

# Determination of dynamics and stage of development of COVID-19 pneumonia based on digital software processing of images of computed tomography of the chest

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**Conflict of interest:** none

**BACKGROUND.** Pneumonia resulting from SARS-CoV-2 infection is characterized by the development of certain radiological patterns such as "ground glass" and others, which can only be detected using high-resolution computed tomography (HRCT) of the chest. The use of CT to combat the coronavirus disease (COVID-19) pandemic varies worldwide. In scientific publications, there is no consensus on the information content of CT for COVID-19 pneumonia, the timing of its implementation at the onset of the disease and control examinations. The long-term consequences of the disease, the possibilities of software processing of CT images of the chest cavity in order to study the dynamics of the process, predict outcomes and evaluate the effectiveness of the therapy, have not been sufficiently studied.

**OBJECTIVE.** To determine the possibilities of digital software processing to increase the information content of CT images and justify its use in determining the dynamics and stage of development of COVID-19 pneumonia.

**MATERIALS AND METHODS.** For image analysis, we used the Dragonfly program, which was provided free of charge for non-commercial scientific research by Object Research Systems (Montreal, Canada). The program allows you to carry out segmentation, mathematical and statistical processing of images, to build conventional and segmented histograms. To use it, it is necessary to reformat DICOM files of CT into so-called raster files (TIFF, JPEG). Further analysis of images of CT slices is performed using gray scale (from 64 to 512 gradations), which correlates with density values on the Hounsfield scale, which allows you to more accurately determine the structure of the organ under study.

**RESULTS AND DISCUSSION.** The analysis of CT for COVID-19 pneumonia with the “ground glass” pattern showed that standard densitometry does not allow to determine the morphofunctional difference between the studied areas of “ground glass” and to determine the stage of its development. The segmentation histogram based on digital software processing of the same “ground glass” areas of the patient with COVID-19 pneumonia has changed significantly with a clear definition of a significant difference in the density of the pattern in dynamics, on the basis of which it can be concluded that the patient is undergoing a process of recovery and COVID-19 pneumonia is at the resolution stage.

**CONCLUSIONS.** Carrying out digital software image processing with a CT segmentation histogram allows you to determine the dynamics and stage of development of COVID-19 pneumonia, evaluate the effectiveness and need for therapeutic measures. In order to conduct an objective control of the inflammatory process in COVID-19 pneumonia, it is necessary to conduct a HRCT of the chest at discharge from the hospital, especially in patients who were treated in the intensive care unit. If there are significant changes, follow-up studies should be carried out after 3 and 6 months, or depending on clinical indications.

**KEY WORDS:** COVID-19 pneumonia, “ground glass” pattern, high-resolution computed tomography, segmentation histogram.