

Multispiral Computed Tomography Comparative Analysis and Justification of Chronic Lung Disease Complications in Patients with Covid-19 Pneumonia

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Abstract:

The article presents the results of computed tomography, magnetic resonance imaging, ultrasound, chest x-ray in patients with COVID-19 pneumonia. A comparative analysis of the diagnostic information content of each of the methods of radiological examination was carried out. It has been determined that magnetic resonance imaging and ultrasound can be used as an alternative to computed tomography.

Keywords: X-ray diagnostics, computed tomography, magnetic resonance imaging, radiography, ultrasound, COVID-19 pneumonia.

Introduction

Due to the high mortality from COVID-19 pneumonia, adequate and timely diagnosis comes to the fore. At the same time, radiation research methods play a huge role in identifying signs of inflammatory changes in the lungs, determining the volume of lung damage, monitoring treatment and predicting the course of the disease. The most informative method of detecting changes in the lungs associated with COVID-19 is rightfully computed tomography of the thoracic cavity, which allows identifying typical manifestations of viral lung lesions [1,7]. However, in some cases, CT is problematic, especially in patients in the intensive care unit. In addition, due to the high radiation load, the question arises of limiting the use of this method in the framework of frequent control studies.

The purpose of the investigation. In order to reduce radiation exposure and obtain additional diagnostic information, magnetic resonance imaging (MRI) was used in a number of patients [8].

Radiography is significantly inferior in the sensitivity of computed tomography, it allows us to confidently detect only severe forms of pneumonia [6]. Most of the available studies indicate that traditional lung radiography has low sensitivity at an early stage.

Ultrasound examination (ultrasound) of the lungs is considered as an alternative to X-ray studies [2]. Important advantages of ultrasound compared to radiography are: zero radiation load, assessment of infiltration in Live mode, the ability to monitor the dynamics of pneumonia. [3]. Demonstrating high sensitivity in the diagnosis of pneumonia, ultrasound at the same time has its limitations — sensitivity parameters are significantly reduced with a small lesion of lung tissue, localization of pneumonia in areas difficult to reach for the ultrasound wave [3, 5]. In this regard, ultrasound in the diagnosis of coronavirus pneumonia requires a more detailed study.

Materials and methods

The clinical and radiation data of 27 patients (15 women and 12 men) who underwent COVID-19 and were observed in medical and preventive institutions of the city of Karaganda, Temirtau from August 2020 to December 2021 were analyzed. The average age of patients was 37.2 ± 15.7 years. All patients underwent high-resolution computed tomography (HRCT), which was performed with a thin slice of 1-2 mm at the inhalation delay in the pulmonary and mediastinal modes with a scanning area from the tops of the lungs to the sinuses, in the native mode on devices with 128 slices. Scanning was carried out on a GE Optima CT 660 computed tomograph

The consequence of the high density of recording for CT studies, as well as the temporary technical malfunction of CT machines caused by the increased round-the-clock load on X-ray tubes, was the inability to perform CT in some patients. It is in such a situation of lack of opportunities that magnetic resonance imaging (MRI) has become an alternative method of diagnosing pulmonary changes.

MRI examination of the chest organs was carried out in 9 patients on Toshiba Titan Vantage 1.5 T MRI scanners (Canon Medical), in T1-, T2-weighted modes (T1VI, T2VI), STIR-modes, in axial and frontal planes, with breath retention.

Radiography was performed in straight posterior and lateral projections, when the patient's condition allowed him to be in a vertical position, whereas in a straight anterior projection — with the patient's horizontal position. During X-ray examination, pneumonia was confirmed or excluded, the extent of darkening was estimated depending on the localization by segments, the presence of complications in the form of destructive processes, pleural effusion.

Ultrasound examination of the lungs was performed on a Toshiba AplioMX ultrasound machine using a 5 MHz convex sensor.

Ultrasound assessed the localization of the process, the length of the infiltration site, as well as the number of B-lines and "air bronchograms" per unit area.

Radiation diagnostic methods were used strictly according to the indications and prescription of the attending physician, and patients or their legal representatives signed an informed consent to conduct the study.

Results and discussion.

Computed tomography.

The most common symptom of COVID-19- pneumonia at the initial stage of development is called a "matte spot" [1,7,9,10,11,12]. This sign is morphologically represented by a compaction of the parenchyma of the organ with partial preservation of pneumatization, due to which bronchial and vascular structures are observed (Fig 1a). The symptom was detected in all patients.

The second most frequent pattern was the consolidation of lung tissue (reticular intra-lobular striation), it was observed in 15 patients (55%). In the images, consolidation is characterized by a pronounced increase in parenchymal density, against which the bronchial structures and vessels do not differ in comparison with the affected area.

The symptom of "cobblestone pavement" ("patchwork quilt") is a combination of changes in the type of "frosted glass" and pronounced thickening of interstitial intra- and inter-lobular partitions (Fig. 2b). This CT pattern was found in 8 patients (about 30%).

Magnetic resonance imaging

The MRI study of OGK was performed on 9 patients on Toshiba MRI scanners in a 1.5-Ton Titanium in T1-, T2-weighted modes (T1VI, T2VI), with respiratory delay. The results of MRI and CT studies of OGK were compared.

The results obtained indicate a high sensitivity of T2-VI in detecting consolidation zones and "frosted glass", with comparable diagnostic value with high-resolution computed tomography data. This is due to the high intensity of the signal in tissues with an increased fluid content (inflammation or edema), both in the alveolar and interstitial spaces.

Ultrasound diagnostics

According to the Russian government, infection due to panic attacks related to COVID-19 caused increased sensitivity [2,3,5].

Ultrasound signs of the lungs are normally: hyperechoic smooth pleural line, sliding of the visceral pleura (the so-called sign of the "seashore"), A-lines, single B-lines (less than four in one intercostal space).

With ultrasound of the lungs and pleural cavity, the detected signs corresponded to the signs of CT. The use of a lung pair of the "frosted glass" type, manifested in the fact that the ultrasound corresponded to multihocal, discrete/merging B-lines.

All patients with confirmed COVID-19 pneumonia on CT OGK had echo signs of interstitial changes in lung parenchyma: multiple (narrow) B-lines, merging (wide) B-lines, as well as areas of subpleural consolidation and the so-called "white lung".

The symptom of "cobblestone pavement" in ultrasound of the lungs is characterized by a combination of B-lines interspersed with unexpressed subpleural consolidation in places of thickening of the septa and alveolar lesions.

An important limitation of the method is the lack of visualization of deeply located structures of lung tissue. Visualization of such areas was possible only with a significant loss of airiness of subpleural areas, for example, during their consolidation. At the same time, only those consolidation zones that are located closer to the pleura are available.

Radiography

The importance of radiography is due to the fact that, due to its availability, it is often the primary, and sometimes the only method used to visualize changes in the lungs when coronavirus pneumonia is suspected in small towns, regional centers of our country. When X-ray diagnostics of coronavirus pneumonia for the correct interpretation of images, it is recommended to pay attention to the following:

- 1) at the onset of the disease, the radiograph shows an increase in the pulmonary pattern of a heavy type due to thickening and compaction, and later swelling of the walls of the bronchi and their stroma in the basal, basal sections and often on the periphery along the costal surfaces. Perhaps you have a suspicion of COVID-19, which may not be recognized, because it is possible to recognize a genetic virus;
- 2) after 7-10 days from the beginning of clinical manifestations, extensive areas of fine-mesh pattern enhancement appear with a decrease in the airiness of the lung tissue, up to the "frosted glass" pattern;
- 3) after a few more days, infiltrates from inhomogeneous medium to homogeneous high intensity appear mainly in the peripheral parts, located along the costal surface.

The correct interpretation of radiographs in patients with coronavirus pneumonia is more difficult in comparison with CT, MRI or even ultrasound. Therefore, if there is a suspicion of the coronavirus nature of pneumonia detected by radiography, it is necessary to prescribe a CT scan.

Conclusions. Computed tomography, of course, is taken into account by the modern method of diagnosing lung infection COVID-19-pneumonia. The presented observations illustrate the diversity of the CT picture of coronavirus pneumonia detected during the initial examination of patients. The sensitivity of the MRI method in assessing inflammatory changes in the lungs in COVID-19 is inferior to CT, however, to identify the main symptoms (an increase in the density of the parenchyma by the type of "frosted glass" and consolidation), it may be a very real alternative in the absence of the possibility of performing CT.

In the conditions of a pandemic and mass admission of patients, lung ultrasound can be very useful, as well as in the absence of a CT scanner, in an intensive care unit, for "bedside" diagnostics. X-ray examination of OGK is not the method of choice for the diagnosis of COVID-19, it is used in patients in intensive care and intensive care units when CT is impossible. The low sensitivity of lung radiography in the early stages is explained by the fact that the initial manifestations of coronavirus pneumonia are areas of "frosted glass" type compaction, the visualization of which in most cases lies beyond the diagnostic capabilities of radiography.

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