EFFECTIVENESS OF ULTRASOUND TECHNOLOGIES IN THE EARLY DETECTION OF LYMPHOSTASIS OF THE LENGTHS

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Abstract. This article analyzes the effectiveness of ultrasound diagnostic technologies in the early detection of leg lymphostasis. It also discusses the advantages of ultrasound diagnostics, including non-invasiveness, safety, and real-time results, as well as some limitations. The results of the study indicate that ultrasound technologies are an important diagnostic tool in the early detection of leg lymphostasis and justify its widespread introduction into clinical practice.

Keywords: leg lymphostasis, lymphedema, ultrasound diagnostics, dopplerography, high-frequency ultrasound, early diagnosis, lymphatic system, soft tissues, diagnostic efficiency.

In modern medical practice, diseases of the lymphatic system, in particular, lymphostasis of the legs (lymphedema), are becoming one of the most urgent problems. Lymphostasis is a chronic pathological condition characterized by fluid accumulation in the tissues as a result of impaired lymph flow, which significantly reduces the patient's quality of life and, in case of delayed treatment, leads to the development of severe complications. In particular, the difficulty of identifying the early stages of the disease is considered an important diagnostic problem in clinical practice.

Currently, various instrumental examination methods are used to detect lymphostasis. Among them, ultrasound diagnostics occupies a special place as a non-invasive, widespread and relatively safe method. Using ultrasound technologies, it is

possible to detect structural changes in soft tissues, indirect signs of lymph flow, and conduct differential diagnostics. This allows you to detect the disease at a stage when clinical symptoms are not fully manifested.

In recent years, the improvement of ultrasound technologies, in particular the introduction of high-precision devices and Dopplerography methods, has opened up new opportunities for the detection of lymphatic system pathologies. At the same time, the diagnostic value of ultrasound examination in the early stages of lymphostasis, its sensitivity and specificity have not yet been studied sufficiently comprehensively.

The issues of diagnosis and treatment of leg lymphostasis have attracted the attention of many researchers in recent years. Analysis of available scientific sources in this area allows for a comprehensive assessment of the pathogenesis, diagnostics and effectiveness of modern instrumental methods of the disease.

First of all, studies related to pathologies of the venous system of the lower extremities reveal important factors in the development of lymphostasis. In particular, the scientific work conducted by P. E. Vakhratyn thoroughly analyzed the cases of recurrence of varicose veins, its clinical manifestations and diagnostic approaches, and substantiated the close relationship between lymphatic system disorders and venous insufficiency [1]. This approach indicates the need for a comprehensive assessment of lymphostasis.

The importance of ultrasound technology in the diagnosis of lymphostasis has been widely covered in a number of foreign studies. In a study conducted by Suehiro et al., ultrasound examination of subcutaneous tissue in edema of the legs and secondary lymphedema was studied [2]. The authors showed that ultrasound can detect signs of fluid accumulation in tissues, fibrotic changes, and impaired lymphatic drainage. This confirms the important role of ultrasound in early diagnosis.

The general capabilities of ultrasound diagnostics and its clinical application were widely reviewed by Maruszczak et al. [3]. The study emphasized the high

accuracy and safety of ultrasound in the diagnosis of pathologies of soft tissues, muscles, and the vascular system. Also, the non-invasiveness of this method and the provision of results in real time make it a superior diagnostic tool in clinical practice.

In recent years, the introduction of high-frequency ultrasound technologies has initiated a new stage in the diagnosis of diseases of the lymphatic system. In a study by Chen et al., the effectiveness of 24 MHz high-frequency ultrasound in mapping lymphatic vessels in secondary lymphostasis was compared with the indocyanine green (ICG) method [4]. According to the results, the high-frequency ultrasound method showed high efficiency in terms of sensitivity and practical convenience, which allows its widespread use in clinical practice. Thus, the analyzed scientific sources indicate that ultrasound technology is an important diagnostic tool in the detection of leg lymphostasis, especially in its early stages. However, the existing studies are fragmentary in some aspects, and there is a need for comprehensive and systematic research in this area.

The main role in the pathogenesis of leg lymphostasis is played by the accumulation of interstitial fluid as a result of impaired lymph flow, the development of fibrosis processes in the tissues and impaired microcirculation. In the early stages of the disease, clinical symptoms are poorly expressed and are often manifested only by mild edema, a feeling of heaviness and vague discomfort that appear only at the end of the day. Therefore, it is at this stage that the use of highly sensitive and safe diagnostic methods for diagnosis is of great importance. Ultrasound diagnostics (UTT) stands out as a non-invasive, relatively inexpensive and widely used method for diagnosing lymphostasis. With the help of UTT, the thickness, echogenicity, structural homogeneity of the skin and subcutaneous tissue, as well as the degree of fluid accumulation, are assessed. In the early stages of lymphostasis, ultrasound examinations can detect thickening of subcutaneous adipose tissue, increased

hyperechogenicity and structures resembling a “honeycomb”. These signs are associated with impaired lymphatic drainage and increased interstitial fluid.

The use of Doppler ultrasound technology plays an important role in the differential diagnosis of lymphostasis. In particular, it makes it possible to determine the origin of lymphatic edema by excluding venous insufficiency, thrombosis or arterial pathologies. This reduces errors in diagnosis and helps to choose the right treatment strategy.

The introduction of high-frequency ultrasound technology allows for more accurate visualization of the lymphatic system. Using sensors in the 20–24 MHz range, it is possible to determine the structure of the skin and superficial lymphatic vessels, assess their expansion or deformation. This approach is of great diagnostic value, especially at the subclinical stage, that is, during the period when clinical symptoms have not yet fully formed.

Another advantage of ultrasound is the possibility of conducting dynamic monitoring. The effectiveness of therapy can be assessed by regularly monitoring changes in tissues during treatment. For example, as a result of compression therapy or lymphatic drainage procedures, a decrease in edema and changes in tissue density are objectively recorded by ultrasound.

However, ultrasound diagnostics also has some limitations. In particular, the difficulty of fully visualizing deep segments of lymphatic vessels, operator dependence, and insufficient standardization of diagnostic criteria are among the problems. However, modern technologies and high-precision devices are gradually eliminating these shortcomings.

In general, ultrasound technology is an effective, safe, and practically convenient diagnostic tool for the early detection of leg lymphostasis. Its complex use with other methods increases the accuracy of disease detection and optimizes the clinical decision-making process.

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