POSSIBILITIES OF RADIATION DIAGNOSTICS FOR CORONAVIRUS INFECTION

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Annotation. After a certain period of time, this period may well go down in history as the “era of COVID-19”. Now, most people are concerned about the timeliness of diagnosis and the beginning of treatment for a new disease for humanity. In this article, we will consider which existing diagnostic methods can be most effective and what equipment will be needed in the near future by medical institutions to combat the pandemic.

Key words: radiation diagnostics, laboratory diagnostics, computed tomography, ultrasound diagnostics, radiography

ВОЗМОЖНОСТИ ЛУЧЕВОЙ ДИАГНОСТИКИ ПРИ КОРОНОВИРУСНОЙ ИНФЕКЦИИ

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Аннотация. Через некоторый промежуток времени данный период вполне может быть войдет в историю как «эпоха COVID-19». Сейчас, большинство людей волнует своевременность диагностики и начало лечения нового для человечества заболевания. В данной статье рассмотрим, какие

существующие методы диагностики могут быть максимально эффективны и какое оборудование потребуется в ближайшее время лечебным учреждениям для борьбы с пандемией.

Ключевые слова: лучевая диагностика, лабораторная диагностика, компьютерная томография, ультразвуковая диагностика, рентгенография

Introduction. The rapid spread of coronavirus infection and the spread of the disease to all age groups of the population requires a comprehensive response from the healthcare system to minimize the consequences of infection. In this regard, rapid and high-quality diagnosis of COVID-19 in patients is of particular relevance.

Laboratory diagnosis of COVID-19 and the related SARS-CoV-2 virus is possible by two main methods: molecular recognition and serological testing. Molecular methods use polymerase chain reaction along with nucleic acid tests and other advanced analytical techniques to detect the genome of the virus. An enzyme immunoassay is used to detect the presence of immune system antibodies against a virus.

The main problem in the laboratory diagnosis of COVID-19 is the large number of false negative tests, especially when biomaterial is collected incorrectly or lack of understanding of the stage of the disease [1, 12, 13].

Therefore, in a situation where there are clinical manifestations of the disease, such as a non-productive dry cough, weakness, fever, difficulty breathing, but there are no positive results of laboratory tests for coronavirus, the main method for differential examination of COVID-19 is radiation diagnostics: computed tomography, radiography and ultrasound study [2, 11, 17].

Computed tomography for diagnosing COVID-19 is the most informative method of radiodiagnosis for COVID-19 disease. Computed tomography very clearly shows the specific changes in the lung tissue that appear in this disease. Detection of pronounced changes on a computed tomography scan of the lungs allows, for example, in the absence of clinical symptoms, to prevent the development of respiratory failure and hospitalize the patient in a timely manner. In the case when computed tomography shows minimal changes in the lung tissue or the lung tissue is not affected at all, then radiation diagnostics allows patients to avoid hospitalization, who can undergo therapy at home. This makes it possible to relieve hospital beds for those who really need urgent care and respiratory support, including invasive ventilation [1, 6, 10].

Computed tomography can detect specific changes, even in the absence of Covid symptoms. On CT images, the virus may appear as bilateral opacities (“ground wall”) and pulmonary consolidations. Also, at an early stage of virus detection, nodular shadows, peripheral localization, and the “cobblestone pavement” symptom appear. One of the signs of coronavirus infection can be a single nodular darkening on the lung

tissue. In some patients, this particular symptom was identified at an early stage of the disease, when clinical signs had not yet appeared. It is also important to note that the images do not show lymphadenopathy, pulmonary destruction, or pleural effusion [2, 8, 15].

When diagnosing COVID-19, radiography can reveal specific changes in the lung tissue. The photographs of an infected person contain a set of signs that indicate infection with coronavirus infection.

The images show an increased pulmonary pattern, nodular darkening of the airways, and local compactions may appear. And just like on a CT image, the radiologist can see the “ground glass” syndrome and the “cobblestone” effect. X-rays show peripheral locations, which are usually located closer to the chest and further from the heart.

Despite the high specificity and sensitivity of computed tomography, under current conditions radiography has a number of undeniable advantages. An X-ray examination takes much less time than a computed tomography, and a specialist, if in doubt about the interpretation of the results, can always send the patient for a computed tomography [3, 5, 19].

In a situation where difficulties arise with the use of stationary X-ray diagnostic systems, the optimal solution is the use of mobile X-ray machines. They allow you to perform not only primary diagnosis, but also monitor the course of the disease. An image on a mobile device can be taken not only by a radiologist or x-ray laboratory technician, but also by nursing staff due to the ease of use of this equipment [1, 4, 18].

Mobile X-ray machines can be either digital or analog. They can be presented both in the form of monoblocks and in the form of portable devices mounted on a mobile base. To carry out radiography in conditions of coronavirus infection, the undoubted priority is digital image processing, which guarantees its higher quality. Digital mobile systems provide higher speed due to the presence of a computer station for processing images, designed for “online” assessment of their quality and subsequent storage. This allows you to evaluate the subsequent dynamics of the disease by comparing digital images of the patient’s lungs. Monoblock digital mobile X-rays, as a rule, differ from other mobile digital devices in the power of their generators [3, 14, 16].

Thus, for performing digital radiography of the lungs for the diagnosis of COVID-19, there are a large number of possibilities when choosing the necessary equipment, depending on the tasks that the medical institution solves.

Ultrasound can also be used to diagnose coronavirus infection. An ultrasound examination shows the condition of the pleural cavity and diaphragm, as well as the soft tissues of the chest wall and ribs. The big disadvantage of this type of study is that it cannot help the doctor assess the condition of the lung tissue. In an ultrasound image

with coronavirus, you can see intense uniform darkening, changes in the diaphragm, and subtotal darkening of the lung. Ultrasound is much less informative and specific than computed tomography or radiography. An ultrasound examination does not allow one to examine small changes in the pattern of the lung, get close to the structure of the roots of the lung, or see heavy shadows. An ultrasound examination can establish the fact of pneumothorax of the lung, but the doctor will not be able to understand how destructive these changes are. This is what makes ultrasound diagnostics a backup technique used in extreme cases [2, 7, 9].

Conclusions. In conclusion, I would like to note that laboratory and radiation diagnostics perfectly complement each other, being responsible for solving parallel problems. Laboratory testing is required to confirm infection with the COVID-19 virus. Without laboratory confirmation, doctors can only suspect a patient is diagnosed with coronavirus. Doctors need radiation diagnostics in order to see the full clinical picture of the disease and assess its severity and dynamics. A wide range of modern devices for radiation diagnostics make it possible to fully conduct primary radiation diagnostics in patients with coronavirus in almost any medical institution.

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