УДК 616.12-008.331.1-079.4 (075.8)

Касимова Нурхон Джураевна

Кафедра пропедевтика внутренних болезней

Андижанский государственный медицинский институт

ЭХОКАРДИОГРАФИЯ ПРИ ДИАГНОСТИКЕ ЛЕГОЧНОЙ ГИПЕРТЕНЗИИ

Резюме: Легочная гипертензия (ЛГ) - это распространенная серьезная клиническая проблема, которой занимаются врачи различных клинических специальностей. Для врача-пульмонолога важен тот факт, что ЛГ является частым и прогностически неблагоприятным осложнением хронических респираторных заболеваний.

Основу обследования больных, у которых предполагается наличие ЛГ, составляет комплекс исследований, включающий полный клинический осмотр, различные лабораторные и инструментальные методы, в том числе катетеризацию правых отделов сердца.

В настоящее время методика катетеризации правых отделов сердца остается "золотым стандартом" в определении давления в легочной артерии (ДЛА) и обязательной составляющей при диагностике ЛГ. Однако этот метод, являясь ин-вазивным, имеет ряд ограничений. Оспаривается возможность и необходимость использования катетеризации правых отделов сердца при динамическом наблюдении.

Ключевые слова: легочная гипертензия, эхокардиография, правое предсердие и правый желудочек сердца.

Kasimova Nurkhon Dzhuraevna

Department of Propedeutics of Internal Medicine

Andijan State Medical Institute

ECHOCARDIOGRAPHY FOR DIAGNOSTICS OF PULMONARY HYPERTENSION

Resume:Pulmonary hypertension (PH) is a common serious clinical problem that is addressed by physicians in various clinical specialties. For the pulmonologist, it is important that PH is a frequent and prognostically unfavorable complication of chronic respiratory diseases.

The basis of the examination of patients in whom PH is suspected is a complex of studies, including a complete clinical examination, various laboratory and instrumental methods, including catheterization of the right heart.

Currently, the technique of catheterization of the right heart remains the "gold standard" in determining the pressure in the pulmonary artery (PAP) and a mandatory component in the diagnosis of PH. However, this method, being invasive, has a number of limitations. The possibility and necessity of using catheterization of the right heart with dynamic observation is disputed.

Key words: pulmonary hypertension, echocardiography, right atrium and right ventricle of the heart.The urgency of the problem.

Relevance. Pulmonary hypertension (PH) is observed in a wide range of diseases and, according to the definition of the European Society of Cardiology (2004), is characterized by a chronic progressive increase in pulmonary vascular resistance, which leads to the development of right ventricular failure and an unfavorable prognosis [1,4].

In 2003 in Venice at the III World Symposium dedicated to pulmonary arterial hypertension, a new classification of PH was proposed, according to which, in particular, arterial and venous PH are allocated [1,6]. The main cause of venous PH is rheumatic heart disease (RHD), which occupy the 4th place in the etiological structure of chronic heart failure (CHF) in our country, accounting for, according to different authors, from 7.4% to 11% [2.4, 6].

One of the factors in the progression of CHF in mitral heart disease (MPS) is LH. Studies on venous PH in rheumatic mitral heart disease (RHMD) are few. In particular, the issues of PH diagnosis from modern positions are not covered,

taking into account various classifications (according to the severity, based on the systolic pressure in the pulmonary artery [1,3], and according to the functional class (FC) [1,3], reflecting tolerance to There is also no data on the 6-minute walk test in patients with MPS complicated by PH, which can objectively assess exercise tolerance.

Numerous studies on primary PH, as a universal model for the study of PH, made it possible to identify several components of its pathogenesis: endothelial dysfunction (ED), hyperproduction of serotonin, proliferation of smooth muscle cells (SMC) of the vessels of the pulmonary circulation, local pulmonary fibrinolysis disorders, etc. [2,5].

Currently, in the literature, ED is considered the central link in the pathogenesis of PH, which is accompanied by overproduction of thromboxane, decreased prostacyclin activity, inhibition of nitric oxide synthesis, increased formation of endothelin-1, etc., which leads to prolonged pulmonary vasospasm and increased proliferation of vascular SMCs [2, 4]. Disorders of endothelial function are also closely associated with the excessive activity of some markers of the endothelium-dependent link of hemostasis, which forms a tendency to hypercoagulability in PH. One of the indicators, the activity of which combines both disorders of endothelial function and hemostasis, is von Willebrand factor (vFW). Currently, there have been numerous studies of the role of vFW in coronary artery disease, venous thromboembolism, primary PH. It has been shown that an increase in this indicator in primary PH is a risk factor for death of patients [1,6]. The study of vFW in rheumatic MPS was carried out in a few foreign studies, which noted the association of increased vFW with atrial fibrillation in patients with mitral stenosis [2].

Currently, the role of rheological disorders in the genesis of LH is being emphasized, since they, among other things, depend on the resistance of the lung vessels and an increase in pressure in the pulmonary vein system, which leads to a slowdown in blood flow through arterioles and venules, a change in the

properties of the erythrocyte membrane and stasis [2 ,4]. Damage to the endothelial layer with the development of ED are important mechanisms for the progression of PH. These disorders are most studied in CHF and it has been shown that rheological disorders and the development of ED determine the severity and prognosis of the disease [2]. It is known that changes in hemorheology also develop in RPD [4]; their relationship with the functional state of patients has been assessed [4]. However, we did not come across comprehensive studies taking into account rheological disorders, changes in hemostasis, including vFW in MPS, complicated by PH.

As the degree of PH progresses, right ventricular failure (RVF) develops, which significantly worsens the patient's life prognosis, including in patients with RP [1,6]. It has also been proven that the presence of right ventricular dysfunction worsens the long-term results of surgical treatment of heart defects [1,2,6]. This makes the study of the functionality of the pancreas extremely relevant.

Currently, echocardiography (EchoCG) and Doppler echocardiography (DEHOKG) are highly informative and non-invasive methods for diagnosing heart disease in RPS. With their help, one can reliably assess the function of the left heart, the structure of the valve apparatus, calculate the systolic pressure in the pulmonary artery (PAP), and also suspect the presence of RV dysfunction [2]. Currently, unified EchoCG markers of RV dysfunction in RPD have not been determined, however, different researchers suggest evaluating some of its indicators: an increase in the end diastolic size (EDS) [3], a decrease in the RV ejection fraction (EF) and hypertrophy of the RV free wall [4]. In addition, using a pulse-wave Doppler study, it is possible to determine the diastolic function (DF) of the heart, that is, the ability of the ventricles to accommodate the required volume of blood coming from the atria during diastole [2]. As can be seen from the definition, DF directly depends on the preload. At the same time, during the formation of rheumatic mitral stenosis (MS), the assessment of

DF of the left ventricle (LV) is difficult, because there is an organic obstacle to blood flow in the LV, therefore, this mode, in the presence of mitral valve defect, may limit the use of this assessment method. In addition, the peculiarities of the anatomical structure of the right ventricle (RV) and the difficulties of its visualization, make the study of the parameters of its functional activity using the indicated EchoCG techniques not entirely correct [5], which necessitates the search for new research methods.

Recently, the literature has discussed the possibility of using tissue Doppler imaging (TDI), including in PH [5]. The technique consists in determining the speed of movement of tissue structures and is intended for an in-depth study of myocardial function [2]. This method provides objective information on the state of global and segmental longitudinal myocardial kinetics. In addition, evidence has been obtained of the advantages of the tissue DEchoCG mode over traditional pulsed EchoCG in the study of blood flow to the heart through the pulmonary veins and the mitral valve, because Unlike the latter, the indices of tissue DEHOCG depend little on preload, which makes it advisable to use this mode in MPS for a comprehensive assessment of intracardiac hemodynamics, including the pancreas [6]. In the foreign literature, works on the use of this technique for MPS are rare. It was shown that the tissue mode allows one to reveal both systolic and diastolic dysfunction of both ventricles of the heart in MPS. We have not come across such works in the domestic literature.

Purpose of the study: To assess the nature of cardiac remodeling in arterial hypertension, its prognostic value for determining individual cardiovascular risk and optimizing patient treatment tactics using a complex echocardiographic research method.

Research methods. The paper presents the diagnostic capabilities of modern echocardiographic methods in the study of the structural and functional state of the right ventricle, various methods for calculating the pressure in the

pulmonary artery, as well as the standard indicators according to the latest recommendations of the European and American Echocardiographic Societies. An algorithm for examining patients with different degrees of pulmonary hypertension, including the use of new echocardiographic technologies, is proposed.

Research results. An easy way to diagnose pancreatic dilatation is qualitative or visual assessment. For this, a visual assessment of the RV size in relation to the size of the left ventricle (LV) is performed from the apical four-chamber position. Normally, the RV is less than the LV and is no more than 2/3 of its size. With moderate dilation of the RV, its size is comparable to the size of the LV and, along with the LV, is involved in the formation of the apex of the heart. With the progression of RV dilatation, its predominance is noted, and the apex of the heart is formed by the RV.

Examination from the apical four-chamber position is used to determine the linear dimensions of the RV and its end-diastolic area.

To diagnose dilatation of the outflow tract of the pancreas (RVD), the trunk and branches of the PA, measurements are taken from the parasternal access, along the short axis, at the level of the aortic root.

With a pronounced overload of the pancreas, dyskinesia of the interventricular septum is determined.

Analysis of the movement of the interventricular septum makes it possible to study the interaction between the RV and LV, to assess the systolic overload of the RV. The most accurate analysis of the movement of the interventricular septum can be carried out when examining in M-mode from the parasternal position.

Hemodynamic changes occurring in PH are reflected in changes in the pattern of blood flow in the PA and movement of the posterior cusp of the PA valve, as well as in the formation of pathological pulmonary and tricuspid regurgitation (RH and TR).

The change in the pattern of blood flow in the PA in PH is characterized by a faster formation of the peak of the linear velocity, a shift in the peak of the flow velocity in the first half of the systole, and a decrease in the acceleration time of blood flow (acceleration time - AT).

An AT value of less than 105 ms confirms the presence of LH. On the slope of deceleration of the flow, incision is formed, the deeper it is, the greater the degree of LH.

With echocardiography, the PAP assessment is based on the study of the TR and RH flows. With an increase in PAP, the blood flow from the LA to the RV cavity increases, and pathological RL is formed. The pressure in the RV increases, as a result of which a reverse blood flow from the RV to the RV occurs in the systole, pathological TR is determined

For the diagnosis of PH, in addition to determining PAP, it is important to know the parameters of pulmonary vascular resistance (PVR). Currently, a formula has been proposed for calculating the LSS according to the data obtained by echocardiography: LSS (Wood's unit) = 10 x VTP (m / s) / UT1VTPZh (cm),

where VTI is the integral of the linear flow velocity in the VTPZ, which is measured in the pulsed Doppler scan mode. To obtain blood flow in the outflow tract of the pancreas, the control volume should be placed immediately under the flaps of the LA valve.

The presented formula makes it possible to fairly accurately estimate the PVR, and the accuracy of this method of estimating PVR increases with VTP (m / s) / VT1VTPZH (cm) more than 0.2. With precapillary pulmonary hypertension, the PVR exceeds 3 units. Wood.

Assessment of the functional state of the LV and RV is of great clinical importance. But if well-known traditional approaches are used to characterize LV systolic function, then these approaches are unacceptable for assessing RV systolic function. This is due to the peculiarities of the structure, location in the

chest and visualization of the pancreas during echocardiography. So, most of the RV lies directly behind the sternum, its cavity has an irregular shape, the walls are trabecular, the position inside the chest wall can vary significantly depending on the position of the patient's body.

Assessment of RV systolic and diastolic function

According to current guidelines from the European Society of Cardiology, the American Society of Echocardiography, the Canadian Society of Echocardiography, and the European Association for Echocardiography, RV systolic function can be assessed in several ways.

In contrast to the LV, the greatest contribution to the systolic function of the RV is made by its longitudinal shortening [39]. Therefore, to assess the systolic function of the RV, the most reliable analysis of changes in the RV along its longitudinal axis. One of the simplest and most reproducible methods is to determine the amplitude of movement of the fibrous ring of the MC, which reflects the movement of the base of the pancreas to its apex. Measurement of the systolic excursion of the annulus fibrosus of the TC (TAPSE) is carried out in M-mode, the cursor is positioned in the projection of the annulus fibrosus of the anterior cusp of the TC. The study is recommended to be carried out from the apical four-chamber approach, since when using this approach, the direction of movement of the fibrous ring of the TC is closest to the location of the cursor. The TAPSE norm is> 20 mm. RV systolic dysfunction is reliably indicated by a TAPSE indicator less than 16 mm.

Studies have shown that the TAPSE value correlates with the RV ejection fraction.

The introduction of tissue Doppler study mode made it possible to develop another approach to assessing RV systolic function. It is based on determining the speed of systolic movement of the basal lateral segment of the pancreas (S ').

The study is carried out in the mode of pulsed tissue Doppler scanning, the control volume is placed in the projection of the basal lateral segment of the pancreas, the scanning beam should be directed parallel to the direction of movement of the fibrous ring of the TC. The most suitable for this is scanning from the apical four-chamber approach. For the analysis, the average value is calculated from three measured values of the parameter S 'of different cardiac cycles. This indicator depends on the heart rate (HR), therefore, when HR is <70 or> 100 per 1 min, it is necessary to correct the measured indicator S 'according to the formula.

To assess RV diastolic function, it is recommended to use the pulsed Doppler and tissue pulsed Doppler modes. The following indicators are measured: E / A - the ratio of the maximum speed of the early peak of RV diastolic filling to the maximum speed of transtricuspid flow during atrial systole (pulse Doppler scan mode); E / E 'is the ratio of the maximum speed of the early peak of RV diastolic filling (pulsed Doppler scan mode) to the diastolic movement rate of the fibrous ring of the MC in the phase of early RV relaxation (tissue Doppler scan mode); DT (deceleration time) - the time of blood flow deceleration in the phase of early diastolic filling of the pancreas (pulse Doppler scanning mode). When examining in the mode of pulsed Doppler scanning, the control volume should be located under the flaps of the TC, the scanning beam is directed parallel to the transtricus-distal flow. When examining in the mode of tissue pulsed Doppler scanning, the control volume should be located in the projection of the base of the anterior cusp of the TC, and the scanning beam is directed parallel to the direction of movement of the fibrous ring of the TC. For this, scanning from the apical four-chamber approach is most suitable.

There are the following variants of impaired RV diastolic function: impaired relaxation, pseudonormal and restrictive type of impairment. If relaxation is disturbed, the E / A index is less than 0.8. In a pseudonormal type of disorder, the E / A ratio is in the range from 0.8 to 2.1, and the E / E 'ratio is

more than 6, or there is a predominance of the diastolic component of blood flow in the hepatic veins. In the restrictive type of violation of RV diastolic function, an increase in the E / A index of more than 2.1 and a decrease in DT of less than 120 ms are characteristic.

An integral assessment of the global RV function can be performed in the mode of pulsed or tissue Doppler scanning according to such an indicator as the Tei index (synonym: MPI (myocardial performance index) - myocardial function index), similarly to the study of global LV function. This indicator is a combination of systolic and diastolic parameters. One of the advantages of this approach is that it can be used even with an insufficient ultrasound window. The Tei index is equal to the sum of IVCT (isovolumetric contraction time) and IVRT (isovolumic relaxation time) divided by the ejection time.

Since PH is accompanied by an increase in IVCT and IVRT and a decrease in ejection time, the Tei index increases. Since the measured time intervals depend on the heart rate, then when the heart rate is <70 or> 100 in 1 min, it is necessary to correct the Tei index according to the formula:

Normally, the average Tei index is 0.28 for pulsed Doppler scanning and 0.39 for tissue pulsed Doppler scanning. In PH, an increase in Tei index with pulsed Doppler scanning more than 0.40 and with tissue pulsed Doppler scanning more than 0.55 indicates a violation of the global RV function.

New echocardiography technologies are not routine methods at present. Many of them are at the development stage and due to the lack of clinical data, the proper values have not yet been determined, therefore they cannot be included in the generally accepted EchoCG protocol.

An important area of modern research is the measurement of the volume and ejection fraction of the pancreas using three-dimensional echocardiography. A clear correlation was found between the RV volume, measured by three-dimensional echocardiography, and the RV volume, determined by magnetic resonance imaging. Compared with two-dimensional echocardiography,

underestimation of the RV volume with three-dimensional echocardiography is less pronounced. However, the lack of the obtained data for the systematization of the research results is that in different studies different methods of three-dimensional echocardiography were used, therefore, currently there are not enough studies to determine the standard values.

The role of stress echocardiography in the diagnosis of PH remains controversial. First, there is no consensus on the methodology and protocol of the stress test. Secondly, there are many important limitations on the assessment and interpretation of Doppler data obtained during exercise testing.

The strain and strain rate techniques make it possible to study the deformation and strain rate of myocardial segments, but at present they are also not included in the standard research protocol, since the studied parameters have high variability and insufficient reproducibility and, therefore, the boundaries of their proper values have not been developed. Despite the limitations of these techniques, research is ongoing on the dataset. In a study by A. Sachdev et al. it was demonstrated that systolic deformity and the rate of pancreatic deformity can serve as parameters for predicting mortality in patients.

Speckle Tracking Imaging technology, being angle-independent, allows for the movement of granular structures of the myocardium on a standard gray-scale image in B-mode to obtain data on the speed of movement and deformation of various parts of the myocardium in the longitudinal and radial directions (2D-strain).

Such a factor as the insufficient number of studies carried out limits the application of this method in clinical practice, however, data have been obtained on a high correlation of deformity indicators with TAPSE values, as well as their higher sensitivity and specificity compared to tissue Doppler sonography, which indicates the need to continue study of the specified method.

Conclusions. In conclusion, it should be noted that of the numerous parameters measured by echocardiography, a number of indicators are especially clinically

important, since they have prognostic value. In the conducted studies, it was found that the likelihood of an unfavorable clinical outcome increases when pericardial effusion is detected, with an increase in the severity of PN dilatation (S more than 27 cm2). Factors of an unfavorable prognosis are also an increase in the Tei RV index of more than 0.88, a decrease in the TAPSE index of less than 15 mm.

Thus, echocardiography is an integral part of the study algorithm for patients with suspected PH. Despite the difficulties that the researcher may face, the limitations of this method, it is impossible to imagine a plan for the diagnostic search and follow-up of patients with PH without echocardiography, since the important advantages of the latter are non-invasiveness and informational content. In addition, the improvement of ultrasound technology contributes to improving the quality and expanding the capabilities of echocardiography.

Summing up, it should be noted that all data obtained using echocardiography should be evaluated in conjunction with the clinical picture. Only a comprehensive and comprehensive analysis of clinical, instrumental and laboratory data will make it possible to make the correct diagnosis, assess the severity of disorders and determine the prognosis of the disease. All the information received is extremely important and necessary for the choice of treatment tactics. Only this approach can allow obtaining the optimal effect of therapeutic and diagnostic measures.

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