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Right Ventricular Outflow Doppler Envelope: Insight into Pulmonary Artery Disease Severity in Two Cardiac Centers in Baghdad

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ABSTRACT

Background: Pulmonary artery hypertension is described as a group of diseases characterized by a progressive increase in pulmonary vascular load resulting in a marked increase in pulmonary artery pressure (PAP). While the reference approach and "gold standard" for quantifying pulmonary artery, pressure is direct pressure measurement with proper cardiac catheterization. Additionally, echocardiography provides the advantage of non-invasively and precision and is widely used to measure systolic pulmonary artery strain.

Objective: Determine the importance of precise Doppler ventricular outflow signals to determine the extent of pulmonary hypertension.

Patients and Methods: From September 2018 to August 2019 we have conducted a cross-sectional descriptive study of 127 patients with a Tricuspid regurgitation pressure gradient greater than 33 mmhg, all of which is right-hand-ventricular, Doppler, which has been performed in hospital and Iraqi cardiovasculatory centre. Patients involved have been confirmed by electrocardiography (ECG) in normal sinus rhythm.

Results: Of the 127 patients, RVOT Spectral Doppler signals were calculated and showed 4 complex patterns; PASP was significantly associated with these different forms of RVOT Doppler Spectral Signals. Both TR pressure gradients (PG) and PASP increased significantly from group I to IV with a p value of approximately 0.05, mean pulmonary PASP was 32.92 in pattern I, 56.07 in pattern II, 73.65 in pattern III and 113.45 in pattern IV, mean TR PG was 27.57 in pattern I, 47.28 in pattern II, 64.32 in pattern III and 102.27 in pattern IV. Alternatively, the integral time of right ventricular outflow (VTI) Acceleration Time (ACT), 'pulmonary vascular resistance' (PVR) showed a significant correlation with the four right ventricular outflow patterns of Doppler with a p-value of 0.05.

Conclusion: These basic measures of the right ventricular outflow Doppler profile can also be used to evaluate patients with pulmonary artery hypertension.

Keywords: Transthoracic Echocardiography, Right Ventricle Outflow Envelop, Pulmonary Artery Hypertension, Acceleration Time.

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INTRODUCTION

Pulmonary hypertension is defined as a mean pulmonary artery pressure greater than 25 mm Hg, which is typically correlated with a systolic pressure greater than 40 mm Hg in the pulmonary arteries. (1,2) PH is considered mild if the PASP(Pulmonary artery systolic pressure) is calculated to be 35 to 45 mm Hg, moderate if 46 to 60 mm Hg, and extreme if > 60 mm Hg.(3) Recent data do not support the definition of PH for exercise as the mean PAP 30 mmHg as measured by correct cardiac catheterization (RHC) and healthy individuals may achieve much higher values. (.4) Transthoracic echocardiography remains an easily accessible and useful non-invasive process. Which should only be used in cases where PH is suspected or confirmed (5) The increase in SPAP has a negative effect on survival. (6) Best validated Doppler parameters for the assessment of systolic RV pressure in daily practice [equal to systolic pulmonary arterial pressure (SPAP) in the absence of pulmonary flow obstruction] Apply the modified Bernoulli equation for the calculation of tricuspid regurgitation velocity. (7) RV is the primary anatomical and physiological interface between the RV and the pulmonary vasculature. The Doppler pulsed-wave RV outflow velocity curve offers a wealth of physiological knowledge on RV and pulmonary vascular activity. This method is relatively easy to conduct and easily reproducible; and, unlike TR-based pressure estimates, RVOT Doppler recordings are available in virtually all patients.(8) The "notched" Doppler signal strongly indicates increased pulmonary vascular resistance and decreased vascular compliance.

Aim of Study

To explain how variations in the right ventricular outflow system Doppler signals may be useful in assessing the gradation of pulmonary hypertension severity.

PATIENTS & METHODS

From September 2018 to August 2019, a cross-sectional descriptive analysis was carried out at the Baghdad University Hospital and the Iraqi Heart Disease Center: absolute echocardiography, 'including' pulsed 'Doppler' spectral signals' around the RVOT,' discernible 'tricuspid' regurgitation' (Tricuspid Regurgitation Pressure Gradient greater than 33mmhg), high boundary resolution of both right and right. Exclusion criteria: cardiac arrhythmia occurred at the time of the study., none of. The Committee was approved, all patients included in this survey obtained writte approval and personal and clinical data, including names, age, gender, address, medical and surgical history and past surgery history (Research designs), were collected and the information was collected. The Committee on Institutional Ethics was approved.

Digitally sensitive 2-dimensional echocardiograms Photos (Philips CX 50) with a 1.5/3.1 MHz phased array transducer are the objects of echocardiographic research. Measured parameters: 1. PG (mmHg) and PR-velocity 2. Through PASP (mmHg) 3. Mean PAP (mmHg) level 4. 4. Complete speed RVOT VTI (cm) 5. Rate(s) 6. Max(cm/s). ACT(s) (speeds of acceleration)7. ET(ms)(jection time) 8. PVR (wood) testing was conducted in accordance with the American Society of Recommendations on Echocardiography.(10) The left portion of the ventricular ejection was the measured use of the Simpson Measure. Absolute tricuspid annulus excursion was used to test global systolic RV function.(11,12) Doppler pulsed wave was used to avoid high lungs velocity cases as an alternative to Doppler continuous wave. Secundary values were obtained by tracing the pulmonary acid The waveform study was performed without knowledge of the pulmonary artery strain.(13) (TSS), which was obtained in order to more reliably analyze the signals.(VTI) values were obtained by tracing the pulmonary acid. It should be remembered that PH patients may have different RVOT patterns; For this study, we selected the best average PASP based on a Doppler interrogatory echocardiographic analysis and the worst RVOT sequence. So, the average speed of the Tricuspid regeneration is not only measured, it is appropriate to test the 'Doppler over' pulsed RVOT signals over many cardiac cycles. For the treatment of systolic pulmonary hypertension, a minimum value of 40 mmHg and above is considered. Mean pulmonary artery pressure (MPAP) = 0.61 SPAP + 2 mmHg (8)'pulmonary vascular resistance' was measured using the following 'equation: pulmonary vascular resistance' = tricuspid valve regurgitation divided by right ventricular outlet velocity. (7)

Statistical Analysis

All data has been coded and uploaded to the machine using the Social Sciences Statistical Suite (SPSS). Data Overview Use No, Percent and Mean + /-SD. Difference between the variables evaluated by the variance analysis (ANOVA) and the chi square test t. P<0.05 was considered to be an important amount.

RESULTS

The study included 127 patients, 72 females were 72(56%) and males were 55 (44%), mean age was 47.87±16.78 years with a range between 2--95 years. Table 1 show the demographic data of the studied group, mean TR PG 53.38±24.94 mmHg and ranged from 33 to 130 mmHg. Mean PASP was 55.09±26.72 mmHg ranging from 40 to 140 mmHg. About mPAP mmHg, mean was 40.99±16.05 and range from 25.37 to 87.40. While mean VTI was 16.25±5.55 with minimum range of 4.3 and upper range of 38 cm. We found that mean peak RVOT velocity was 85.81± 25.59 ranging from 38 to 207 cm/s. Regarding the ACT, mean was 90.03±32.40 ms; the lowest duration was 33 ms and the highest was 169 ms. About the ET and ACT/ ET, their means were 271.35±52.33 and 0.33±0.10 ranging from 122 to 459 ms and 0.13 to 0.62 respectively.

Table 1: Demographic data of the studied group

Variables	No	Minimum	Maximum	Mean	Std. Deviation
Age years	127	2	95	47.87	16.78
TR PG mmHg	127	33	130	53.38	17.94
PASP mmHg	127	40	140	55.09	26.72
mPAP mmHg	127	25.37	87.40	40.99	16.05
VTI cm	127	4.3	38.0	16.25	5.55
Peak RVOT velocity cm /s	127	38.00	207.00	85.81	25.59
ACT ms	127	33.00	169.00	90.03	32.40
ET ms	127	122.00	459.00	271.35	52.33
ACT/ ET	127	0.13	0.62	0.33	0.10
PVR Wood	127	0.99	10.56	2.60	1.49

We found that 'visual inspection' of all 127 'RVOT Doppler' spectral signals' in Figure 1 showed '4' dynamic pattern shapes. Due to the early systolic peak, Pattern II had a three-way contour accompanied by a long slowing time (Figure 1B), Pattern III' and 'IV are identical to Pattern 2, except that Pattern III had a mid-systemic knot (Figure 1C), and Pattern IV significantly decreased signal volume as shown in Figure 1D. Pattern I 'was defined as the parabolic contours of the ejectionvelocity envelope (Figure IA);

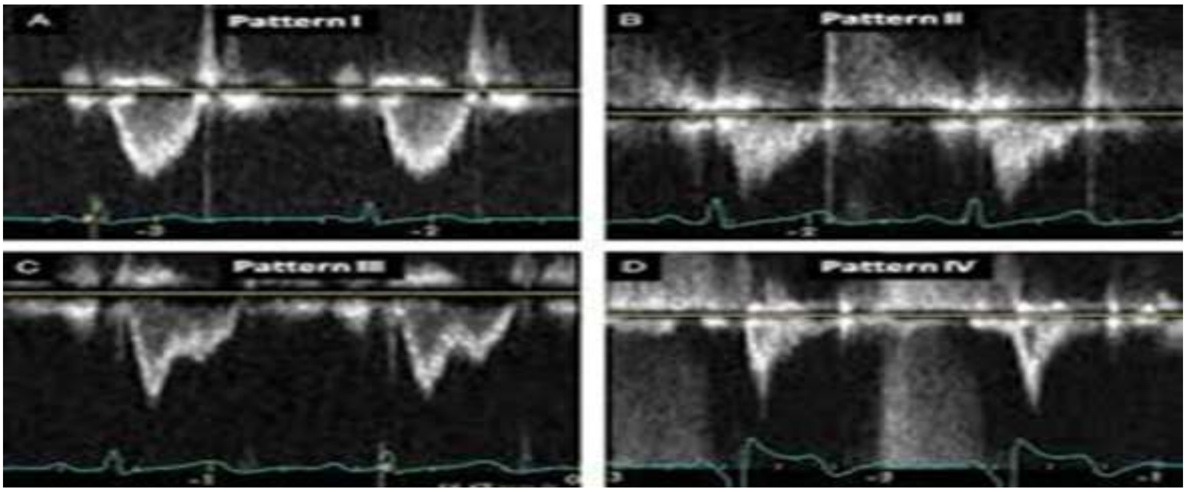

Figure 1: **Visual inspection of RVOT envelop shapes by pulsed doppler**

Doppler and the echocardiography data of the studied population are divided into four groups by their spectral Doppler ventricular outflow pattern. Both TR PG and PASP increased significantly from pattern I to IV with p value < 0.05, mean PASP was 41.92±11.11±11.11 in pattern I, 56.07±6.23 in pattern II, 73.65±11.79 in pattern III and 113.45±16.64 in pattern IV and mean TR PG was 27.57±10.63 in pattern I 47.28±6.75 in pattern II, 64.32±11.53 in pattern III and 102.27±18.11 in pattern IV. Furthermore mean mPAP recorded significant direct correlation with RVOT envelope pattern, mean mPAP from pattern I to pattern IV was 29±2, 36.20±3.80, 46.92±7.1 and 68.65±13.90, P value <0.05. With regard to the RVOT VTI, its value decreased significantly with Different pattern shapes in which mean VTI 18.16±3.84 in pattern I, 15.65±6.30 in pattern II, 15.30±6.23 in pattern III and 11.59±5.02 in pattern IV, p value <0.05. About the RVOT pulsed peak velocity the was no significant correlation with the shape of RVOT pulsed envelope. When assessing ejection time, it was higher in pattern I than II and higher in pattern III than IV, p value was <0.05. Both ACT, ACT/ET and pulmonary vascular resistance showed significant correlation with different types of RVOT spectral Doppler signals as shown in Table 2 with a p value <0.05

Table 2: **Comparison between different RVOT pulsed envelope patterns according to echocardiographic data**

Variables	Mean ±SD				P value
	Pattern I	Pattern II	Pattern III	Pattern VI	
TR PGmmHg	27.57±10.63	47.28±6.75	64.32±11.53	102.27±18.11	0.0001
PASP mmHg	41.92±11.11	56.07±6.23	73.65±11.79	113.45±16.64	0.0001
Mean PAP mmHg	29±2	36.20±3.80	46.92±7.19	68.65±13.90	0.0001
RVOT VTI cm	18.16±3.84	15.65±6.30	15.30±6.23	11.59±5.02	0.0001
Peak velocity cm/s	85.49±19.41	89.35±34.47	84.61±24.81	85.55±23.36	NS
ACT ms	120.75±25.31	74.41±9.80	68.35±11.55	50.18±11.56	0.0001
ET ms	281.89±42.31	262.52±53.40	285.82±50.51	199.18±39.24	0.003
PVR wood	1.63±.42	2.70±.98	3.12±1.03	5.44±2.51	0.0001
AT/ET	0.42±.06	0.29±.08	0.24±.05	0.26±.08	0.0001

DISCUSSION

Echocardiography remains one of the most effective and commonly available non-invasive imaging tools used in the screening and monitoring of PH patients. In our study, we found that mean TR PG was 53.38, which is more than the upper limit of normal physiological TR PG (<25mmHg); Also mean PASP was 55.09 (normal cut-off value for 40mmHg (1) due to pulmonary hypertension complaints from both patients. Mean ACT was 90 ms, which was lower than average, Guazzi M et al (3) found an ACT of less than 100 ms suggesting a high pulmonary hypertension risk. Mean PVR 2.60 wood was of moderate height, (Wood) regular PVR approximately 1.5 Wood, slightly elevated 1.5–2.49 WU, significantly elevated 2.5–3.49 WU and > 3.5 Wood. (4) It has' been' known for decades that a rounded Configuration or parabola of the RVOT Doppler flow pattern is typically seen in healthy individuals, whereas the triangular flow pattern is commonly seen in PH patients.(16.17) Our results that seem to contradict the research already reported by Arkles(9) and Kitabatake(16). Nevertheless, it is important to differentiate between our study and two of its key differences. Second, our data collection for Kitabatake et al.(16) was considerably higher. Second, our study reported significantly higher pulmonary stress rates. In' the case' of party'Arkles(9), These researchers 'divided the population' into three' groups of 33' + 1, 46' + 12 and 50 + 9mmHg respectively' with corresponding mean pulmonary pressure; mean pumonic artery pressure was 29±2, 36,20±3,80, 46,92±7,19 and 68,65±13,90mmHg respectively in the four groups analyzed using Chemla Formula(54). Our research is in agreement with Lo 'pez A and Edelman K(19) 22 + 5, 38 + 4, 49 + 6,, and 70 + 11 mmHg in which four patterns with identical data shown in each pattern were observed.

Various potential 'mechanisms' have been suggested to explain 'changes in the flow structure due to PH, including rapid acceleration of the pulmonary artery flow due to proper ventricular pressure' overload; decreased 'capacity and increased impedance' of the pulmonary vascular artery; it is clear that none of these variables may occur in isolation; but, due to their interdependence, interactive.

With respect to the RVOT VTI, it was substantially associated with various RVOT envelope trends and inversely related to the p value 0.05. 18.16±3.84 in pattern I, to be 15.65±6.30 in pattern II, 15.30±6.23 in pattern 3 and 11.59±5.02 in pattern IV, consistent with Lo' pez A and Edelman K(19) in pattern I and II, 15+4, 10+2 in pattern III and IV respectively, respectively. ACT reaches 140 milliseconds in normal people, and shortens slowly with increasing degrees of pulmonary hypertension. The shorter the acceleration time, the greater the pressure on the pulmonary artery. Some studies have indicated that at an ACT of less than 70 to 90 milliseconds, PASP would reach 70 mm Hg.(20) Early research from Kitabatake et al study (41) offers an approximation of mPAP's time to peak velocity, or ACT, of the RV outflow velocity curve. A mean ACT In subjects with a mean PA pressure of 19 mm Hg or less, 137±24 ms were observed as ACTs of 97±20 ms and 65±14 ms, respectively, in patients with 20 to 39 mm Hg and 40 mm Hg or more. We observed in our analysis that ACT slowly decreases from pattern I to pattern IV with major correlation. Arkles S (44) et al. Found that the mean ACT was 113±29 in no notch pattern and 67±21, ACT was 114.9±22.9 in round type 72.8±9.9 in notch type as recorded in our study. However, the Doppler index, either ACT or ACT / RVET, measured from the velocity pattern is considered independent of the direction of the beam, as the vector of the ejection flow during systole (19) hardly changes. We're speculating that the 'RVOT' spectral 'Doppler' pattern is produced not only by changes in 'elasticity and impedance' of the pulmonary circulation' but also by 'conforming changes' to the right' atrial 'ventricular' system as a result of the 'PH.'(21,22,23,24).

CONCLUSION

An assessment of RVOT spectral signals reveals four complex patterns that suit the frequency of pulmonary hypertension regardless of the etiology of pulmonary hypertensions. The RVOT Doppler signals in patients with pulmonary hypertension These specific tests should be assessed periodically.

CONFLICT OF INTEREST

None

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