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Echocardiographic Assessment of Pulmonary Hypertension among Sudanese Population

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Abstract:
Background*: Pulmonary arterial hypertension is most often diagnosed in its advanced stages because of the nonspecific nature of early symptoms and signs. Although clinical assessment is essential when evaluating patientswith suspected pulmonary arterial hypertension. This study aimed to assess and evaluate pulmonary artery hypertension in a Sudanese using echocardiogram.*
Materials and Methods*: The methodology based on echocardiogram images for a sample size of three hundred participants 157 males(52.3%), 143 females(47.7%), with age range 20 to 69yearsold their weight between 20-100 Kg, they were investigated by Easote MY LAB 50 echocardiography ultrasound machine applying the ideal positions for adult echocardiogram.*
Results*: this study demonstrated that right ventricle (RV) dimension in age group(40-50 years),included 107 participants between 2-2.5 cm with significant correlation P-value 0.007, the tricuspid regurgitation maximum (TRmax) reported mild were 83.3% of patients, moderate TR max 9.7%, and severe TR max in 21 of patients 7%. There was a significant correlation between TR and weight especially with high weight patients 80-100 Kg, 21 of patients were severe TR and moderate TR was 29 of the patients. So there is significant correlations between them by p-value 0.000.50 of participants had a moderate to severe TR and most common were female by 15, and 19 female out of 50 respectively. Mean and Std. deviation for RV dimension, TRmax, and PASP were 2.29±0.11, 2.80±0.36, 37.4±10.8 respectively.*
Conclusion:*. The study revealed echocardiography provides an estimate of pulmonary artery pressure,. It provides an estimate of pulmonary artery pressure, useful in ruling out secondary causes of PH, valuable in assessing prognosis and treatment options, monitoring the efficacy of specific therapeutic interventions, and detecting the preclinical stages of the disease, more studies with a large population is recommended*
Key Word*: PulmonaryArtery hypertension; Echocardiogram; Tricuspid regurgitation;the right ventricle; pulmonary artery systolic pressure.*

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I. Introduction

Pulmonary hypertension (PH) is a hemodynamic and pathophysiologic condition defined as an increase in mean pulmonary artery pressure (MPAP) of $25 mm at rest as assessed by right-heart catheterization (RHC). It can be found in multiple clinical conditions with distinct pathogenetic and clinical features, such as pulmonary arterial
hypertension (PAH) and left-heart, lung, and thromboembolic diseases. [(1,2)]
Guidelines recommend that a detailed echocardiographic assessment is performed in all patients with suspected PH. Transthoracic echocardiography provides several measures that can be used to estimate right heart hemodynamics. For example, systolic pulmonary artery pressure(Ppa) calculated from the tricuspid regurgitant velocity (TRV) is used to alert suspicion of PH, although Ppa may be underestimated by echocardiography due to an insufficient Doppler envelope or eccentric tricuspid regurgitation jet. No single echocardiographic measure can diagnose PH specifically and isolated abnormalities on echocardiography require cautious interpretation.

Therefore, other surrogate echocardiographic measurements of PH must be examined by echocardiography if PH is suspected. Further assessment of right ventricular (RV) function should be considered when one or more of these abnormalities are identified. [3]

Once PH has been suspected, further evaluation should be undertaken to establish any potential underlying cause. This includes assessment for congenital heart disease (CHD), valvular heart disease (VHD), and left heart disease. These assessments are out of the scope of this protocol, but as the most frequent cause of PH will relate to impaired left ventricular (LV) function, it is imperative to highlight that a detailed assessment of diastolic LV function is undertaken. In our experience, this is something that is often overlooked. This should include measurement of left atrial diameter and volume (indexed for body surface area), LV hypertrophy, transmitral inflow patterns, tissue Doppler imaging of the basal lateral wall of the LV, and, in some cases, pulmonary venous flow. [4]

Echocardiography also provides information about etiology and prognosis in patients with PH. Patients with established PH or high probability for PH should have a full assessment to exclude left-sided heart disease or intracardiac shunts as the cause of PH. Right ventricular dilatation and dysfunction are considered poor prognostic markers in patients with PH. In our study we assess Phi n Sudanese patients using Echocardiogram. [5]

A precise evaluation and assessment of pulmonary pressure are of fundamental importance in the diagnosis and management of patients with pulmonary hypertension (PH). Doppler echocardiography is a low-cost, non-invasive technical method that is widely used for anatomical and functional assessment of the right cardiac chambers and estimation of pulmonary pressure, and the hemodynamic information obtained correlates well with that obtained through cardiac catheterization. Although the most appropriate and common technique for determining pulmonary pressure is a measurement of the gradient between the right ventricle and right atrium through tricuspid regurgitation, it can also be determined by analysis of pulmonary regurgitation or systolic pulmonary artery flow. When transthoracic echocardiography does not provide adequate viewing, transesophageal echocardiography is an excellent choice, allowing for high-quality imaging of cardiac structures and detection of some PAH-related disorders. In the literature, the role of echocardiography in the diagnosis of PAH, as well as in therapeutic tools and prognostic evaluation has been well established. ([6]

II. Material And Methods

This is prospective, descriptive, and analytical study carried out on 300 participants at ultrasound department in Omdurman military hospital from June 2017 to 10 June 2021. The study included 300 Sudanese candidate their ages between (20-69) years. They were deeply investigated by echocardiography

The device used was the Italy ultrasound machine Easote MY LAB 50. (SN 03486 manufacture 2005 modules; Doppler.CFM). An investigation was done on participants by using phased array linear high frequency and convex probe echocardiography with 5 MHZ frequency. Coupling agent ultrasound gel was used as a coupling medium between the probe and the patient's skin.

In this study we measured tricuspid regurgitation velocity (TRV) by continuous wave (CW) Doppler across the tricuspid valve. A TRV equal to <2.8 m/s was considered normal. Right ventricle/left ventricle basal (RV) diameter ratio is >1.0, PA diameter with >25 mm is considered abnormal when pulmonary pressures measured invasively are >25 mmHg. Changes in heart rate have no significant effect on acceleration time so acceleration time of <105 ms is considered a marker of raised pulmonary artery pressure (PAP).

Subjects & selection method:

The first step in assessing the probability of PH by echocardiography is to measure the peak TRV. If this is a good-quality signal and is greater than 3.4 m/s, there is a high probability of PH. If the peak TRV is below 3.4 m/s, we assess the probability of PH in combination with other echocardiographic markers.

The assessment of the probability of PH by echocardiography is just one part of the overall clinical judgment as to the presence of PH in certain patients. Echocardiographic findings should be interpreted alongside other clinical findings to establish the likelihood of PH before confirmatory diagnosis as needed by RHC.

In healthy patients whom with spontaneously breathing cardiac patients, pulmonary artery pressure (PAP) can be accurately estimated from the transthoracic Doppler study of the pulmonary artery and tricuspid regurgitation blood flows. The echocardiographic parameters used for grading the probability of PH showed in the table(1) below. If the TRV is ≤3.4 m/s, then other echocardiographic parameters suggested to assign the probability of PH. These parameters are split into three categories (A: the ventricles; B: the pulmonary artery; C: the IVC and right atrium). Parameters from at least two different categories are needed to determine the probability of PH.

Echocardiography also provides information about the etiology and prognosis in patients with PH. Patients with established PH or high probability for PH should have a full assessment to exclude left-sided heart disease or

intracardiac shunts as the cause of PH. Right ventricular dilatation and dysfunction are considered poor prognostic markers in patients with PH.

Table 1: Echocardiographic signs used to help grade the probability of PH.

A: The ventricles	**B: Pulmonary artery**	**C: Inferior vena cava and right atrium**
Right ventricle/left ventricle basal diameter ratio >1.0	Right ventricular outflow Doppler acceleration time <105 ms and/or mid systolic notching	Inferior vena cava diameter >21 mm with decreased inspiratory collapse (<50% with a sniff or <20% with quiet respiration)
Flattening of the interventricular septum (left ventricular eccentricity index >1.1 in systole or both systole and diastole)	Early diastolic pulmonary regurgitation (PR) velocity >2.2 m/s	Right atrial area (end-systole) >18 cm2
PA diameter >25 mm		

to assess the probability of pulmonary hypertension usingparameters identified from within ≥2 categories (the ventricles,pulmonary artery, or the inferior vena cava and right atrium) inconjunctionwithtricuspidregurgitationvelocity.AdaptedfromESC/ERSGuidelines for the diagnosis and treatment of pulmonary hypertension2015.[7]

Inclusion criteria:

1. Male and female with age between 20-60 years old
2. Randomly male and female their weight is between 20-100 Kg.
3. Patients with signs, symptoms or electrocardiographic or radiographic findings suggestive of pulmonary hypertension
4. Patients with a previous history of angina, severe vascular disease, or another life-threatening disease.

Exclusion criteria:

1. Pregnant women;
2. Patients less than 20 years old or children
3. Physically active patients or fit patients.

Procedure methodology:

As part of a full echocardiographic assessment, Doppler examination should be performed in the following sequence: 1) color Doppler in all apical projections; 2) color Doppler in parasternal projections (long axis/short axis); 3) pulsed-wave Doppler for transmitral velocities; 4) pulsed-wave Doppler for left ventricles (LV) outflow tract; 5) pulsed-wave Doppler for the tricuspid inflow; 6) pulsed-wave Doppler for the RVOT; 7) continuous-wave Doppler across the LV outflow aortic valve; 8) continuous-wave (CW) Doppler across the tricuspid valve (for tricuspid regurgitation); 9) continuous-wave Doppler (WC)across the pulmonary valve (for pulmonary regurgitation); and 10) tissue Doppler imaging (TDI) of the RV free wall.

TR assessment

Peak TR velocity is the key parameter in determining the probability of PH, but the TR signal can be absent in a proportion of patients. The prevalence of TR in patients with a PASP ≥35 mmHg is only 80% but increases to greater than 95% in those with PASP >50 mmHg . If the TR signal is absent, probability estimation should be based on clinical context taking into consideration other concordant clinical and echocardiographic signs of RV pressure overload.In patients with severe TR, TR velocity can be significantly underestimated and cannot be used alone to exclude PH. The severity of the volume of TR is distinct from velocity and the probability of PH in this context should be determined in conjunction with other echocardiographic parameters.

PASP assessment

Color flow Doppler should be used to exclude atrial and ventricular septal defects. Following a thorough clinical review, a bubble study and transoesophageal echocardiogram may be considered to fully exclude cardiac causes of PH, especially in those patients with confirmed PH.

It is recognized that some guidelines use an absolutepulmonary artery systolic pressure (PASP) value to guide the management of patients with PH secondary to left heart disease.PASP >50 mm Hg is considered a class IIa indication for surgery.In this subset of patients, in addition to determining the probability of PH using TR velocity, resting PASP can be estimated by echocardiography using standard methods. [8]

A pulmonary regurgitation (PR) signal is obtained in the parasternal short-axis view using color Doppler. CW Doppler at a sweep speed of 100 mm/s is used to measure the peak PR velocity. Peak pressure difference (measured by the Bernoulli equation) is then added to the RAP. This method has been validated

against gold standard catheter measurements. Mean PAP can be approximated from the peak PR Doppler signal using the following formula: mPAP = 4(PRpeak velocity)^2 + RAP.[9,10]

Mean pulmonary pressure is calculated by the formula: **$mPAP = 90 - (0.62*AT_{RVOT})$**. For example, if the AT_{RVOT} is 80 ms, the mPAP = 90 −(0.62*80), that is 40.4 mmHg (normal < 25 mmHg). On the other hand, if the AT_{RVOT} is 137 ms, then the calculated mPAP is 90 − (0.62*137) = 5.06 mmHg. Images below represent normal sonographic appearance for pulmonary artery by Echocardiogram.

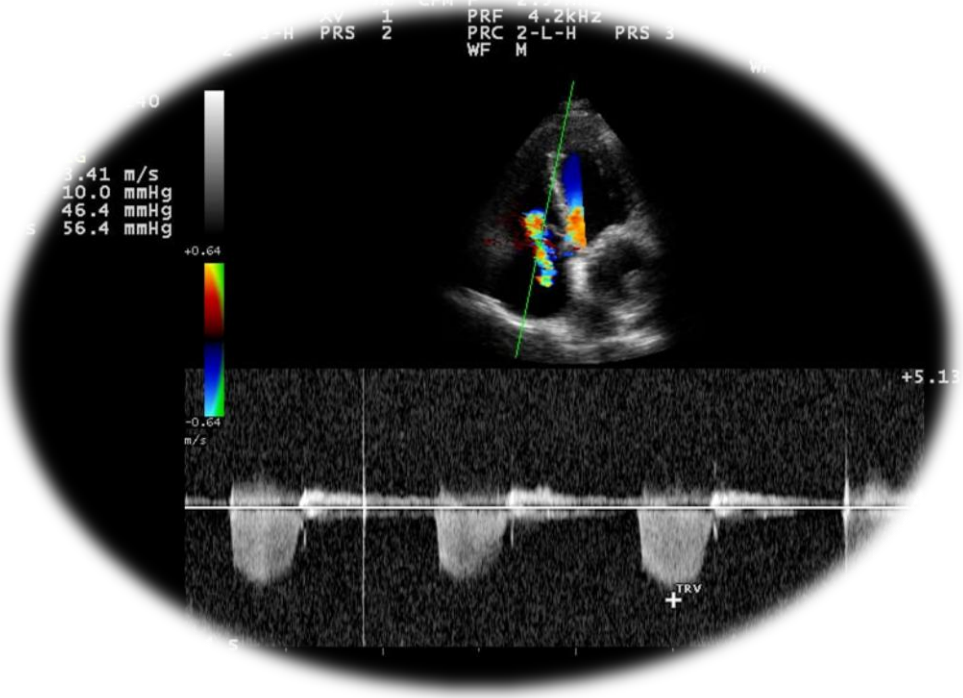

Image 1:42 yrs. M with moderate Tricuspid regurgitant jet TV max (3. 23 m/s) PAP elevated by 10 mmHg with PASP 51.7 mmHg (Bernoulli equation) 4 (TV max)^2 + PAP.

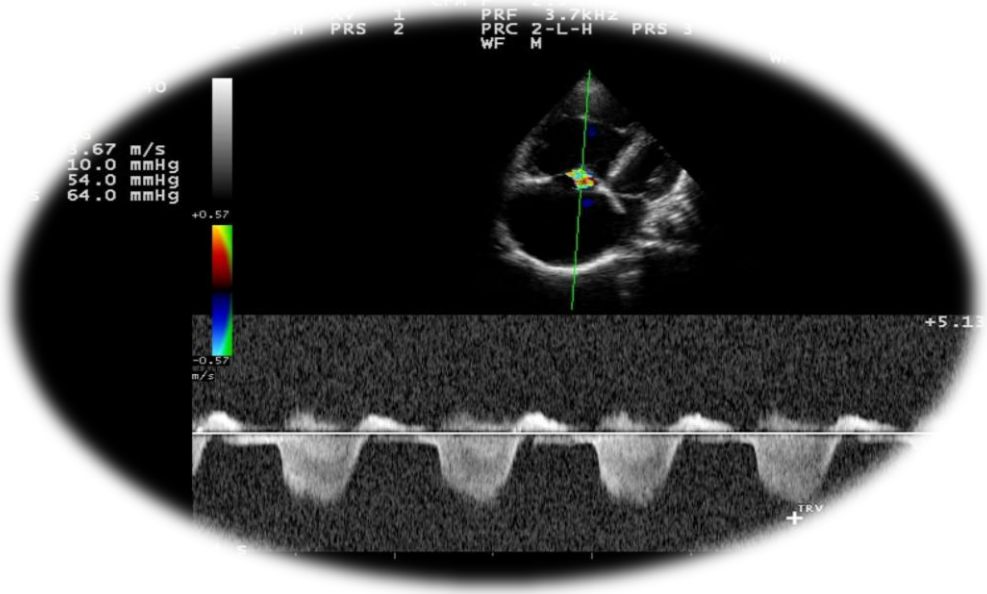

Image 2 : 38 yrs. F with severe Tricuspid regurgitant jet TV max (3. 67 m/s) PAP elevated by 10 mmHg with PASP 64 mmHg (Bernoulli equation) 4 (TV max)^2 + PAP.

Statistical analysis

By using the SPSS program version16 all data and variables are analyzed. Descriptive statistics, including frequency and percentages, were calculated. An ANOVA test was applied to test the significance. Data are presented as percentages and frequencies The complex tables were used in the analysis and was carried out the relationship between different variables and the important statistical indicators was drawn from the study. The covariates for the multivariable regression analysis were chosen as potential confounding factors based on their significance in univariate analysis. The *p*-value of less than 0.005 was considered to be statistically significant.

III. Results

All collected data analyzed and tabulated in tables and graphs as follows:

Figure (1) shows gender distribution among a sample of the study in which male is more than female participants' which present 157 of total 300 by 52.3% and female are 143 represent 47.7%

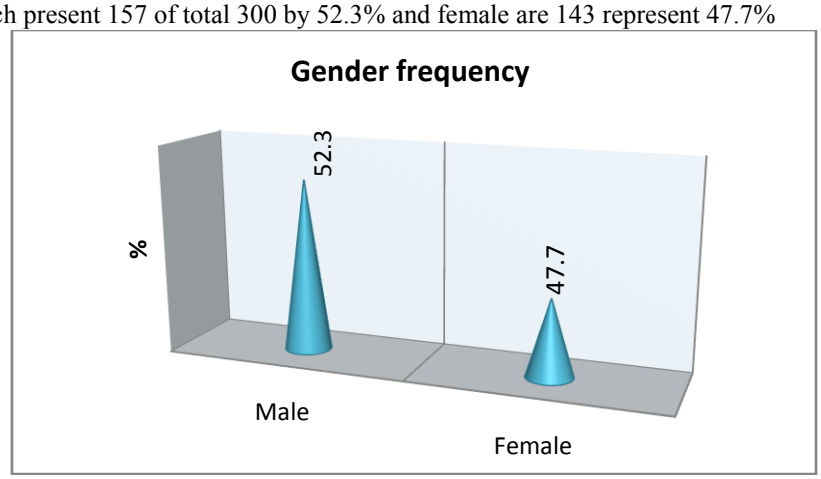

Figure (1) shows gender distribution among a sample of the study

In figure 2 shows demonstrate the age of participants, the most common age are 40-50 years by 36%,30-40 years are 33%, 50-60 years are 18%, more than 60 years are 9% and few percentages in aged group 20-30 years

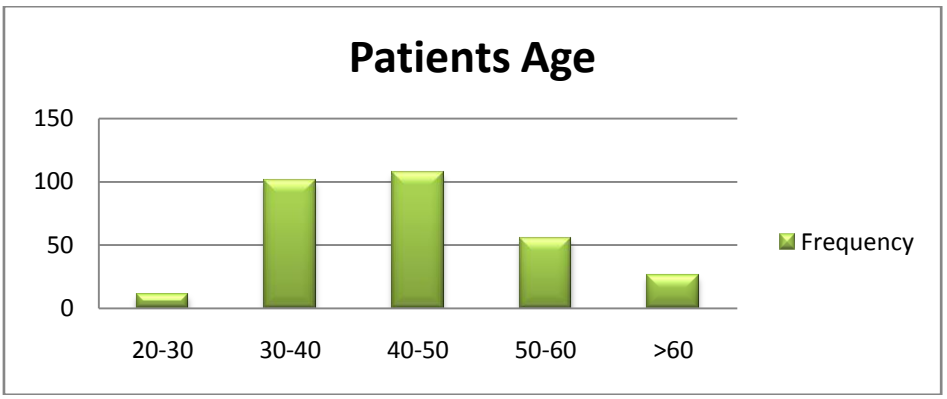

Figure 2: shows patients age distribution

In table 2 shows descriptive statistics for mean + Std. of age, weight, RV, TVMAX and PASP were 37.2 ±11.06 , 61.3 ± 10.03 ,2.29 ± 0.11, 2.8± 0.36 , and 37.4 ± 10.8 respectively.

Table 2: shows mean + Std. of age, weight, RV, TVMAX, and PASP

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age(Yrs)	300	20.0	69.0	37.243	11.0646
Weight(Kg)	300	40	90	61.35	10.031
RV dimensions(Cm)	300	2.0	2.8	2.296	0.1134
TVMAXms	300	2	4	2.80	0.368
PASPmmHg	300	26.0	80.0	37.440	10.8199
Valid N (listwise)	300				

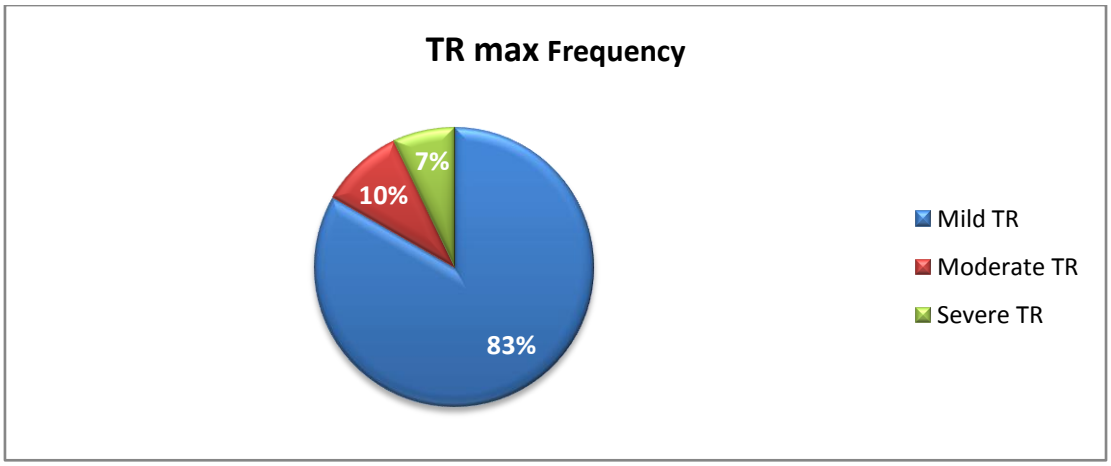

Figure 3: show TR max frequency

In table 3 shows 44 of the patients had moderate to severe TR and PASP indicated to PH different male and female, the PASP measurement range from 50 mmHg -74 mmHg which is considered highly indicator to PH.

Table 3: shows relation between echo finding (TR max) with PASP and gender

		Echo finding																				Total
		Mild TR with PASP 26mmHg	Mild TR with PASP 27mmHg	Mild TR with PASP 29mmHg	Mild TR with PASP 31mmHg	Mild TR with PASP 33mmHg	Mild TR with PASP 35mmHg	Mild TR with PASP 37mmHg	Mild TR with PASP 39mmHg	Mild TR with PASP 41mmHg	Mild TR with PASP 43mmHg	Mild TR with PASP49mmHg	moderate TR with 50mmHg	Moderate TR with PASP56mmHg	Moderate TR with PASP54mmHg	Moderate TR with PASP 52mmHg	Moderate TR with PASP 50mmHg	moderate TR with PASP 51mmHg	Moderate TR with PASP 53mmHg	Moderate TR with PASP 56mmHg	severe TR with PASP 61mmHg	Severe TR with PASP 74mmHg	
gender	M	3	3	14	32	35	27	14	5	2	0	0	5	5	2	1	1	1	3	3	1	0	157
	F	2	5	5	27	37	23	14	3	2	2	1	4	2	2	2	1	2	4	2	2	1	143
Total		5	8	19	59	72	50	28	8	4	2	1	9	7	4	3	2	3	7	5	3	1	300

In table 4 shows the PASP measurement range from 50 mmHg -74 mmHg common with 40-80 Kg weight with p-value 0.002 considered significant correlation.

Table 4: show relation between echo finding (TR max) with PASP and weight

weight * Echo finding		Echo finding																					Total
		Mild TR with PASP 26mmHg	Mild TR with PASP 27mmHg	Mild TR with PASP 29mmHg	Mild TR with PASP 31mmHg	Mild TR with PASP 33mmHg	Mild TR with PASP 35mmHg	Mild TR with PASP 37mmHg	Mild TR with PASP 39mmHg	Mild TR with PASP 41mmHg	Mild TR with PASP 43mmHg	Mild TR with PASP49mmHg	Moderate TR with 50mmHg	Moderate TR with PASP56mmHg	Moderate TR with PASP54mmHg	Moderate TR with PASP 52mmHg	Moderate TR with PASP 50mmHg	moderate TR with PASP 51mmHg	Moderate TR with PASP 53mmHg	Moderate TR with PASP 56mmHg	severe TR with PASP 61mmHg	Severe TR with PASP 74mmHg	
weight	20-40	2	2	5	18	18	32	21	8	2	1	1	1	0	0	0	0	0	0	0	0	0	111
	40-60	3	6	13	25	35	16	5	0	1	0	0	3	4	2	2	1	1	5	4	1	0	127
	60-80	0	0	1	16	19	2	2	0	1	1	0	5	2	1	0	1	1	2	1	1	1	57
	80-100	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	1	0	5
Total		5	8	19	59	72	50	28	8	4	2	1	9	7	4	3	2	3	7	5	3	1	300
P-value		0.002																					

In table 5 shows find the correlation between TV max and RV dimension with a p-value of 0.00 considered a significant correlation.

Table 5: show relation between TR max with RV dimension

RV dimension * TV max		TV max																					
		2.30m/s	2.35m/s	2.45m/s	2.55m/s	2.65m/s	2.75m/s	2.84m/s	2.95m/s	3.0m/s	3.9m/s	3.17m/s	3.21m/s	3.28m/s	3.30m/s	3.40m/s	3.50m/s	3.58m/s	3.65m/s	3.68m/s	3.78m/s	3.87m/s	3.88m/s	4.00m/s	4.19m/s
RV dimension	2.0cm	3	3	6	26	37	19	16	3	1	1	3	1	1	1	0	2	0	1	1	1	1	2	0	1
	2.1cm	0	1	8	22	32	10	14	1	0	0	3	0	3	1	1	0	1	0	1	2	0	0	1	0
	2.2cm	1	3	2	7	4	10	0	2	1	1	2	0	0	1	2	1	1	0	1	0	1	0	1	1
	2.3cm	0	0	1	3	0	7	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	1	0	0
	2.4cm	0	0	1	0	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
	2.5cm	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	2.6cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
P value		0.00																							

In figure3 represent PASP of 300 patient mean ± std. (37.44±10.82), and moderate and severe subjects in figure4 for 50 patients (59.26±9.34),

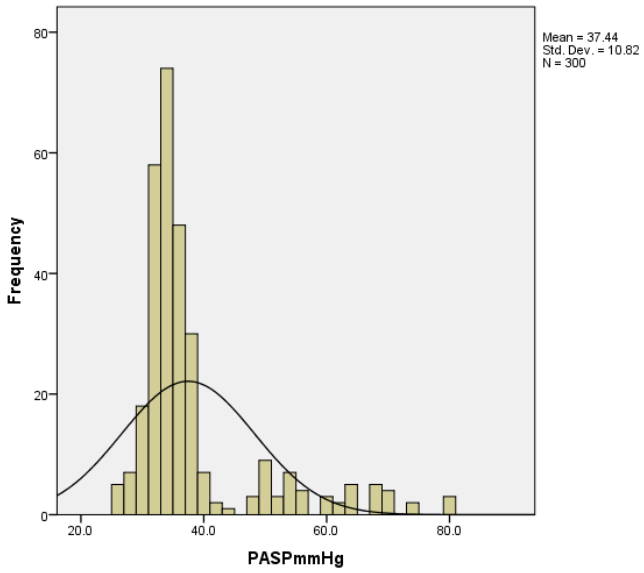

Figure 3: Shows the PASP of all subjects

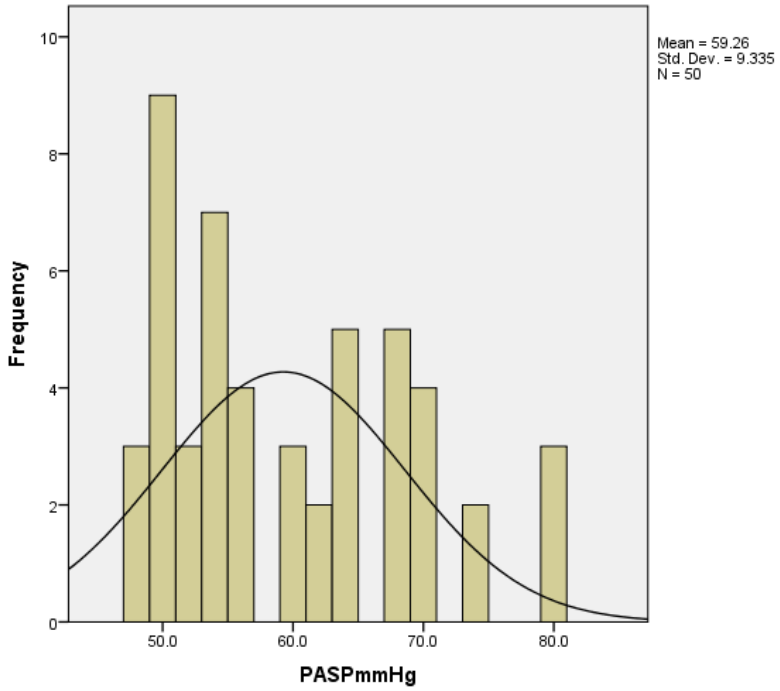

Figure 4: Shows the PASP of moderate and severe subjects

IV. Discussion

The most accurate and reliable noninvasive method of echocardiographic PAP assessment is based on tricuspid regurgitation. It reflects the difference between RV and RA pressure and can be calculated by the Bernoulli equation. [(11)] When estimated RA pressure is added to that gradient, systolic RV pressure is obtained. Results from this method, which is simple and easily applied, have correlated well with those from invasive PAP measures in hemodynamics laboratory tests, with a correlation coefficient (r) between 0.89 and 0.94. Although this method is only valid in cases of tricuspid valve insufficiency, this is rarely regarded as a limitation, since approximately 90% of patients with PH present with this condition. The accurate estimation of RA pressure makes for a more precise calculation of systolic pressure in the pulmonary artery, and several noninvasive approaches have been proposed for that assessment. The RA pressure can be determined by the respiratory variation in inferior vena cava diameter observed through the subcostal window). It is important to point out that, due to alterations in intrathoracic pressures, the estimation of the diameter and inspiratory collapse of the inferior vena cava is not useful in patients under ventilation with positive pressure. [(12)]

Other approaches to assessing RA pressure include clinical examination of the distention of the jugular (secondary to retrograde circulatory arrest) and the determination of values of 10 mmHg or 14 mmHg for the estimation of the RA pressure. Systolic RV pressure estimated using the techniques for calculating RA pressure also correlates well with values obtained in the hemodynamics laboratory. [(13)]

Three hundred participants underwent echocardiogram examination to assess the pulmonary artery pressure,157 male(52.3%) and 143 females (47.7%) so most of the gender distribution are male type. as represented in figure (1).

The ages of participants range from 20 to 60 years old were deeply investigated by Easote MY LAB 50 echocardiography ultrasound machine applying the ideal positions for adult echocardiogram using required and suitable equipment. The most frequent age is 40-50 years old are 107 participants represent 36%,30-40 years are 33%, 50-60 years are 18%, more than 60 years are 9% and few percentages in aged group 20-30 years. figure (2)

Age is the most important correlation with Systolic pulmonary artery pressure (SPAP),The age-related increase in SPAP is more common in patients with diabetes and is likely due to pulmonary artery noncompliance or abnormal left ventricular (LV) diastolic filling pressures occurring with aging and systemic hypertension. In this study, we demonstrate descriptive statistics for mean + Std.Deviation of age, weight, RV, TVMAX and PASP were 37.2 ±11.06 , 61.3 ± 10.03 ,2.29 ± 0.11, 2.8± 0.36 , and 37.4 ± 10.8 respectively. Table (2)

These results are significant and deal with Sheikhzadeh et al In her studies, she identified 73 persons from the University Hamburg-Eppendorf, 18 persons from the Ghent University, 11 persons from the University of Münster, and 21 persons from the University of Lübeck. Thus, echocardiographic recordings of a total of 123

normal persons comprising 72 men and 52 women at a mean age of 42 ± 14 years (range 16–77 years) were available for uniform assessment of normal MPA-d and MPA-r. as 95 quantiles of normal persons, MPA dilatation as diameters > upper normal limits, MPA aneurysm as diameters >4 cm, and indication for surgery as MPA diameters >6 cm. [(14)]

A total of 300 patients we find 83% of them with mild TR max, 10% moderate and 7% were severe TR max measurements. At the time of definitive diagnosis, most patients with PAH show at least moderate TR, with SPAP ≥60 mm Hg. TR is usually caused by tricuspid annular dilation, altered RV geometry, and apical displacement of the tricuspid leaflets. The degree of TR cannot be used as a surrogate for the degree of PAP elevation. As in table 3, we find about 44 of patients had moderate to severe TR and PASP indicated to PH different male and female, the PASP measurement range from 50 mmHg -74 mmHg which is considered highly indicator to PH, most effective in both male and female by 22 of total patients for both respectively. Severe TR max with PASP with 61mmHg and 74 mmHg in 4 patients. Recently, Argiento et al., 50 in a series of 113 healthy volunteers (mean age, 37 613 years; range, 19–63 years; 57 women [50%]) reported exercise flow-corrected upper limits of normal for MPAP of 34 mm Hg at a cardiac output (CO) of <10 L/min, 45 mm Hg at a CO of <20 L/min, and 52 mm Hg at a CO of <30 L/min.[(15)] Table (3)

In table 4 we find the PASP measurement range from 50 mmHg -74 mmHg common with 40-80 Kg weight with p-value 0.002 considered the significant correlation between them and most common weight-related to moderate TR with PASP were13 of patients their weighted 60-80Kg and severe TR with PASP were 2 of patients and their weighted were 80-100Kg are 4 moderates TR with PASP and one patient were severe TR with PASP with significant relation between weight and echo finding. Table (4)

In this regard, the European Society of Cardiology guidelines for the diagnosis and treatment of PH suggests considering (1) PH unlikely for TRV # 2.8 m/sec, SPAP # 36 mm Hg (assuming RAP of 5 mm Hg), and no additional echocardiographic signs of PH; (2) PH possible for TRV# 2.8 m/sec and SPAP # 36 mm Hg but the presence of additional echocardiographic signs of PH or TRVof 2.9 to 3.4 m/sec and SPAP of 37 to 50 mm Hg with or without additional signs of PH; and (3) PH likely for TRV > 3.4 m/sec and SPAP > 50 mm Hg with or without additional signs of PH.(2)

In this study the correlation between TV max and RV dimension with p value 0.00 considered significant correlation.RV dimension and TV max, 2cm, 2.1 cm, and 2.2cm RV dimension to 2.55 cm, 2.65 and 2.75 TV max represent the most frequents normal participants, therefore are 26, 37, 19 in 2 cm RV respectively, while 22,32, and 10 of participants in 2.1 cm measurements respectively and few of participants measure 2.2cm RV are 7,4, 10 related to TV max. Few patients RV dimension measure 2.4cm to 2.6 cm with high TR max range between 3.68 m/s -4.19m/s respectively which considered high suggested PH. Table(5)

In figure 3 shows PASP mean and std. deviation and frequency which were 33.08±2.95, most of the patients with 32 to 33 mmHg PASP.Weak and clinically irrelevant correlations were foundbetween mean PAP and indices of pulmonary artery flow. Astatistically significant and clinically relevant correlation wasfound between systolic PAP and regurgitation tricuspid flow. In3 patients (14%), pulmonary artery pressure could not be assessedechocardiographically.

Our result was deal withBouhemadet al[16] Among the 20 patients in whom transesophageal echocardiography was performed immediately after pulmonary artery catheter removal, tricuspid regurgitation flow was present in 19. Doppler measurement of tricuspid flow was possible in 17 patients (85%), either by transesophageal (59% of the patients) or transthoracic approach (70% of the patients). His statistically significant correlations were found between absolute values or variations of sPAP derived from tricuspid regurgitation flow and corresponding values measured by the pulmonary artery catheter. He concluded that In cardiac patients, Doppler examination of pulmonary artery flow at the main trunk of the pulmonary artery is accurate for diagnosing pulmonary artery hypertension.

V. Conclusion

Detailed echocardiographic assessment of patients with PH allows useful diagnostic information to be collected. It can also be used to assess the severity of right ventricular dysfunction, providing prognostic information and a non-invasive means of following disease progression or response to therapy.

Echocardiography is a non-invasive procedure that plays an important role in the evaluation of PH. It can be used to accurately quantify PAPs, showing their impact on the right heart chambers and systemic veins. It is also useful as an analytical tool in the evaluation of therapeutic responses and prognoses.

Regarding the right ventricle (RV) dimension, 133 participants (44.3%) revealed that their (RV) dimension of 2.3 cm, the maximum and minimum RV dimensions reported were 2.1cm and 2.8cm seen in one participant (0.3%) and one participant (0.3%) respectively. Considering the pulmonary artery systolic pressure (PASP), 33 mmHg was the most frequent value noted in 73 participants, the low and the high value represented 26mmHg and 80 mmHg seen in 5 participants and 30 participants respectively.

The study revealed that the standard value of the pulmonary artery pressure in a healthy Sudanese population is markedly greater than the universal slandered reported in the public literature, larger populations may be needed to corroborate our normative thresholds.

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