumbar spine, rather than at the femoral neck densitometry (Z = -2,20±0,15 and -0,96±0,08 respectively, r<0,001). Contrary no significant differences in comparing mean values of lumbar spine and hip BMD values were found in adults. Lumbar spine BMD scores were significantly lower in children compared to adults (Z = -2,20±0,15 and -1,22±0,16 respectively, r<0,001). In the study of the femoral neck, by contrast, adults showed lower BMD scores than children (Z = -1,35±0,18 and -0,96±0,08 respectively, r<0,05). QUS of the forearm was more informative for adults. Thus the frequency of osteopenia and osteoporosis at the lumbar spine densitometry prevailed in children.

Osteoporosis of lumbar spine was detected in 53.1% and osteopenia in 37.5% of the children, whereas only 7.1% of adults had lumbar osteoporosis. 32.2% of the lumbar spine and 38.5% of hip BMD studies in adults were within normal limits in this study.

We found a higher degree of secondary hyperparathyroidism (sPTH) in children and adults with osteopenia and osteoporosis as compared to patients with normal BMD scores. In children with osteopenia and osteoporosis of the spine sPTH level was within 697,5±132,0 and 492,0±77,1 pg/ml (p <0.05), whereas in adults sPTH was higher in osteoporosis (582,8±122 and 952±80,3 pg/ml, respectively). It should also be noted that in the MBD study of hip in children the sPTH level was higher with osteopenia (782,7±114,5 pg / ml) whereas in adults sPTH was higher with osteoporosis (875,6±75,0 pg / ml).

Conclusions:

Children and adolescents with CKD are more prone to bone disorders according to DEXA densitometry studies. High turnover bone disease with high levels of sPTH was prevalent in children, accompanied by osteopenia and osteoporosis. In adults, along with the high turnover boone disease, intact mineral bone density and low-turnover bone disease were observed as well.

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