Supplementary material

Wiliński J, Skwarek A, Chukwu O, et al. Peak systolic velocity of right ventricular free wall myocardium by tissue Doppler imaging does not help to identify patients with acute pulmonary embolism and stratify 30-day mortality risk in all-comers with acute pulmonary embolism. Pol Heart J. 2024.

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Table S1. Clinical characteristics of the study participants

		Acute PE diagnosis (all subjects, n=189)			30-day mortality prediction in patients with PE (n=99)		
	All subjects (n=189)	Patients without PE (n=90)	Patients with PE (n=99)	*P*-value	Survivors (n=88)	Non-survivors (n=11)	*P*-value
Male, n (%)	89 (47.09%)	38 (42.22%)	51 (51.52%)	0.2	48 (54.55%)	3 (27.27%)	0.11
Age, years, median (IQR)	70 (60 - 80)	69.5 (61 - 79)	70 (58.5 - 80)	0.76	69 (57 - 79.25)	77 (70 - 89.5)	0.01
Body mass index, kg/m^2, median (IQR)	27.15 (23.6 - 30.93)	26.25 (22.24 - 29.51)	27.68 (25.24 - 31.25)	0.88	27.81 (25.47 - 31.25)	26.91 (23.05 - 30.89)	0.41
Arterial hypertension, n (%)	116 (61.38%)	55 (61.11%)	61 (61.62%)	0.94	55 (62.5%)	6 (54.55%)	0.64
Hyperlipidemia, n (%)	80 (42.33%)	43 (47.78%)	37 (37.37%)	0.15	33 (37.5%)	4 (36.36%)	0.91
Diabetes, n (%)	42 (22.22%)	18 (20%)	24 (24.24%)	0.48	21 (23.86%)	3 (27.27%)	0.71
Coronary artery disease, n (%)	55 (29.1%)	35 (38.89%)	20 (20.2%)	0.39	19 (21.59%)	1 (9.09%)	0.45
Chronic heart failure, n (%)	63 (33.33%)	37 (41.11%)	26 (26.26%)	0.02	23 (26.14%)	3 (27.27%)	0.75

Atrial fibrillation (present or prior), n (%)	28 (14.81%)	14 (15.56%)	14 (14.14%)	0.78	12 (13.64%)	2 (18.18%)	0.64
Stroke, n (%)	10 (5.29%)	8 (8.89%)	2 (2.02%)	0.052	2 (2.27%)	0 (0%)	0.94
Chronic lung disease, n (%)	19 (10.05%)	12 (13.33%)	7 (7.07%)	0.15	6 (6.82%)	1 (9.09%)	0.59
Malignancy, n (%)	43 (22.75%)	21 (23.33%)	22 (22.22%)	0.76	19 (21.59%)	3 (27.27%)	0.4
Infection, n (%)	74 (39.15%)	37 (41.11%)	37 (37.37%)	0.60	31 (35.23%)	6 (54.55%)	0.23
PESI, points, median (IQR)	94 (79 - 115)	94 (79 - 115)	95 (79.25 - 115.75)	0.68	93 (70.5 - 109.5)	132 (110.5 - 165.5)	<0.001
D-dimer, ng/mL, median (IQR)	3764 (1962.5 - 7147)	2890.5 (1681.25 - 4850)	5010.5 (2657.75 - 7985.75)	<0.001	5134 (2554.25 - 7985.75)	4737 (4280.5 - 7499)	0.66
Troponin T, pg/mL, median (IQR)	21.51 (11.53 - 49.65)	19 (13 - 48.81)	22.17 (10.73 - 50.2)	0.69	21.26 (9.4 - 44.99)	70.29 (28.6 - 136)	0.02
NT-proBNP, pg/mL, median (IQR)	831 (218 - 3409)	975 (263 - 4454.25)	606 (154 - 2842)	0.14	548.5 (143.75 - 2599.75)	2984 (1711 - 7791)	0.01

Abbreviations: NT-proBNP, N-terminal pro-B-type natriuretic peptide; PESI, Pulmonary Embolism Severity Index

Table S2. Selected echocardiographic parameters

		Acute PE diagnosis (all subjects, n=189)			**30-day mortality prediction in patients with PE (n=99)**		
	All subjects (n=189)	**Patients without PE (n=90)**	**Patients with PE (n=99)**	***P*-value**	**Survivors (n=88)**	**Non-survivors (n=11)**	***P*-value**
LVEF, %, median (IQR)	55.00 (49.00 – 63.00)	55.00 (50.00 – 63.00)	55.50 (46.00 - 64.75)	0.65	56.00 (53.00 – 64.00)	55.00 (50.00 – 63.00)	0.60

RVTD/LVTD, median (IQR)	0.91 (0.80 - 1.05)	0.94 (0.84 - 1.06)	0.88 (0.77 - 1.03)	0.03	1.00 (0.89 - 1.08)	0.94 (0.84 - 1.06)	0.55
RVTD/LVTD >0.9, n (%)	95 (50.26%)	37 (41.11%)	58 (58.59%)	0.02	50 (56.82%)	8 (72.73%)	0.52
TAPSE, mm, median (IQR)	21.00 (17.00 – 25.00)	21.00 (17.00 – 24.00)	21.00 (17.00 – 25.00)	0.98	19.00 (16.00 – 20.00)	21.50 (17.75 - 25.00)	0.15
RVTD/LVTD >1 and TAPSE<16 mm, n (%)	14 (7.41%)	6 (6.67%)	8 (8.08%)	0.73	6 (6.82%)	2 (18.18%)	0.23
60/60 sign, n (%)	26 (13.76%)	4 (4.44%)	22 (22.22%)	<0.001	16 (18.18%)	6 (54.55%)	0.01
McConnell sign or right ventricle's hipokinesis, n (%)	25 (13.23%)	6 (6.67%)	19 (19.19%)	0.01	16 (18.18%)	3 (27.27%)	0.43
RVFWLS, %, median (IQR)	-20.00 (-24.58 to -15.33)	-20.00 (-24.33 to -15.00)	-20.67 (-25.33 to -16.00)	0.35	-18.33 (-21.67 to -15.58)	-20.00 (-24.33 to -15.17)	0.31
TDI RV basal segment / tricuspid annular S', cm/s, median (IQR)	15.00 (12.00 – 19.00)	16.00 (12.00 – 20.00)	15.00 (13.00 - 18.50)	0.74	15.00 (13.00 – 18.00)	19.00 (14.50-20.50)	0.12
TDI RV mid segment S', cm/s, median (IQR)	13.00 (10.00 – 16.00)	13.00 (10.00 - 17.25)	13.00 (10.00 – 16.00)	0.56	13.00 (10.00 – 16.00)	13.00 (11.00 – 19.00)	0.47
TDI RV apical segment S', cm/s, median (IQR)	9.00 (7.00 – 12.00)	10.00 (7.00 – 13.00)	9.00 (7.00-12.00)	0.47	9.00 (7.00 – 12.00)	10.00 (8.00 - 13.50)	0.55
TDI RV free wall S', cm/s, median (IQR)	12.33 (10.33 - 15.67)	12.67 (10.25 - 16.42)	12.33 (10.67 - 15.17)	0.58	12.17 (10.58 - 14.33)	15.00 (11.00 - 17.33)	0.27
TDI basal / tricuspid	25 (13.23%)	13 (14.44%)	12 (12.12%)	0.64	11 (12.5%)	1 (9.09%)	0.88

annular S' <9.5 cm/s, n (%)							

Abbreviations: LVEF, left ventricular ejection fraction; LVTD, left ventricular transverse diameter; RV, right ventricle; RVFWLS, right ventricle free wall longitudinal strain; RVTD, right ventricular transverse diameter; TAPSE, tricuspid annular plane systolic excursion; TDI, tissue Doppler imaging

Table S3. PE prediction based on echocardiographic parameters

	Area under the curve, x, 95% CI	***P*-value**	**Cut-off value**	**Sensitivity, %, 95% CI**	**Specificity, %, 95% CI**	**Correctly classified, n (%)**	**Positive predictive value, %, 95% CI**	**Negative predictive value, %, 95% CI**
TDI RV basal segment / tricuspid annular S', [cm/s]	0.514 (0.429, 0.599)	0.74	21	88.89 (80.99 - 94.32)	20.45 (12.6 - 30.39)	106 (56.08)	55.7 (47.59 - 63.58)	62.07 (42.26 - 79.31)
RVTD/LVTD, x	0.593 (0.512, 0.675)	0.03	0.89	65.66 (55.44 - 74.91)	52.22 (41.43 - 62.87)	112 (59.26)	60.19 (50.32 - 69.48)	58.02 (46.54 - 68.91)
TAPSE, mm	0.365 (0.204, 0.527)	0.18	15	90.91 (58.72 - 99.77)	13.64 (7.25 - 22.61)	22 (22.22%)	11.63 (5.72 - 20.35)	92.31 (63.97 - 99.81)

Abbreviations CI, confidence interval; other – see Table 2

The exclusion criteria

The exclusion criteria covered non-diagnostic CTPA, recurrent PE, chronic thromboembolic pulmonary hypertension, echocardiograms of inadequate quality in which not all parameters from the adopted protocol could be evaluated, severe valvular failures and tricuspid valve replacement.

Echocardiographic assessment

The structured study had a unified protocols of clinical and biochemical assessment and TTE which was executed within 24 hours of admission to the ward by an experienced sonographer cardiologist (J.W.) with echocardiographic systems of Vivid S60N or Vivid S6 (General Electric Company, Boston, Massachusetts, United States of America). The measurements of RV longitudinal strain by two-dimensional speckle-tracking echocardiography were performed within six segments of RV at the same time in the apical four-chamber view as described before [2, 5-7]. Additionally, in 4-chamber view, adjusted to minimize the incidence angle between the Doppler beam and longitudinal wall motion, S' of all three segments of RV free wall were measured using TDI modality and their average value was calculated. Therefore, sample volume of pulsed TDI was placed in the middle of the basal segment (noteworthy, it is also one of the two recommended methods to assess tricuspid annulus velocity next to pulsed Doppler sample volume placement directly in the tricuspid annulus), mid and apical segments of the RV free wall. Optimal gain was used to achieve high quality of recording. Each S' velocity value was regarded as the highest systolic velocity without overgaining the Doppler envelope [8, 9]. The analysis included TTE parameters of proved prognostic value [1, 2].

Detailed statistical analysis

Non-normality of distribution was demonstrated with the Shapiro–Wilk test. Consequently, quantitative variables are expressed as median with interquartile range (IQR) and Mann-Whitney U-test was applied for their comparisons. Qualitative variables are expressed as numbers (percentage) and the Fisher test or $\chi 2$ test were used for their comparisons, when adequate. Standard receiver-operating characteristic (ROC) analysis was performed, area under the curve (AUC) was calculated for quantitative TTE parameters that differed the groups of survivors and non-survivors with P-value up to 0.2 (no analysis for PE detection was done since the studied TDI parameters were out of the adopted probability range). Sensitivity, specificity and accuracy and the corresponding 95% confidence interval (CI) were determined. Youden index was used to calculate optimal cut-off values. Univariate Cox-proportional hazard models were built. The hazard risk (HR) for the event of death during the 30-day observation was calculated. Due to the relatively small number of fatal events, the multivariate analysis was not performed. We calculated the hazard risk (HR) for the event of death during the 30-day observation. Correlation between variables was measured using Spearman's method. Two-sided P-values <0.05 were considered statistically significant. Statistical analysis was performed with the R Project for Statistical Computing version 4.3.0 (The R Foundation for Statistical Computing, Free Software Foundation Inc., Vienna, Austria).

Clinical course of the study participants

Four patients required systemic thrombolysis with alteplase within 24 hours from admission to the ward. Two of them died, and two survived. Another two patients died due to PE related heart failure, in other 5 PE contributed to death by aggravating chronic diseases (2 chronic heart failure, 1 chronic kidney failure, 1 chronic lung disease and 1 disseminated neoplastic disease).

None of the subjects required rescue thrombolysis. The median time of hospitalization was 9 days (1-32 days).

Study limitations

The study has a relatively low number of participants. Iner- and intravariability of echocardiographic parameters was not assessed.