MICRO-X-RAY STRUCTURAL ANALYSIS OF THE VERTEBRAE IN PATIENTS WITH BRONCHO-OBSTRUCTIVE LUNG DISEASE ACCORDING TO COMPUTER TOMOGRAPHY DATA

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Abstract. Epidemiological data indicate an increase in bone mineral density (BMD) disorders in people of different age groups. A special group consists of patients with broncho-obstructive lung diseases (BOLD), among which the majority are patients with bronchial asthma (BA) and chronic obstructive pulmonary disease (COPD). Today the most informative and reliable method of osteoporosis (OP) diagnosing is quantitative computer densitometry. Available modern multi-slice computer tomographs and special programs allow accurate assessment of BMD. One of such program is "QST Pro".

The aim: to conduct a micro-X-ray structural analysis of the bone tissue of the lumbar (L1–L3) vertebrae in patients with COPD and to determine its correlation with standardized methods of OP diagnosing.

Materials and methods. 100 computed tomograms (CT) of the chest were analyzed in the K-Pacs program – 65 patients with BOLD and 35 subjects without somatic pathology of the same age (from 40 to 80 years) and sex, who underwent densitometry with the determination of the T-criterion used to diagnose BMD disorders. We used the Dragonfly license program developed by Object Research Systems (Montreal, Canada) to carry out micro-X-ray structural analysis of CT slices. To work with the program, CT dicom files are transformed into raster files (tiff, jpeg, raw). Further analysis of slices is carried out by grayscale (by image pixels, not by voxels of dicom files). Grayscale analysis correlates with Hounsfield units (HU). For analysis and construction of histograms, axial CT sections of the lumbar (L1–L3) vertebrae on chest CT were selected.

Results. During the examination of patients with BOLD and persons without somatic pathology of the same age and sex, the average value of the BMD of the lumbar (L1–L3) vertebrae, Z- and T-criteria was determined by the method of quantitative computer densitometry. According to the T-criterion, the presence of osteopenia or OP was assessed. The value of the T-criterion was interpreted as follows: from 3.0 to –1.0 — the normal; from –1.0 to –2.5 — osteopenia; from –2.5 to –5.0 — OP. For each range of T-criterion values, the range of BMD in HU was determined. Based on the results of the examination, it was established that 62 (95.4 %) patients with BOLD had systemic pathological changes in bone tissue. In 18 patients from 65, osteopenia was detected, and in 44 — OP, which was 8 times higher than the frequency of diagnosis of OP in people without somatic pathology. When comparing the average values of CT densitometric indicators (HU) in the studied ROI (zone of interest), it was found that they correspond to the values of the T-criterion: normal — above 150 HU, osteopenia – from 110 to 150 HU, osteoporosis – below 110 HU.

Conclusions. Micro-X-ray structural analysis with the construction of ordinary and segmented histograms allows to reveal a significant difference in the structure of the vertebrae with different degrees of mineral metabolism disorders. This makes it possible to create intelligent programs based on convolutional neural networks, which will significantly increase the informativeness of diagnostics.

Key words: broncho-obstructive lung diseases, micro-X-ray structural analysis, computer tomography, densitometry, osteoporosis, osteopenia.