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Original article

Echocardiographic Society of Serbia (ECHOS) survey on the use of echocardiography in pulmonary hypertension

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Abstract

Introduction. Pulmonary hypertension (PH) is a chronic progressive disease affecting about 1% of the world population. The Echocardiographic Society of Serbia (ECHOS) conducted a national survey to assess the use of echocardiographic parameters for non-invasive assessment of the likelihood of PH and its early detection in real-life practice.

Methods. The survey consisted of 23 questions on demographics, routine assessment of right heart morphology and function, echocardiographic parameters used to screen for PH and report writing standards. The survey was sent as an online questionnaire by email to all members of ECHOS.

Results. A total of 150 (22.7%) members responded to the survey. Echocardiographic examinations are most commonly performed by cardiologists (51%) with more than 10 years of experience in echocardiography (46%). More than half of the survey participants (55%) routinely assess right ventricular (RV) function and morphology. Echocardiographic parameters used to assess PH such as RV outflow tract flow profile and pulmonary artery diameter are routinely assessed by half of the respondents, while other parameters such as right atrial area are less commonly evaluated (23%). Systolic RV function is routinely assessed by the majority of respondents (90%), as is systolic RV pressure (97%). In patients with pulmonary thromboembolism, an echocardiographic examination is performed routinely during hospitalisation (95%). When screening for PH, all respondents assess left ventricular function. Most survey respondents consider routine assessment of RV parameters to be clinically important and believe that targeted echocardiographic courses are required to improve PH screening (96%).

Conclusion. This survey highlights the lack of standardised echocardiographic assessments in screening for PH among ECHOS members. There is a need for targeted echocardiographic education that would improve routine echocardiographic practise in assessing right heart function and the likelihood of PH.

Kew words Echocardiographic Society of Serbia, ECHOS, pulmonary hypertension, survey

Introduction

Pulmonary hypertension (PH) is a chronic progressive disease affecting approximately 1% of the world population[1] The estimated time from onset of symptoms to PH diagnosis is > 2 years.[2] Because of the high morbidity and mortality, early detection and referral to a PH centre is critical. PH is invasively defined by right heart catheterization (RHC) as mean pulmonary artery pressure (mPAP) > 20 mmHg at rest.[2] However, echocardiography plays an essential role in the detection and follow-up of patients with PH. It provides a comprehensive assessment of hemodynamic parameters and right ventricular (RV) function, which in turn allows echocardiographic estimation of PH probability. The key parameter for assessing the likelihood of PH is elevated systolic pulmonary artery pressure (sPAP), estimated by measuring peak tricuspid regurgitation (TR) velocity. Other parameters of RV function and morphology are also used to assign PH probability (low, intermediate, high). These parameters include: enlargement of the right ventricle and atrium, flattening of the interventricular septum (IVS), indices of RV systolic function, including tricuspid annular plane systolic excursion (TAPSE), RV fractional area change (FAC), tricuspid annular velocity (S' wave), RV free-wall strain, RV ejection fraction (RVEF) derived from 3D echocardiography, as well as RV outflow tract Doppler profile (midsystolic

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Table 1. Characteristics of survey participants

Age	Number (%)
< 35 years	30 (20%)
35-50 years	63 (42%)
>50 years	57 (38%)
Experience in echocardiography	
< 5 years	56 (37%)
5-10 years	25 (17%)
> 10 years	69 (46%)
Level of training/specialty	
Cardiologist	76 (51%)
Internal Medicine specialist	44 (29%)
Resident	27 (18%)
Pulmologist	1 (0.7%)
Pediatric cardiologist	1 (0.7%)
Medical doctor	1 (0.7%)
Affiliation	
Primary Care Centre	14 (9%)
Secondary Care Centre	36 (24%)
Tertiary Care Centre	85 (57%)
Private Practice	15 (10%)

Table 2. Echocardiographic assessments

RV morphology and function	
Routinely	83 (55%)
Only when referred for RV assessment	1 (1%)
Only in decompensated heart failure	10 (7%)
Only when suspected of RV dysfunction by initial echocardiographic view	56 (37%)
Pulmonary artery diameter	
Routinely	83 (55%)
Only in suspected PH	43 (29%)
Never	24 (16%)
RVOT flow profile assessment	
Routinely	86 (57%)
Only in suspected PH	43 (29%)
Never	21 (14%)
RV free-wall diameter	
Routinely	26 (17%)
Only in suspected PH	94 (63%)
Never	30 (20%)
RV diameter	
Routinely	119 (79%)
Only in suspected PH	23 (15%)
Never	8 (5%)
RA area	
Routinely	35 (23%)
Only in suspected PH	57 (38%)
Never	58 (39%)
Agitated saline contrast use in enlarged RV	
Routinely	12 (8%)
Only in suspected PH	63 (42%)
Never	75 (50%)

PH ,pulmonary hypertension; RA, right atrium; RV, right ventricle; RVOT, right ventricular outflow tract

"notching", decreased pulmonary ejection acceleration time), pulmonary artery diameter (PA), inferior vena cava (IVC) diameter and inspiratory collapsibility, and a recently introduced parameter TAPSE/sPAP, which is a non-invasive measure of RV-PA coupling.[2]

PH is classified into 5 groups (Group 1: pulmonary arterial hypertension, Group 2: PH associated with left heart disease, Group 3: PH associated with lung diseases and/or hypoxia, Group 4: PH associated with pulmonary artery obstruction (including chronic thromboembolic PH (CTEPH)), Group 5: PH with unclear and/or multifactorial mechanisms).[2] As left heart disease is the most common cause of PH, it is important to assess left-sided valvular heart disease and left ventricular (LV) systolic and diastolic function.

The Echocardiographic Society of Serbia (ECHOS) conducted a nationwide survey to assess the use of echocardiographic parameters for non-invasive assessment of the likelihood of PH and its early detection in real life clinical practice. The goal of the survey is to determine the degree of use of current recommendations for echocardiographic detection of PH.

Methods

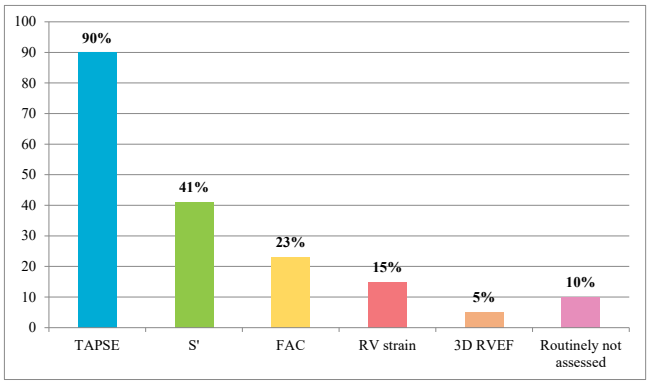
The survey was designed by ECHOS Research Committee as an online questionnaire that was sent to all members of ECHOS by email. All members (660 at the time of the survey) were invited to complete an online questionnaire anonymously by selecting one or more answers to each question. The survey was conducted from May 4 to June 4, 2023, and included 23 questions on demographics, routine assessment of right heart morphology and function, echocardiographic parameters used for screening at PH, and report writing standards. Questions were based on current European Society of Cardiology (ESC) and European Association of Cardiovascular Imaging (EACVI) guidelines and related to the use of echocardiographic parameters in the assessment of PH. All respondents agreed that the obtained data could be used for academic purposes and for scientific publications.

Results

A total of 150 (22.7%) members of ECHOS participated in the survey (Table 1). Most respondents were over 35 years of age (80%) and had more than 10 years of experience in echocardiography (46%). Echocardiographic examinations were predominantly performed by cardiologists (51%) who were from tertiary care centres (57%). Most survey participants consider routine assessment of RV parameters to be clinically important and believe that targeted echocardiographic courses are necessary for PH screening (96%).

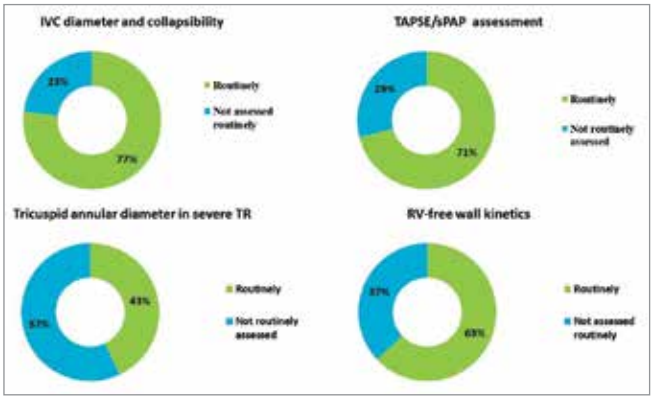
The function and morphology of the RV was routinely assessed in only 55% of cases (Table 2). The RV systolic function is most commonly assessed with TAPSE, followed by tricuspid S' velocity and FAC (Figure 1). Most reports (79%) routinely include RV diameter. More than one-third of survey respondents (39%) never report

Figure 1. Percentual use of echocardiographic parameters in assessment of right ventricular systolic function



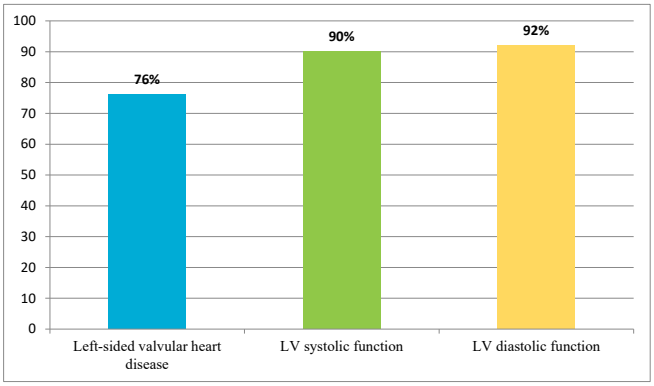
3D, three dimensional; FAC, fractional area change; RV, right ventricular; RVEF, right ventricular ejection fraction; S', peak systolic tricuspid annular velocity; TAPSE, tricuspid annular plane systolic excursion

Figure 3. Routine assessment of echocardiographic parameters



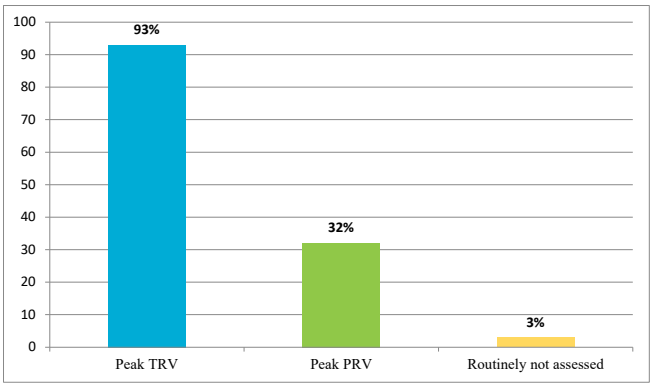
IVC, inferior vena cava; RV, right ventricle; sPAP, systolic pulmonary artery pressure; TAPSE, tricuspid annular plane systolic excursion; TR, tricuspid regurgitation

Figure 5. Left ventricular (LV) echocardiographic parameters assessment when evaluating pulmonary hypertension probability



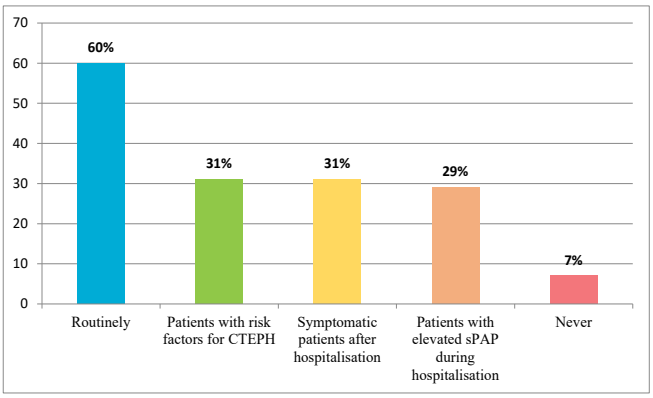
right atrial area (RAA) area, and almost as many respondents (38%) report it only when PH is suspected. RV free wall motion is not routinely assessed in 37% of cases. Half of the respondents never perform agitated saline contrast in the presence of an enlarged RV. Pulmonary artery diameter and flow profile are routinely assessed in 55% and 57%, respectively (Table 2).

Figure 2. Percentual echocardiographic assessment of systolic pulmonary artery pressure



PRV, pulmonary regurgitation velocity; TRV, tricuspid regurgitation velocity

Figure 4. Echocardiographic follow-up of patients 3-6 months after hospitalisation for pulmonary thromboembolism



CTEPH, chronic thromboembolic pulmonary hypertension; sPAP, systolic pulmonary artery pressure

Further, systolic PA pressure is usually calculated by measuring maximum tricuspid regurgitation velocity (93%) (Figure 2). RV-PA 'Coupling' (TAPSE/sPAP) is estimated by only 27% of respondents. RV wall thickness is most commonly measured when PH is suspected (63%). About half of the respondents report the phase of cardiac cycle (systole or diastole) when they observe a flattened interventricular septum (55%). Inferior vena cava diameter and inspiratory collapsibility is routinely assessed in 77% of participants (Figure 3).

In addition, almost all routinely perform an echocardiographic examination during hospitalisation for pulmonary embolism (PE) (95%). There are different standard protocols for follow-up for CTEPH in patients after acute PE (Figure 4).

Finally, all respondents assess left ventricular function in the PH probability assessment, while the assessment of LV function is not standardised (Figure 5).

Discussion

This is the first survey on the use of echocardiographic parameters in assessing the likelihood of PH in Serbia. The aim of this survey was to assess the implementation of the new ESC guidelines for PH detection and follow-up in our echocardiographic community.

PH probability

Increased PA pressure over time leads to RV overload and dysfunction, which can be detected by echocardiography[3-5]. However, echocardiography is not sufficient to diagnose PH, but only to assess the likelihood of PH and thus indicate the need for RHC. There is no single echocardiographic parameter that is sufficient to conclude PH. Therefore, it is necessary to perform a comprehensive echocardiographic exam to assess systolic pressure PA and additional signs suggestive of PH: increased RV diameter, RA area, IVS flattening, distended IVC with decreased inspiratory collapsibility, shortened RV outflow tract acceleration time of pulmonary ejection, decreased RV systolic function and the presence of pericardial effusion.[2]

This survey showed that routine assessment of RV function and morphology was suboptimal (45%), especially considering that most respondents were cardiologists with more than 10 years of echocardiographic experience working in tertiary centres. sPAP is most commonly assessed by measuring peak TR velocity or by measuring peak pulmonary regurgitation velocity if TR is not available. This is in line with the guidelines, which state that TR velocity above 2.8 m/s implies a PH probability. However, almost a quarter of respondents does not usually estimate IVC diameter and inspiratory collapsibility, i.e. right atrial pressure, which is important for accurate estimation of sPAP. According to the guidelines, the degree of echocardiographic PH likelihood can be altered if additional indices from at least two of three categories are present (LV and RV relationship parameters, PA parameters and IVC and RA parameters). Therefore, the assessment of additional echocardiographic signs can be crucial. Furthermore, standard and advanced echocardiographic parameters of RV structure, function and haemodynamics correlate with functional status and natriuretic peptide levels and may be useful for follow-up in patients with precapillary PH.[6]

CTEPH

Echocardiography is indicated for risk stratification of patients with acute pulmonary embolism (PE).[7] It can provide information about RV overload, the presence of right-to-left shunts, patent foramen ovale and right ventricular thrombi, which are associated with increased mortality. The survey found that almost all respondents regularly performed an echocardiographic examination in patients with acute PE. However, there were significant differences regarding the echocardiographic follow-up of these patients (Figure 4). According to the guidelines,[2] echocardiographic follow-up is indicated in patients who have persistent dyspnoea or functional limitations after the acute PE and in asymptomatic patients with risk factors for CTEPH (recurrent PE or deep vein thrombosis, echocardiographic signs of RV overload during acute PE, persistent perfusion defects, permanent intravascular devices, thrombophilic disorders, malignancy) or a high CTEPH prediction score.[8]

Advanced echocardiographic techniques

The survey results show that RV systolic function is most commonly assessed with standard transthoracic echocardiography, while advanced echocardiographic techniques, such as RV strain and three-dimensional RVEF were less commonly used. This is in line with the previous ECHOS survey of echocardiographic practise in Serbia, which showed low availability of advanced echocardiographic techniques (speckle tracking strain echocardiography and three-dimensional echocardiography, 19% and 11%, respectively.[9] However, it should be emphasised that it has been suggested that speckle-tracking strain and three-dimensional echocardiographic indices might perform better than conventional echocardiographic parameters in assessing regional and global RV dysfunction in patients with PH.[10] In addition, 3D RV strain and 3D RV EF were found to be independent predictors of mortality in PH patients.[10]

RV-PA coupling

RV-PA coupling reflects the relationship of RV contractility and RV afterload. With increased PA pressure and increased RV afterload, RV contractility increases through hypertrophy and RV remodelling as an adaptive response.[11] Because RV-PA is an invasive parameter measured during RHC, several non-invasive surrogate parameters have been proposed.[12] The new guidelines introduced the TAPSE/sPAP ratio as a non-invasive measure of RV-PA coupling.[2] In our survey, only 29% of respondents rated this parameter. This is probably due to the fact that TAPSE/sPAP has only recently been introduced and it takes time to be fully implemented in clinical practice.

Conclusions

This is the first national survey of echocardiographic assessment of the likelihood of PH and its early detection. The survey revealed a lack of standardised echocardiographic assessments when screening for PH. There is a need for targeted echocardiography courses that would improve routine echocardiographic practice in assessing right heart function and evaluating the likelihood of PH to promote early treatment and management of PH.

Conflict of interest: None to declare.

References

1. Hoeper MM, Humbert M, Souza R, et al. A global view of pulmonary hypertension. Lancet Respir Med 2016; 4: 306–322.
2. Humbert M, et al. ESC/ERS Scientific Document Group. 2022 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension. Eur Heart J 2022;43(38):3618-3731.
3. Rudski LG, Lai WW, Afilalo J, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. J Am Soc Echocardiogr 2010;23:685–713.
4. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the

European Association of Cardiovascular Imaging. Eur Heart J Cardiovasc Imaging 2015;16:233–270.
5. Galderisi M, Cosyns B, Edvardsen T, et al. Standardization of adult transthoracic echocardiography reporting in agreement with recent chamber quantification, diastolic function, and heart valve disease recommendations: an expert consensus document of the European Association of Cardiovascular Imaging. Eur Heart J Cardiovasc Imaging 2017;18:1301–1310.
6. Stanković I, Grujičić K, Cerović M, et al. The relationship between functional status, natriuretic peptide levels and echocardiographic parameters in patients with precapillary pulmonary hypertension. Medicinska istaživanja 2023; 56(2): 69-78.
7. Konstantinides SV, et al. ESC Scientific Document Group. 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS). Eur Heart J. 2020;41(4):543-603.
8. Klok FA, Dzikowska-Diduch O, Kostrubiec M, et al. Derivation of a clinical prediction score for chronic thromboembolic pulmonary hypertension after acute pulmonary embolism. J Thromb Haemost 2016; 14: 121–128.
9. Stefanović M, Krljanac G, Mladenović Z, et al. Current echocardiography practice in Serbia - a national survey by the Echocardiographic Society of Serbia. Srp Arh Celok Lek 2020; 148 (7-8): 430-435.
10. Vitarelli A, Mangieri E, Terzano C, et al. Three-dimensional echocardiography and 2D-3D speckle-tracking imaging in chronic pulmonary hypertension: diagnostic accuracy in detecting hemodynamic signs of right ventricular (RV) failure. J Am Heart Assoc 2015;4(3):e001584.
11. Todaro MC, Carerj S, Zito C, et al. Echocardiographic evaluation of right ventricular-arterial coupling in pulmonary hypertension. Am J Cardiovasc Dis 2020;10(4):272-283.
12. Tello K, Wan J, Dalmer A, et al. Validation of the tricuspid annular plane systolic excursion/systolic pulmonary artery pressure ratio for the assessment of right ventricular-arterial coupling in severe pulmonary hypertension. Circ Cardiovasc Imaging 2019;12:e009047.

Sažetak

Istraživanje Ehokardiografskog društva Srbije (ECHOS) o primeni ehokardiografije kod plućne hipertenzije

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Uvod. *Plućna hipertenzija (PH) je progresivna hronična bolest koja pogađa oko 1% globalne populacije. Ehokardiografsko udruženje Srbije (ECHOS) je sprovelo nacionalnu anketu sa ciljem da se ispita način procene ehokardiografskih parametara koji su ključni za neinvazivno određivanje verovatnoće PH i njeno rano prepoznavanje u svakodnevnoj praksi.*

Metode. *Anketa sastavljena od 23 pitanja o demografskim podacima, rutinskoj proceni funkcije i morfologije desnog srca, ehokardiografskim parametrima kod sumnje na PH i standardima pisanja izveštaja, poslata je elektronskom poštom svim ECHOS članovima.*

Rezultati. *Anketu je popunilo 150 članova (22.7%). Ehokardiografske preglede najčešće obavljaju kardiolozi (51%) sa preko 10 godina iskustva (46%). Oko polovine anketiranih članova (55%) rutinski procenjuje funkciju i morfologiju desne komore (DK). Parametre procene postojanja PH, kao šte su profil protoka u izlaznom traktu DK, dijametar plućne arterije, rutinski se procenjuju u oko polovini slučajeva, dok se pojedini parametri kao što je površina desne pretkomore rutinski procenjuju ređe (23%). Sistolna funkcija DK rutinski se procenjuje u većini slučajeva (90%), kao i sistolni pritisak u DK (97%). Rutinski ehokardiografski pregled kod pacijenata sa dokazanom plućnom tromboembolijom se radi tokom iste hospitalizacije (95%). Kod sumnje na postojanje PH, svi anketirani članovi procenjuju funkciju levog srca. Većina smatra da je rutinska procena parametara DK važna u kliničkoj praksi i da su potrebni fokusirani kursevi iz ehokardiografije u prepoznavanju PH (96%).*

Zaključak. *Anketa ukazuje na suboptimalnu primenu ehokardiografskih parametara i tehnika u rutinskoj praksi u cilju prepoznavanja PH. Postoji potreba za fokusiranim ehokardiografskim edukacijama u cilju unapređivanja ehokardiografske prakse u proceni funkcije desnog srca i verovatnoće postojanja PH.*

Ključne reči: *Ehokardiografsko udruženje Srbije, ECHOS, plućna hipertenzija, anketa*