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Association between CHA2DS2-VASc and PESI scores and right ventricular dysfunction in patients with acute pulmonary thromboembolism diagnosed by computed tomography pulmonary angiography

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Abstract
Background: Pulmonary thromboembolism (PTE) stands as a prominent etiological factor in cardiovascular fatalities, wherein dysfunction within the right ventricular region (RVD) serves as a pivotal prognostic determinant of deleterious consequences. The CHA2DS2-VASc and Pulmonary Embolism Severity Index (PESI) scores are established tools in the risk stratification of thromboembolic events, but their association with RVD in PTE patients remains to be elucidated. This investigation sought to elucidate the relationships between the CHA2DS2-VASc and PESI scores, examining each of their respective links to RV dysfunction as delineated through CTPA.
Materials and Methods: This cross-sectional, comparative, multi-center study included 145 patients with acute PTE diagnosed by CTPA. Patients were categorized into two groups based on the presence (Group 1, n=107) or absence (Group 2, n=38) of RVD. The quantification of the CHA2DS2-VASc and PESI indices was executed, subsequent to which their interrelations with RVD were meticulously analyzed utilizing logistic regression techniques, complemented by an examination via ROC curve analytics.
Results: Patients with RV dysfunction had statistically significantly higher mean CHA2DS2-VASc & PESI scores (3.69±1.32 vs. 3.01±1.14 & 128.37±15.33 vs. 102.47±54.12; respectively with P = 0.001). Also, our study showed that both CHA2DS2-VASc score, and PESI score had significant positive correlation. CHA2DS2-VASc score at cut off value >3 and PESI score at cut off value >95 were independent predictors of RV dysfunction in acute PE patients. ROC curve analysis demonstrated that AUC for CHA2DS2-VASc score was higher than that of PESI score (AUC=0.89 vs. 0.63).
Conclusion: In patients with acute PE, the CHA2DS2-VASc and PESI scores are independent predictors of right ventricular dysfunction. These easily calculated scores can be used for risk stratification, identifying high-risk patients who require more comprehensive treatment and follow-up.

Keywords: Pulmonary thromboembolism, CHA2DS2-VASc score, PESI score, right ventricular dysfunction, computed tomography pulmonary angiography

Introduction
Pulmonary thromboembolism (PTE) occupies the position of the third most prevalent etiological contributor to cardiovascular fatalities, subsequent only to myocardial infarction (MI) and cerebrovascular incidents (CVA) [1].
The majority of clinically noteworthy PEs are initiated as VTEs in the veins of the lower extremities or pelvis. Infrequently, thromboembolic incidents originating in the upper extremities precipitate PE. A multitude of pathophysiological conditions contribute to the genesis of VTE [2].
Virchow's triad, comprising hypercoagulability, venous stasis, and endothelial injury, serves as a foundational model for elucidating numerous risk factors associated with thromboembolic events [3].
Given the heterogeneity in clinical manifestations of PE, the diagnostic assessment predominantly relies on evaluating the probability of PE coupled with the patient's hemodynamic stability.

Various scoring systems are employed to facilitate the precise determination of the likelihood of PE and related thromboembolic phenomena [4].
CHA2DS2-VASc and CHADS2 score have similar and modest predictive value for pulmonary embolism [5].
The study thoroughly investigated the strong correlation between RVD and the multifactorial CHA2DS2-VASc scores in patients with acute PTE. The CHA2DS2-VASc scores include factors such as congestive heart failure or left ventricular systolic dysfunction, hypertension, age 75 years or older, diabetes mellitus, prior stroke incidents, presence of vascular disease, age 65 to 74 years, and female sex [6].
The Pulmonary Embolism Severity Index (PESI) forecasts the 30-day prognosis of patients experiencing pulmonary embolism, utilizing a set of 11 clinical parameters [7].
In the context of acute PE, impairment in RV function is recognized as a pivotal predictor of unfavorable clinical outcomes. CT pulmonary angiography, with its proficient capability to intricately visualize cardiac morphologies, stands as an advantageous methodology for the expedited assessment of RV dynamics, offering a strategic alternative to the often-time-consuming echocardiographic evaluations conducted in inpatient settings [8].
Our objective was to assess the correlations between the CHA2DS2-VASc and PESI scores and their respective associations with RV dysfunction as observed on CTPA.

Materials and Methods

This was a cross-sectional, comparative, multi-center study that was carried out at the Cardiology department of Benha University Hospital and Benha Insurance Hospital from November 2022 to November 2023.
This study included 145 patients with acute pulmonary embolism; then according to finding of CTPA, participants were classified into two groups: Group 1: patients with RV dysfunction (107 patients) (73.8%). Group 2: patients without RV dysfunction (38 patients) (26.2%).

Inclusion criteria: Encompassed individuals aged 18 years and older who had been diagnosed with PTE via CTPA and were subsequently enrolled in the study.

Exclusion criteria: Encompassed individuals with antecedent thromboembolic events, prior diagnoses of RV dysfunction, or the presence of any concurrent conditions that could influence the patient's hemodynamic status, such as septic shock.

All patients were subjected to
History taking including age, gender, and history of diabetes mellitus, hypertension and history of recent surgery or malignancy.

Clinical examination: Clinical examination was done including heart rate, SBP, DBP, respiratory rate, oxygen saturation under non-invasive monitoring and lower limb oedema.

Calculation of CHADS2-VASC score and PESI score
CHADS2-VASc- score: It was calculated based on the presence of various risk factors, with each factor assigned a specific number of points. The constituent elements and their respective point allocations include CHF (1 point), HTN (1 point), age exceeding 75 years (2 points), DM (1 point), prior occurrences of stroke or TIA (2 points), vascular disease (1 point), age ranging from 65 to 74 years (1 point), and the gender category, wherein males are assigned 1 point. The aggregate score represents the cumulative total of points corresponding to each risk factor identified in the patient [9].

PESI score: It assesses the severity of pulmonary embolism in patients. It considers various clinical parameters, including age (equal to the patient's age in years), male sex (+10 points), presence of cancer (+30 points), CHF (+10 points), chronic pulmonary disease (+10 points), HR greater than 110/min (+20 points), SBP less than 100 mmHg (+30 points), RR of 30/min or higher (+20 points), temperature below 36 °C (+20 points), altered mental status (+60 points), and arterial oxy-hemoglobin saturation below 90% (+20 points). The total score was calculated by summing the points for each parameter, and it is used to stratify patients into different risk categories for management and treatment purposes [10].

Laboratory investigations: Blood samples for random blood glucose, renal function tests were performed using standard laboratory methods, Troponin-I and D-dimmer.

Electrocardiography: Twelve-lead electrocardiogram at 25 mm/s speed and1.0 mV/10 mm calibration was recorded for all patients to detect the presence of sinus tachycardia, S1Q3T3 pattern or signs of RV strain.

Echocardiography
Detailed transthoracic echocardiographic assessments were conducted utilizing a Philips Epic 7C system, equipped with the S5-1 probe and a 5.5 X transducer, alongside a concurrent ECG signal. For these examinations, patients were positioned in the left lateral decubitus posture. Echocardiography was performed to assess right ventricular pressure overload, focusing on the right side. Key findings included an enlarged right ventricle in the parasternal long-axis view, dilated RV with a basal RV/LV ratio greater than 1, McConnell's sign, and decreased TAPSE less than 16 mm in the four-chamber view. All echocardiographic data were acquired and subsequently archived for offline analysis.

2D echocardiography: The determination of the LVEF was executed by applying the modified biplane Simpson's method, which involved the quantification of LV end-diastolic and end-systolic volumes captured from both the apical four-chamber and apical two-chamber perspectives. Ejection fraction is the fraction of the end –diastolic volume that is ejected with each beat; that is, SV divided by end-diastolic volume. Stroke volume = end-diastolic volume – end systolic volume.

Computed tomography pulmonary angiography: All CT scans were performed using a 16-section multi-detector CT scanner (TOSHIBA TEX303A/B) following the standard CTPA protocol for PE, with images acquired 20 seconds after injecting 100 ml of contrast media at a rate of 5 ml/s. CTPA is the standard imaging technique for diagnosing acute PE, allowing direct visualization of thrombi and excluding other diseases. A proficient radiologist meticulously assessed the CTPA scans, scrutinizing indicators of RV dysfunction by evaluating the RV to LV

diameter ratio, curvature of the interventricular septum, and the retrograde movement of contrast medium into the IVC. The diagnostic criteria for RV dysfunction were established by identifying the presence of one or more of the following: an RV/LV diameter ratio of 0.9 or greater, or notable bowing of the interventricular septum.

Statistical analysis

Data were analyzed using IBM SPSS version 26, with the Kolmogorov-Smirnov test checking data normality. Numerical values were described by range, mean, and standard deviations, with differences tested by the t-test for parametric data. Categorical variables were expressed as numbers and percentages, analyzed using the chi-square test. Pearson's correlation coefficient was used for variable correlations, while univariate and multivariate logistic regression analyses identified predictor variables. Significance was set at $p<0.05$. ROC curves plotted sensitivity against 1-specificity, with areas under the curve indicating test accuracy. Accuracy classifications ranged from excellent (0.90-1) to fail (0.50-0.60), with the best cut-off point balancing sensitivity and specificity.

Result

The study included 145 patients with pulmonary thrombo-embolism then according to CTPA; patients were divided into two groups: Group I: patients with RV dysfunction (n = 107 patients) (73.8%), Group II: patients without RV dysfunction (n= 38 patients) (26.2%).

Data of all studied patients were prescribed in Table 1.

Component of both CHA2DS2-VASc score & PESI score and its distribution among studied patients showed in Table 2.

Comparison between the two groups revealed significant differences in demographic data and chronic disease history. Group I patients were older (mean age = 66.12±12.10 vs. 57.36±16.99, P = 0.02) and predominantly female (61.7%, P = 0.001). Group I also had higher rates of hypertension (94.3% vs. 5.7%, P = 0.001), recent malignancy, and chronic pulmonary disease ($p<0.05$). Table 3.

Clinically, Group I had lower mean SBP, DBP and higher HR, RR, and temperature (all P = 0.001), but no significant difference in oxygen saturation (P = 0.36). Laboratory data showed higher D-dimer levels in Group I (81.9% vs. 18.1%, P = 0.001) but no difference in troponin levels. ECG data indicated a higher incidence of RV strain in Group I (96.4% vs. 3.5%, P = 0.001). Both CHA2DS2-VASc and PESI scores were higher in Group I (P = 0.001). Table 3.

A statistically significant positive association was observed between the CHA2DS2-VASc score and the PESI score, evidenced by r of 0.388 and a p-value of 0.023.

At the univariate logistic regression analysis, age > 80, female gender, history of HTN, DM, vascular disease, lower SBP, higher heart rate >110 B/min, congestive heart failure, RV strain in ECG, CHA2DS2-VASc score, and PESI score (original version) were significantly associated with presence of RV dysfunction in CTPA with P value < 0.05. Then, in the multivariate logistic regression analysis; congestive heart failure, DM, RV strain in ECG, CHA2DS2-VASc score and PESI score (original version) were the only independent predictors of RV dysfunction in patients with pulmonary thrombo-embolism with P value < 0.05. Table 4.

ROC curve was used to test the diagnostic value (overall accuracy) of CHA2DS2-VASc score and PESI score (Original version) in prediction of RV dysfunction in patients with pulmonary thrombo-embolism. CHA2DS2-VASc score cutoff > 3 was shown to have the best diagnostic accuracy (sensitivity = 86%, specificity = 64% and AUC = 0.89). PESI score (original version) cutoff value> 95 was shown to have the best diagnostic accuracy (sensitivity = 84%, specificity = 63% and AUC = 0.63). AUC of CHA2DS2-VASc score was higher than that of original PESI score. So, CHA2DS2-VASc score was more accurate in predicting RV dysfunction in CTPA in patients with pulmonary thrombo-embolism. Figure 1 and Figure 2.

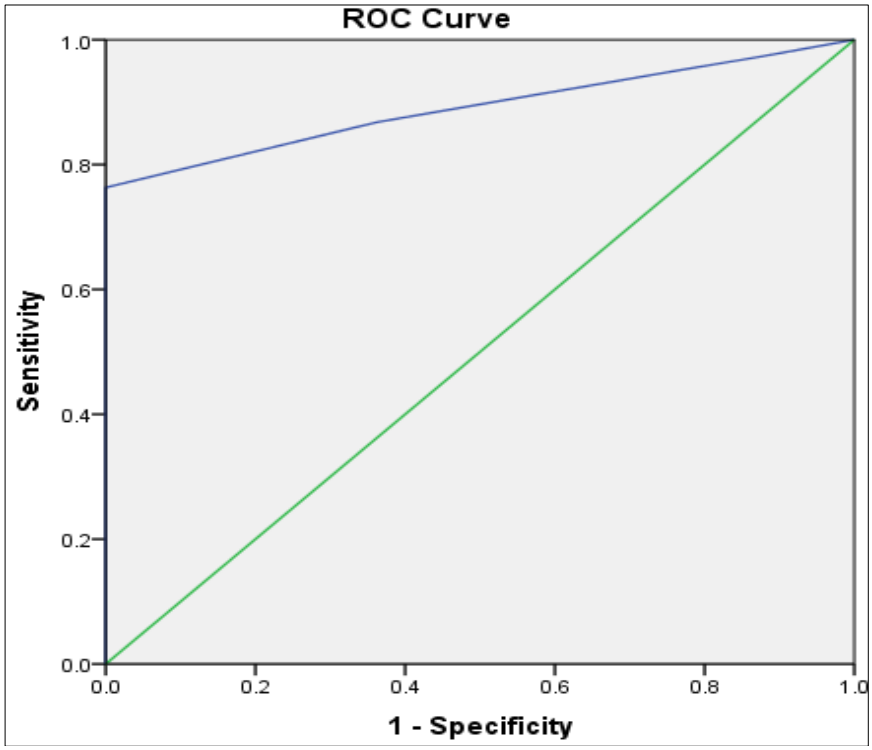

Fig 1: Sensitivity and specificity of CHA2DS2-VASc score for RV dysfunction prediction

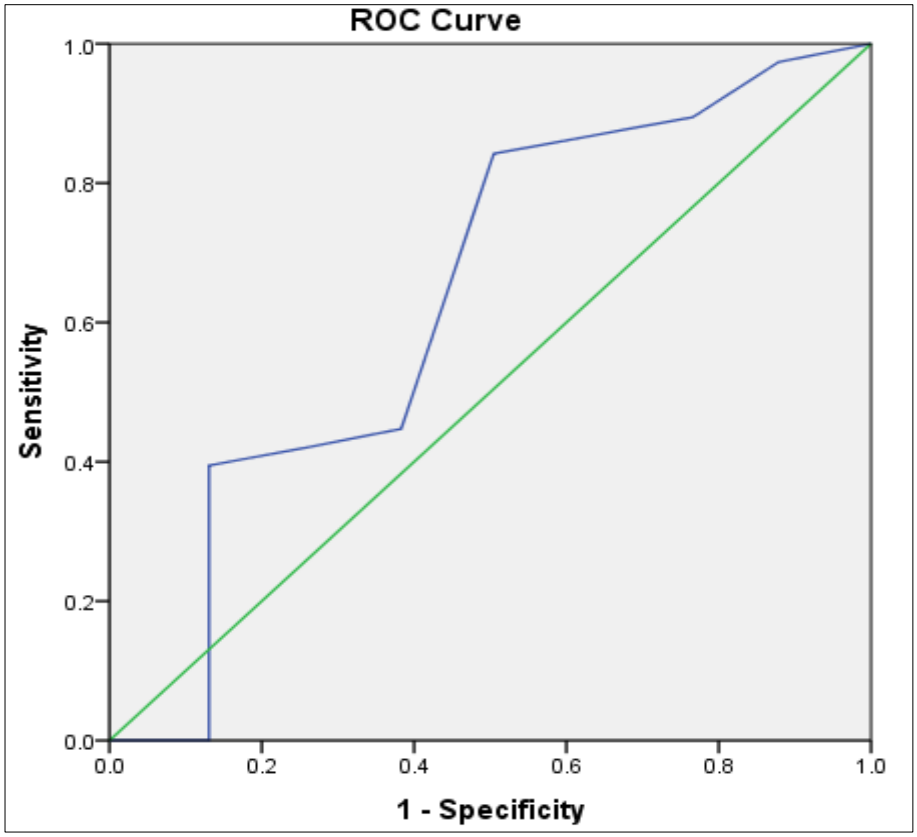

Fig 2: Sensitivity and specificity of PESI score (Original score) for prediction of RV dysfunction

Discussion

The association between CHA2DS2-VASc and PESI scores and RVD in patients with acute PTE is a critical area of investigation due to the prognostic implications of RVD in this patient population [11]. Our study aimed to elucidate this relationship using CTPA as a diagnostic tool.

In the current study, patients with RV dysfunction were significantly older with female predominance. This finding aligns with the investigation conducted by *Cho et al.,* [13] which was directed towards evaluating the severity of pulmonary embolism in emergency department patients by utilizing the RV/LV diameter ratio as a diagnostic metric. They found that the mean age in the group with RV dysfunction was significantly higher than that of the other group without RV dysfunction with P value < 0.001.

In the current study, patients with RV dysfunction had significantly lower both SBP & DBP and higher respiratory rate and heart rate with P value < 0.001 for all of them. This concordance is mirrored in the study undertaken by *Alirezaei et al.,* [11] which endeavored to elucidate the interrelations between the CHA2DS2-VASc and Pulmonary Embolism Severity Index (PESI) scores, alongside their respective correlations with RV dysfunction as visualized through CTPA. Their analysis disclosed that a tachycardic condition characterized by a heart rate surpassing 109 beats per minute emerged as the predominant risk factor in patients manifesting RV dysfunction, evidenced by a p-value of 0.026, underscoring its statistical relevance. Likewise, *Cho et al.,* [13] found that MAP was recorded lower in patients with RV dysfunction with P value = 0.001and the mean HR was higher in patients with RV dysfunction with P value = 0.001.

The current study showed that patients of group I had statistically higher incidence of RV strain in ECG than those of group II with P value =0.001. This was concordant with *Sroor et al.,* [14] who found that RBBB as a sign of RV strain was significantly related to the group of patients with RV dysfunction.

In our study, the mean CHA2DS2-VASc score& PESI score were statistically significantly higher in Group I than in Group II (P = 0.001). These findings are consistent with previous studies. Gok *et al.,* [6] found that the CHA2DS2-VASc score was more significant in the sub-massive PTE group (P = 0.002) and reported a significant positive correlation between PESI scores and RV/LV > 1 diameter ratio groups (p< 0.001). Alirezaei *et al.,* [11] showed that both scores were considerably higher in patients with RV dysfunction (P = 0.04 for CHA2DS2-VASc and P = 0.023 for PESI). Zorlu *et al.,* [12] also found that the CHA2DS2-VASc score was higher in high-risk groups, particularly in patients with RV dysfunction (p< 0.011). These results corroborate our findings, emphasizing the higher risk profiles in patients with RV dysfunction as indicated by elevated CHA2DS2-VASc and PESI scores.

In our study, the multivariate logistic regression analysis showed that CHA2DS2-VASc score and PESI score (original version) were an independent predictors of RV dysfunction in patients with pulmonary thrombo-embolism with P value < 0.05. That was similar to Gok *et al.,* [6] who investigated the predictors of the RV dysfunction using univariate and multivariate analysis and found that CHA2DS2-VASc was an independent predictor of RV dysfunction with P value = 0.034 as well as PESI score with P value < 0.001. The same was denoted by Zorlu *et al.,* [12] as CHA2DS2-VASc score and PESI score (simplified version) were predictors of RV dysfunction with P value 0.035 and 0.037; respectively.

In our current study; by using ROC analysis we demonstrated that CHA2DS2-VASc score cutoff > 3 (sensitivity = 86%, specificity = 64% and AUC = 0.89) &

PESI score (Original version) cutoff value> 95 (Sensitivity = 84%, specificity = 63% and AUC = 0.63) were predictors of presence of RV dysfunction. This was similar to Alirezaei *et al.,* [11] who revealed that results of the ROC analysis showed that AUC value of CHA2DS2-VASc score for predicting RV dysfunction 0.625 (95% confidence interval [CI]: 0.3531- 0.712) with 61.54% sensitivity and 60.0% specificity (p =.020). The AUC of the PESI score for predicting RV dysfunction registered at 0.635, encompassing a 95% CI of 0.542-0.712. Diagnostic performance metrics revealed a sensitivity of 66.7% and specificity of 60.0%, substantiated by a p-value of 0.018. According to Zorlu *et al.,* [12] CHA2 DS2 -VASc score were compared with ROC statistical analysis to show the development of RVD in patients with APE (AUC: 0.88, 95% CI: 0.844–0.921). Similarly, Gok *et al.,* [6] established through ROC analysis that the CHA2DS2-VASc score accurately predicted RVD with a sensitivity of 70% and specificity of 50% (AUC: 0.621 [CI: 0.671-0.670]).

In this study, a notably significant positive association was detected between the CHA2DS2-VASc score and the PESI score, evidenced by a p-value of 0.023. It was similar to Alirezaei *et al.,* [11] who showed that CHA2DS2-VASc score, and PESI score (Original version) had positive correlation. The study had some limitations including a small sample size, predominance of female participants, and reliance on two-dimensional echocardiography for assessing RV dysfunction. It lacked post-discharge follow-up and faced challenges in data collection due to the absence of a hospital database system. Also we couldn't assess RV recovery and differentiate between patients that treated conservatively and those received thrombolytic therapy.

Table 1: General, clinical and laboratory findings of the studied cases

Demographic data	**Cases (n = 145)**	
	No.	%
Gander		
Male	43	29.7%
Female	102	70.3%
Age (Years)		
Min.–Max	33 – 82	
Mean±SD.	60.12± 16.99	
History of chronic diseases		
Diabetes mellitus	88	60.7%
Hypertension	105	72.4%
Recent malignancy	43	29.7%
Previous stroke	57	39.3%
Vascular disease	58	40.0%
Chronic pulmonary disease	66	45.5%
vital signs		
SBP (mm/Hg)	Min.–Max	60 – 210
	Mean±SD.	147.6 ± 49.69
DBP (mm/Hg)	Min.–Max	30 – 110
	Mean±SD.	83.25 ± 24.71
Heart rate (B/m)	Min.–Max	43 – 162
	Mean±SD.	91.37 ± 37.83
Respiratory rate(cyc/min)	Min.–Max	13 – 26
	Mean±SD.	17.61 ± 3.90
Temperature C°	Min.–Max	36 - 38.5
	Mean±SD.	37.1 ± 0.31
O_2 Saturation %	Min.–Max	69 – 94
	Mean±SD.	83.36 ± 8.75
Clinical examination		
lower limb swelling due to DVT	11	7.6
Heart failure	34	23.4
Altered mental condition	29	20.0
Lab investigation		
Blood Urea (mg/dl)	Min.–Max	5.0 – 80.0
	Mean±SD.	24.35± 21.25
creatinine (mg/dl)	Min.–Max	0.7 – 1.7
	Mean±SD.	1.18 ± 0.31
Random blood glucose	Min.–Max	40 – 510
	Mean±SD.	274.54 ± 162.36
Troponin	Positive	87 (60.0%)
	Negative	58 (40.0%)
D dimer	Positive	122 (84.1%)
ECG		
RV strain	Yes 85	58.6
	No 60	41.3
Sinus tachycardia	Yes 88	60.7
	No 57	39.3
Computed tomography pulmonary angiography (CTPA) and ECHO		

Dilated RV	Yes	103	71.0
RV/LV ≥ 1	No	29	29.0
McConnell's sign	Yes	95	65.5
	No	29	34.5
TAPSE	≤16mm	107	73.7
	>16mm	38	26.3
Ejection fraction	≥50%	105	72.4
	<50%	40	27.6
RV/LV ratio by CTPA	≥0.9	107	73.7
	<0.9	38	26.3
Bowing of inter ventricular septum	Yes	72	49.7
	No	73	50.3

SD: Standard Deviation, DBP: Diastolic Blood Pressure, SBP - Systolic Blood Pressure, B/m, Beats per minute, C°: Degrees Celsius, O2: Oxygen, DVT: Deep Vein Thrombosis, ECG: Electrocardiogram, RV: Right Ventricle, LV: Left Ventricle, TAPSE: Tricuspid Annular Plane Systolic Excursion, CTPA: Computed Tomography Pulmonary Angiography

Table 2: Components of CHA2DS2-VASc score and PESI score risk factors among the patients

CHA2DS2-VASc score	**Cases (n = 145)**	
	No.	**%**
Congestive heart failure	34	23.4
Hypertension	105	72.4
Age > 75 years	43	29.7
Diabetes mellitus	88	60.7
Previous stroke or TIA	57	39.3
Vascular disease	58	40.0
Age 65–74 years	29	20.0
Sex category (Female gender)	102	70.3
PESI score		
Age >80	14	9.7
Male sex	43	29.7
Cancer	43	29.7
Chronic heart failure	34	23.4
Chronic pulmonary disease	66	45.5
Heart rate > 110/min	43	29.7
SB*P*<100 mmHg	29	20.0
Respiratory rate >30 breaths/min	42	28.9
Temperature <36 C	15	10.3
Altered mental status	29	20.0
Arterial oxy-hemoglobin saturation <90%	86	59.3

Table 3: General, clinical and laboratory findings of the studied cases according to RV dysfunction

Demographic data	**With RV dysfunction (n = 107)**		**Without RV dysfunction (n = 38)**		**Test of sig (P value)**
	No.	**%**	**No.**	**%**	
Gander					
Male	41	38.3%	2	5.3%	X^2=14.65
Female	66	61.7%	36	94.7%	P= 0.001*
Age (Years)					t- test =2.81
Min.–Max	54 – 82		32 – 74		P=0.02*
Mean±SD.	66.12+ 12.10		57.36+ 16.99		
History of chronic diseases					
Diabetes mellitus (n=88)	68	77.2%	20	22.7%	1.4 (0.236)
Hypertension (n=105)	99	94.3%	6	5.7%	31.5 (0.001*)
Recent malignancy (n=43)	41	95.3%	2	4.7%	14.68 (0.001*)
Previous stroke (n=57)	40	70.2%	17	29.8%	1.63 (0.42)
Vascular disease (n=58)	39	67.2%	19	33.8%	2.14 (0.23)
Chronic pulmonary disease(n=66)	57	86.3%	9	13.7%	7.06 (0.008*)
vital signs					
SBP	136.96 ± 49.69		180.61 ± 31.69		5.12(0.001*)
DBP	77.15 ± 25.31		100.32 ± 14.51		5.32(0.001*)
Heart rate	98.37 ± 33.43		73.37 ± 24.83		3.62(0.001*)
Respiratory rate	18.61 ± 3.25		15.61 ± 2.44		5.09(0.001*)
Temperature	37.77 ± 0.70		36.8 ± 0.42		3.52(0.001*)
O2 Saturation	84.16 ± 7.51		82.64 ± 11.47		0.93 (0.36)
Clinical examination					
lower limb swelling (n=11)	11	100.0%	0	0.0%	14.68 (0.001*)
Heart failure (n=34)	30	88.2%	4	11.8%	14.68 (0.001*)
Altered mental condition (n=29)	29	100.0%	0	0.0%	12.05 (0.001*)

Lab investigation					
Blood Urea	17.45± 12.33			21.35± 30.36	t=1.35 p =0.12
Creatinine	1.20 ± 0.33			1.08 ± 0.31	t=1.23 p =0.06
RBS	291.14 ± 142.36			272.36 + 116.70	t=2.13 p =0.36
Troponin (n=87)	67 (77.0%)			20 (23%)	X^2=1.16 P = 0.32
D dimer (n=122)	100 (81.9%)			22 (18.1%)	X2 =15.3 p = 0.001*
ECG					
RV strain (n=85)	82	96.4%	3	3.5%	20.54 (0.001*)
Sinus tachycardia (n=88)	69	78.4%	19	21.6%	2.14 (0.14)
Score					
CHA2DS2-VASc score	3.69±1.32			3.01±1.14	t=12.45 p =0.001*
PESI score (Original version)	128.37±15.33			102.47±54.12	t=13.53 p =0.001*

χ^2: Chi square test, t: for independent t- test, *: Statistically significant at $p \leq 0.05$, RV: Right Ventricular, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, O2 Saturation: Oxygen Saturation, RBS: Random Blood Sugar, ECG: Electrocardiogram

Table 4: Univariate and multivariate logistic regression analysis using backward wald method for the most predictor factors of RV dysfunction

	Univariate				**Multivariate**			
	P value	**OR**	**95% C.I. for OR**		**P value**	**OR**	**95% C.I. for OR**	
			Lower	**Upper**			**Lower**	**Upper**
Age >80	0.038*	1.443	1.020	2.043	-	-	-	-
Female gender	0.229	0.025	0.000	10.154	-	-	-	-
Hypertension	0.024*	14.77	4.696	31.653	-	-	-	-
Vascular disease	0.060	27.44	0.791	795.260	-	-	-	-
Chronic Pulmonary diseases	0.218	0.144	0.007	3.159	-	-	-	-
Altered mental status	0.184	0.003	0.000	17.260	-	-	-	-
Heart rate > 110/min	0.001*	0.950	0.925	0.976	-	-	-	-
SB*P*<100 mmHg	0.001*	1.314	1.169	1.476	-	-	-	-
Respiratory rate	0.021*	1.700	1.082	2.673	-	-	-	-
Arterial oxy-hemoglobin saturation <90%	0.851	1.012	0.894	1.146	-	-	-	-
Congestive heart failure	0.025*	13.549	1.392	131.917	0.001*	1.314	1.169	1.476
DM	0.001*	1.314	1.169	1.476	0.002*	9.36	2.241	14.365
RV strain in ECG	0.021*	1.700	1.082	2.673	0.001*	5.21	1.364	11.254
CHA2DS2-VASc score	0.003*	11.412	1.241	124.917	0.001*	1.214	1.249	1.541
PESI score (Original version)	0.001*	1.327	1.249	2.417	0.001*	7.16	2.741	12.845

CI, confidence interval; OR, odds ratio, *: Statistically significant at $p \leq 0.05$

Conclusion

CHA2DS2-VASc and PESI scores were an independent predictor of RV dysfunction in patients with acute PE. So, considered as a simple and easy calculated score to predict RV dysfunction and can be used as a key for risk stratification of acute PE patients for prediction of higher risk patients who need more comprehensive treatment and follow up.

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Conflict of interests: None to be declared.

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