Standards of bone densitometry and radiological examination in osteoporosis

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Key words: *osteoporosis, diagnosis, bone densitmtry, DXA, bone minaral density, vertebral fractures, spinal morphometry*

The aim of this study is to present diagnostic standards of osteoporosis based on current literature and guidelines of International Osteoporosis Foundation (IOF), National Osteoporosis Foundation (NOF) and International Society of Clinical Densitometry (ISCD).

Nowadays there are two valid definitions of osteoporosis. Definition published by WHO in 1994 determines osteoporosis as a skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increased in fracture risk. The criteria of this definition are fulfilled by bone mineral density assessment (low BMD) or prevalence of low-trauma fractures (fragility). It has been revealed that 55-74% of osteoporotic fractures occur in persons who do not fulfill WHO criteria, therefore in 2001 a panel of experts of National Osteoporosis Foundation (NOF) and National Institutes of Health USA (NIH) developed a new definition. In this definition osteoporosis is defined as a skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fracture. Bone strength reflects the integration of two main features: bone density and bone quality. Bone mineral density is common criterion of both definitions.

Dual Energy X-ray absorptiometry (DXA) is the standard method of bone mineral density assessment. Osteoporosis should be diagnosed on basis of measurements in proximal femur or spine. The lowest result of one of measured regions of interest (ROI) is accepted for diagnosis. The regions used for assessment in proximal femur are „total", „neck" or „trochanter", never „Ward". In spine the L1-L4 segments are used for assessment, never single vertebra. According to WHO categories T-score value ranging form -1 to -2.4 is classified as osteopenia, T-score -2.5 or less as osteoporosis. Measurements taken in other regions or with different techniques are not equivalent and cannot be used as interchangeable. DXA measurements in other regions of skeleton can be used only for screening, not for diagnosis. Quatitatvive Ultrasounds technique (QUS) does not measure bone mineral density. It measures bone acoustic parameters and might be applied in fracture risk assessment. There were plans to unify the results of different measurements in the form of fracture risk coefficient, however due to many objective difficulties this has not been realized so far.

Decrease of BMD and age are the strongest fracture risk predictors. Fracture risk of proximal femur is the best determined by BMD measurement in proximal femur, and similarly fracture risk of spine is the best determined by BMD measurement in spine. If we attempt to calculate absolute, 10-year fracture risk of proximal femur BMD measurement in proximal femur must be performed.

Radiological examination in osteoporosis is performed mainly in order to detect or exclude vertebral fractures. It has diagnostic and predictive value and this is the final verification of treatment efficacy. Vertebral fractures occur in every 5 woman aged over 50 yrs and in every 2 aged over 80 yrs. After the first vertebral fracture the risk of subsequent fractures increases 10 fold, and risk of proximal femur fractures increases 2.3 fold. 60% of vertebral fractures are asymptomatic therefore they commonly remain undiagnosed. Even when radiological examination is performed 34% of these fractures remain unnoticed.

Osteoporotic vertebral fractures are diagnosed on the basis of thoracic and lumbar spine radiograms. To avoid high doses of radiation only lateral projection of radiograms are performed. The radiation doses are: lateral projection of thoracic spine 290μSv, lumbar spine 530μSv. AP projection of thoracic spine 480 μSv, lumbar spine 530μSv; that makes radiation of 1830μSv altogether. The AP projection is recommended only if there are other clinical indications (e.g. low back pain).
Genant classification is generally applied for qualitative spinal fracture assessment (grade I - mild - 20-25^0; grade II moderate up to 40^0 ; and grade III severe above 40^0). Morphometric measurements submit more precise information. In this method posterior, medial, and anterior vertebral height are measured.

20% decrease of any height is accepted as a fracture threshold. Spinal fractures can be also diagnosed using fan beam densitometers.

Routine application of DXA morphometry reveals 30% of previously undiagnosed spinal fractures, and combined with BMD measurement increases efficacy of proximal femur fracture risk prediction 2 fold and spinal fracture risk 25 fold. Undeniable advantage of this method is minimal radiation (41μSv). The disadvantage is low precision in detection of mild fractures.

Radiological assessment of spine and other parts of skeleton might submit also information to differential diagnosis.