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RESEARCH

THE VALIDITY OF THE SPESI SCORE IN MORTALITY PREDICTION AT FOUR-YEAR FOLLOW-UP OF PATIENTS WITH PULMONARY EMBOLISM AND AGED OVER 65 YEARS

Abstract

Introduction: This study investigates the values of the simplified pulmonary embolism severity index score, its individual criteria, the size of the pulmonary artery in which thrombus was detected by computed tomographic angiography, and systolic pulmonary artery pressure in predicting 30-day, 90-day, and longer-term mortality for patients in two age groups (over and under 65 years of age).

Materials and Method: This study evaluated the data of 303 patients. It was designed as a retrospective cohort study and was conducted between January 1, 2019 and March 9, 2019, with a four-year follow up (2011–2015).

Results: The mean age of the patients is 57.42 ±17.02. Among the patients who died, the simplified pulmonary embolism severity index score was higher than those who survived ($p < 0.005$), and a correlation was detected between 30-day and 90-day mortality and the score. It was found that pulmonary artery localization with thrombus and pulmonary artery pressure measurement do not have a significant correlation with mortality. While the score is correlated with 30-day and 90-day mortality in the under-65 age group, there was no correlation between 30-day mortality and the score in the over-65 age group. However, 90-day mortality was correlated with the score in the over-65 age group.

Conclusion: Although this study validates the score in estimating 30-day and 90-day mortality, it was not sensitive in predicting 30-day mortality in patients over 65 years of age. Moreover, it was not sensitive in the estimation of late mortality after 90 days for this age group.

Keywords: Venous Thromboembolism; Pulmonary Embolism; Mortality.

INTRODUCTION

The annual average incidence of venous thromboembolism (VTE) is between 8–27/100 (1). Although there are differences in studies, a non-negligible part of the patients is aged over 65 years. As the age increases, the risk, recurrence, and mortality of VTE also increases (1). In previous studies, early mortality rates after pulmonary embolism (PE) vary between 2% and 95% depending on the severity of the embolism (2, 3). Risk assessments of the cases are important in determining the treatment approach and prognosis. Further, 30-day and 90-day mortality in PE has been studied in large case groups with validated prognostic models, such as the original or simplified Geneva prognostic score, Hestia score, the pulmonary embolism severity index (PESI), and simplified pulmonary embolism severity index (sPESI) (4, 5). The role of these prognostic models in predicting mortality and the contribution on imaging methods with clinical severity are still observed in various case groups (6).

There are only a limited number of studies that indicate the accuracy of these scores in terms of prognostic evaluation in predicting mortality and survival among elderly patients (7). Prognostic indicators for PE have been validated only in predicting short-term mortality (8). Determining the medium- and long-term prognostic prediction success of clinical scores will help clinicians in the management of these patients and development of appropriate follow-up strategies, particularly for elderly patients.

In this study, we aimed to show the validity of the sPESI and the criteria that constitute sPESI, separately, in the estimation of 30-day and 90-day mortality as well as late mortality after 90 days. Moreover, their relationship with the actual survival time in our hemodynamically stable, hospitalized acute pulmonary embolism cases is also studied. In addition, we observed whether pulmonary artery size detected with thrombus using computed tomographic (CT) angiography and systolic pulmonary artery pressure (sPAP) evaluated by echocardiography contributes to mortality prediction. As a secondary aim, we investigated the differences in these assessments by age—that is, among patients aged below 65 years and those aged over 65 years.

MATERIALS AND METHODS

This study was planned as a retrospective cohort study and was conducted between January 1 and March 9, 2019. It was approved by the ethics committee of the Yedikule Chest Diseases and Chest Surgery Training and Research Hospital and the use of electronic data was allowed (Date: 12.06.2020, No 2431). The examinations of 2860 patients over the age of 18 years who applied to our hospital and underwent pulmonary CT angiography with a pre-diagnosis of pulmonary embolism between 2011 and 2015 were evaluated. Hemodynamically unstable patients and patients with an uncertain diagnosis (n = 2430), patients with suboptimal imaging quality (n = 19), patients lost-to-follow up in four years (n = 44), terminal stage cancer patients (n = 21), and patients without clinical information (n = 43) were excluded from the study. Hence, 303 patients with acute PE confirmed by CT angiography, who have been followed up for four years by our hospital, were included in the study; all their data were recorded.

Outcomes

The demographic characteristics of the patients and all parameters that constitute PESI and sPESI (age over 80 years, history of cancer, chronic cardiopulmonary disease, heart rate > 110 / minute, blood pressure < 100 mmHg, oxygen saturation, and arterial oxyhaemoglobin saturation < 90%) were recorded from the hospital electronic data system. All patients diagnosed with CT angiography examinations were re-evaluated by the hospital radiologist according to the size of the pulmonary artery where the thrombus was located. sPAP measured by echocardiography was also recorded. Patients were

given 1 point in the presence of sPESI parameters. Those with 0 points were recorded as low risk and those who received 1 point or more were categorized as high risk (3). Further, the mortality data of the patients were obtained from the national death reporting system.

Data Analysis

SPSS 23.0 for Windows was used for statistical analysis. Descriptive statistics included the number and percentage for categorical variables and the mean, standard deviation, minimum, and maximum for scale variables. The Shapiro-Wilk test was used to test the normality assumption. Two independent patient group comparisons were conducted using the Student's t-test when scale variables were normally distributed and using the Mann Whitney U-test when the normality condition was not satisfied. Comparisons of ratios in independent groups were performed with the Chi-square test. To examine the relationships, Pearson's and Spearman's correlations were used for parametric and non-parametric variables, respectively. The survival analyses were performed using Life Tables and the Kaplan-Meier analysis. Cut-off points were determined by receiver operating characteristic curves and tested using the log-rank test of equality. The significance level, alpha, was accepted as $p < 0.05$.

RESULTS

Characteristics of Population

The average age of the patients in our study is 57.42 ±17.02; 60.1% are women (182/303) and 39.9% are men (121/303). At the four-year follow-up, 22.8% of the patients died. The median survival time of the patients who died was 137 days. Further, the 30-day mortality was 3.6%, 90-day mortality was 8.9%, and late mortality after 90 days was 13.8% (n = 11, n = 27, and n = 42, respectively). In terms of the comorbidities of patients, malignancy was found in 20.1% of the patients and chronic cardiopulmonary disease (CCD) in 32.7% of the patients (n = 61 and n = 99, respectively). The percentage of patients with the simplified pulmonary embolism severity index of above 1 was 56.4% (n = 171). Further, the subsegmental embolism rate was 20.1% (n = 61), and the mean sPAP measured by echocardiography was 37.16 ±13.76 (min 20, max 85), as presented in Table 1.

Differences between Alive and Exitus Population

With regard to mortality, the PESI score had 91.3% sensitivity, 53.8% specificity, 36.8% positive predictive value, and 95.5% negative predictive value. Among the patients who died, advanced age, male gender, presence of malignancy, CCD, high heart rate, lower blood pressure, and higher sPESI values were detected. No significant difference was found in terms of ECHO findings, sPAP, and pulmonary artery localization of embolism in CT angiography. Among the patients who died, the most important element of sPESI was determined as malignancy, with the lowest p-value, and the second most important was age, as indicated in Table 2.

The Relationship Between Mortality and sPESI Criteria

When sPESI criteria were evaluated individually, and then sPESI as a whole was evaluated, it was determined that all parameters were highly correlated with survival. In particular, malignancy was found to have a higher correlation than the sPESI itself ($r = 0.454$ $p < 0.001$). sPAP was found to be not correlated, but sPESI was found to be correlated with both 30-day and 90-day mortality. Further, malignancy, heart rate, and oxygen saturation components of sPESI were associated with 30-day mortality; in addition to these factors, age was also found to be associated with 90-day mortality, as presented in Table 2. However, late survival after 90 days (n = 42) was neither correlated with sPESI and sPESI components nor with sPAP.

Table 1. Demographical and clinical characteristics of the patient group

		Mean ± SD	Min–Max
Age		57.42 ± 17.02	20–94
		N	**%**
Gender	Female	182	60.1
	Male	121	39.9
State	Alive	234	77.2
	Exitus	69	22.8
Death within 30 days	Yes	11	3.6
	No	292	96.4
Death within three months	Yes	27	8.9
	No	276	91.1
Malignancy	Yes	61	20.1
	No	242	79.9
Chronic Cardiopulmonary Disease	Yes	99	32.7
	No	204	67.3
sPESI Score	1	171	56.4
	0	132	43.6
Echo Finding	Yes	123	40.6
	No	180	59.4
Bilateral	Yes	106	35
	No	197	65
Main Pulmonary Artery	Yes	55	18.2
	No	248	81.8
Lobar	Yes	52	17.2
	No	251	82.8
Segmental	Yes	119	39.3
	No	184	60.7
Subsegmental	Yes	61	20.1
	No	242	79.9
		Median	**Min-Max**
Survival		137	11–1510
		Mean ± SD	**Min-Max**
Heart Rate		92.05 ± 19.04	50–179
Systolic Blood Pressure		121.24 ± 15.71	80–180
SpO2		94.67 ± 6.63	0–99
sPAP		37.16 ± 13.76	20–85

Survival Analysis and Mortality Risk Factors

Since no correlation is observed among 30-day survival, 90-day survival, and sPESI criteria, survival analysis was performed for 69 exitus patients using the Kaplan-Meier method. The log-rank test of equality suggested a significant difference, (χ^2 (1) =14.075, $p < 0.001$) only for different groups of malignity. Patients with malignity have a shorter survival term. Further, receiver operating characteristics (ROC) curves of age, heart rate, systolic blood pressure, and SpO2 indicators were observed to determine the cut off points, sensitivity, specificity, and the area under curve (AUC) values, as depicted in Figure 1.

Patients who are older than the age of 55.50 years (AUC 0.703, $p < 0.001$; CI: 0.643–0.7639), who have a heart rate greater than 108.50 (AUC 0.703, $p < 0.001$; CI: 0.636–0.701), who have smaller SBP than 112.50 (AUC 0.616, $p = 0.05$; CI: 0.528–0.607), and who have SpO2 lower than 93.50 (AUC 0.607, $p = 0.07$; CI: 0.527–0.687), and have more risk than the other patients do in terms of mortality.

Localization of Pulmonary Arterial Thrombus via CT angiography

Pearson's Chi-square test suggests that there is a significant difference between the ratio of subsegmental and other patients in malignity, χ^2 (1) =5.035, $p = 0.031$. In addition, Pearson's Chi-square test suggests that there is a significant difference between the ratio of subsegmental patients and other patients in terms of the PESI score, χ^2 (1) =5.927, $p = 0.020$.

Differences in Age Categories

When we compared the two groups of patients who are older and younger than 65 years of age, we observed that the patients who are aged older than 65 years (n = 107) have significantly lower heart rate and SpO2 as well as a greater percentage of CCD. The percentage of mortality and the sPESI is also significantly higher ($p = 0.001$, $p < 0.001$) in the older group.

Thereafter, the correlations with survival were observed for different age groups, as presented in Table 4. For patients who are aged 65 and older, significant correlation was found with malignity, SBP, and sPESI score (respectively, $p = 0.001$, $p = 0.023$, $p = 0.004$). The 30-day survival was found to be correlated with malignity and SpO2 ($p = 0.001$, $p = 0.043$) and 90-day survival was found to be with malignity and sPESI ($p = 0.001$, $p = 0.038$).

In patients younger than 65 years of age, survival is significantly correlated with age, malignity, heart rate, SpO2, and sPESI ($p < 0.001$, $p < 0.001$, $p = 0.001$, $p = 0.006$, $p < 0.001$). The 30-day and 90-day survival rates are both correlated with age, malignity, heart rate, and sPESI; in addition, SpO2 is correlated with 90-day survival.

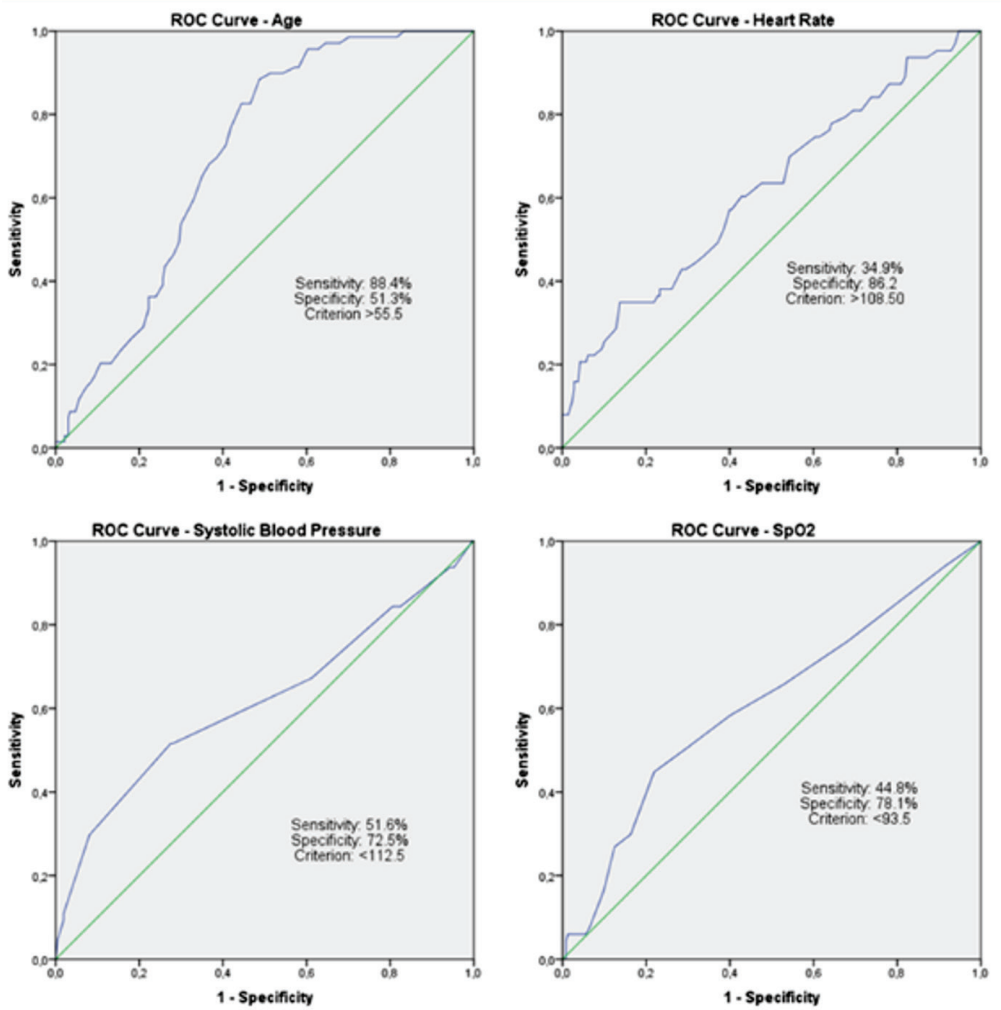
For both groups, no correlation is observed with the anatomical location of PE. Moreover, no correlation with survival is observed between any of these factors in the patients who died later than 90 days.

DISCUSSION

In this study, we examined the characteristics of stable acute pulmonary embolism in patients that we monitored in our hospital and determined the average age of the patients as 57.42 ±17.02. VTE, as it is known, is a disease that usually afflicts the elderly. In previous studies, half of the patients were aged 65 years and older, and the risk of VTE increases with age (1). In our study, the percentage of patients over the age of 65 (n = 107) was only 35%.

In general, the incidence of VTE is reported to be slightly higher or equal in favour of men; however, it varies depending on the age of patients (9). The incidence of VTE is higher in female patients under the age of 45 years and over the age of 80 years. In this study, the percentage of female patients was higher (60.1% vs. 39.9%). This may be due

Figure 1. ROC Curves



to the longer life expectancy of women, estrogen, pregnancy, use of oral contraceptives, or it may be due to those patients who applied to our center for lung metastasis or malignancies like those of the breast (10).

In this study, the 30-day and 90-day mortalities were determined as 3.6% and 8.9%, respectively. Jimenez et al. reported 30-day mortality as 1.8% and 7-day early mortality as 8.9% in their large case registry study (11). Further, the 90-day mortality has been reported to be in the range of 3.3%–19.75% in various studies. However, there are limited number of studies that report a mortality of 90 days or more (12). Therefore, our study is important in terms of questioning the role of the sPESI score in estimating 90-day mortality.

We compared sPESI scores, the individual sPESI criteria, pulmonary artery pressures, and anatomical localization of the embolism of our patients who are alive and those who passed away. sPESI value was observed to be higher in patients who died. All sPESI criteria, except saturation, also showed

significant differences (Table 2). Since our patients were stable, their saturation was generally not low (93%). The ratio of the patients who died was higher among males than females. In addition, among sPESI criteria, malignancy was the most significant criterion among the patients who died. This may be due to a large number of patients with malignancy who applied to our center because of both pulmonary-originated and respiratory symptoms.

With regard to the pulmonary artery pressure, our measurements that are evaluated by echocardiography did not detect a significant difference ($p = 0.277$) between the patients who died (39.92 ±15.99) and those who survived (36.52 ±13.19). In Ceylan et al. (13), no relationship was found between 30-day mortality and sPAP. In particularly, in non-severe pulmonary embolism, the frequency of false positive and false negative results with transthoracic echo is known (14). Moreover, in ESC guidelines, it is stated that the positive predictive value of echocardiography in estimating mortality in acute pulmonary embolism is below 10% in meta-analyses (15).

In the patients who died within 30 days, the presence of malignancy, high heart rate, low SpO2 value and high sPESI score are found associated with death. In those who died within 90 days, age was also associated. In the study of Mizuno et al., no correlation was detected between PESI, sPESI and mortality (16). This may be due to the low mortality rates (2.5%) in their study. Jimenez et al. reported that simple PESI had the same reliability as the original PESI in estimating 30-day mortality, and simple PESI provided an accurate estimation without causing confusion in determining mortality (3).

In our study, most of the sPESI factors were found to be strongly correlated with mortality (Table 2). Malignancy was also found to have a stronger correlation than sPESI itself. Alotaibi et al. also found a higher risk of short-term mortality after pulmonary embolism in patients with cancer compared to those without cancer (17).

In general, when mortality was evaluated, sPESI was found to be associated with mortality, while malignancy and age were found to be the strongest associated criteria. Overall, sPESI was also found to be correlated with 30-day and 90-day mortality, but age was not correlated with 90-day mortality. In addition, the presence of CCD and SBP are not correlated with either 30-day or 90-day mortality (Table 2).

Although in the patients in our study, age was found to be correlated with mortality in general, when we evaluated the effect of sPESI criteria on survival time of the 69 patients who died, we found that age had no effect on survival. We believe that this is due to the small number of patients over 80 years of age. The reason why people over the age of 80 are included in the sPESI criteria may be that the high number of patients with pulmonary embolism who are aged over 80 years in countries where the sPESI score is modeled. The fact that the average life expectancy is shorter in our country compared to the countries where the modeling was proposed may explain the low number of patients over 80 years of age.

We found that the mortality risk was higher in our patients over 55.5 years of age (AUC = 0.703, $p < 0.001$). Barco et al. also reported that in Canada and the United States, the annual mortality rate due to age in PE cases decreased and the age of death regressed to 68 from 73 years (18). They stated that the increase in comorbidities related to PE—such as cancer, respiratory diseases, and infection—in all age groups causes deaths due to PE occurring at an earlier age. Similarly, in our study, the most effective sPESI criterion was found to be the presence of malignancy; CCD was also higher in patients who died.

Further, sPESI criteria such as heart rate, blood pressure, and oxygen saturation alone were not found to be effective in estimating the survival time of patients who died. Considering all criteria, it was observed that total sPESI was not significant in the estimation of survival time in 69 patients who died.

Moreover, we observed heart rate above 108.50

Table 2. Differences in Alive and Exitus Patients, and Correlations (CCD: chronic cardiopulmonary disease; SBP: systolic blood pressure; sPAP: systolic pulmonary artery pressure)

		Alive (n = 234)		Exitus (n = 69)		P
Age		54.70	±17.53	66.67	±11.01	0.000
Gender (Male)		133	56.8%	49	71%	0.037
Malignity		24	10.3%	37	53.6%	0.000
CCD		68	29.1%	31	44.9%	0.019
Heart Rate		89.64	±16.60	100.08	±24.01	0.002
SBP		122.79	±14.35	116.13	±18.78	0.011
SpO2		95.30	±3.56	92.52	±12.11	0.066
sPESI Score (1)		108	46.2%	63	91.3%	0.000
sPAP		36.52	±13.19	39.92	±15.99	0.277
Echo Finding		98	41.9%	25	36.2%	0.486
Bilateral		85	36.3%	21	30.4%	0.392
Main Pulmonary Artery		43	18.4%	12	17.4%	0.999
Lobar		42	17.9%	10	14.5%	0.588
Segmental		96	41.0%	23	33.3%	0.265
Subsegmental		50	21.4%	11	15.9%	0.394

Correlations						
	Status (1: Ex, 0: Alive)		**Death within 30 days**		**Death within 90 days**	
	rho	p	rho	p	rho	p
Age	0.295	0.000	0.053	0.357	0.116	0.043
Malignity	0.454	0.000	0.387	0.000	0.392	0.000
CCD	0.142	0.013	-0.060	0.298	0.004	0.939
Heart Rate	0.174	0.004	0.139	0.021	0.174	0.004
SBP	-0.173	0.004	0.073	0.229	-0.071	0.241
SpO2	-0.156	0.007	-0.138	0.017	-0.153	0.008
sPESI Score	0.382	0.000	0.171	0.003	0.251	0.000
sPAP	0.054	0.548	-0.051	0.571	0.031	0.729

per minute to be a risk indicator of mortality (AUC = 0.619, p = 0.04). Similarly, Gök et al. reported that a heart rate above 109.50 per minute was an independent risk factor (AUC = 0.780, p = 0.018) (19).

Similarly, when the blood pressure level, another sPESI criterion, was evaluated on mortality, it was reported to be risky below 112.50 mmHg (AUC = 0.616, p = 0.05, sensitivity = 51.2%, specificity = 72.5%). Blood pressure below 100 mmHg is an important clinical severity parameter in sPESI, but in our patients, the cutoff point was 112.5 mmHg. Bach et al. reported 99 mmHg in their study (sensitivity = 56%, specificity = 78%) (20).

With regard to the saturation values of our cases, mortality risk was found when the saturation was below 93.50% (AUC = 0.607, p = 0.07, sensitivity = 44.6%, specificity = 78%) (Figure 1). Becattini et al. found that the oxygen saturation below 88% was a risk factor for mortality (21). In our study, the cut off values of blood pressure and oxygen saturation were calculated to be higher (112.50 mmHg and 93.50%) than those specified for the sPESI score, while heart rate was found to be lower (108.50/min). Therefore, we can declare that these values may vary according to the patient population included in each study.

Table 3. Differences in patients aged older than 65 and others (CCD: chronic cardiopulmonary disease; SBP: systolic blood pressure)

	65 and Older (n = 107)		Younger than 65 (n = 196)		P
Gender (Male)	59	55.1%	123	62.8%	0.220
Status (Exitus)	37	34.6%	32	16.3%	0.001
Death within 30 days	3	2.8%	8	4.1%	0.752
Death within 90 days	12	11.2%	15	7.7%	0.300
Survival	426.27	±462.04	281.97	±415.21	0.180
Malignity	24	22.4%	37	18.9%	0.458
CCD	58	54.2%	41	20.9%	0.000
Heart Rate	88.74	±18.00	93.91	±19.40	0.031
SBP	120.68	±15.85	121.54	±15.67	0.665
SpO2	93.96	±4.34	95.53	±3.27	0.001
sPESI Score (1)	81	75.7%	90	45.9%	0.000
sPAP	39.35	±14.54	35.91	±13.22	0.177
Echo Finding	49	45.8%	74	37.8%	0.180
Bilateral	31	29%	75	38.3%	0.130
Main Pulmonary Artery	24	22.4%	31	15.8%	0.163
Lobar	22	20.6%	30	15.3%	0.266
Segmental	39	36.4%	80	40.8%	0.538
Subsegmental	15	14%	46	23.5%	0.053

In addition, when we evaluate the 30-day and 90-day mortality according to the localization of the anatomical involvement of the embolism in pulmonary angiography, no difference in survival was detected (Table 2). Although Harihahan et al. showed that the location of the clot was correlated with short-term prognosis (22), we did not detect this correlation in our study. Moreover, there is no difference between the pulmonary artery pressure of the patients in terms of anatomical involvement, and no correlation was detected between pulmonary artery pressure and survival (Table 2). As in our study, Furlan et al. did not detect this correlation when only the extent of angiographic involvement was considered (23). Nevertheless, when the group with subsegmental involvement was compared with the groups with segmental and lobar pulmonary artery involvement, it was observed that sPESI and malignancy had a lower association in the subsegmental group. In 69 patients who had subsegmental involvement and died, the mean and median values of life expectancy were higher than other anatomical involvements. As already stated in the PE guidelines, due to the low mortality rate, treatment is not recommended for subsegmental embolism if there is no malignancy, if the patient is not symptomatic, and if it is detected incidentally (15).

The patients aged over and under 65 years of age were also compared. As shown in several studies (24, 25), the number of comorbidities in elderly patients over 65 years of age is higher than in younger patients, and this negatively affects the mortality and prognosis of patients. In addition, Duru et al. found a significant relationship between comorbidities and pulmonary embolism over 65 years of age (26). They reported in their study that congestive heart failure was the most common comorbidity and that pulmonary embolism was also responsible for early mortality. They also emphasized that bed rest for more than three days is also associated with pulmonary embolism.

In our study, mortality and cardiopulmonary disease rates and sPESI score were found higher, while the saturation and heart rate were found to be lower in the group of patients aged over 65 years (Table 3). In the group older than 65 years, blood pressure, presence of malignancy, and high sPESI score were associated with mortality. The presence of malignancy was associated with both 30-day and 90-day mortality. Oxygen saturation was significant only at 30-day mortality. sPESI score was associated with 90-day mortality, but not with 30-day mortality. In the younger group, age, heart rate, oxygen saturation, presence of malignancy and sPESI score were associated with mortality. These parameters were also associated with 90-day mortality; however, low saturation was not associated with 30-day mortality (Table 4). Similar to our findings, Jara-Palomares et al. emphasized that sPESI is a good prognostic tool in their study where they found various scores for 30-day mortality in patients under the age of 50 (27). They also reported different characteristics in different age groups. However, they did not separately work on sPESI criteria. Similar to our study, Sandal et al. found a relationship between sPESI and 30,90-day and 5-year mortality (28). However, they did not observe the sPESI criteria individually and they did not question the validity of sPESI in elderly patients.

The limitations of our study are the facts that it was conducted retrospectively, at a single center, and with a relatively small patient population. The fact that we have a small number of patients over the age of 80 can also be considered a weakness. However, we believe that it will contribute to meta-analyses, since there are limited studies that have investigated the operability of sPESI in estimating 90-day mortality and subsequent mortality and examining its criteria separately. It is also powerful in terms of assessing the effectiveness of the anatomical localization of the thrombus and the measurement of sPAP in mortality estimation and survival evaluation in real-life data.

Table 4. Correlations for patients with different age groups (CCD: chronic cardiopulmonary disease; SBP: systolic blood pressure)

	Status (1: Ex, 0: Alive)		Death within 30 days		Death within 90 days	
	rho	p	rho	p	rho	p
Patients aged 65 years and older (n = 107)						
Age	-0.088	0.368	0.051	0.599	-0.156	0.110
Malignity	0.316	0.001	0.316	0.001	0.306	0.001
CCD	0.156	0.110	-0.071	0.466	0.089	0.363
Heart Rate	0.144	0.158	0.076	0.454	0.125	0.221
SBP	-0.230	0.023	0.155	0.129	-0.151	0.139
SpO2	-0.018	0.853	-0.199	0.043	-0.148	0.135
sPESI Score	0.274	0.004	0.096	0.324	0.201	0.038
Bilateral	-0.118	0.227	-0.108	0.266	-0.162	0.096
Main Pulmonary Artery	-0.014	0.885	0.044	0.650	0.022	0.823
Lobar	-0.030	0.763	0.054	0.583	-0.108	0.270
Segmental	-0.020	0.839	-0.129	0.187	-0.146	0.133
Subsegmental	0.046	0.638	0.094	0.333	-0.058	0.552
Patients aged below 65 years (n = 196)						
Age	0.367	0.000	0.194	0.006	0.226	0.001
Malignity	0.563	0.000	0.428	0.000	0.450	0.000
CCD	0.010	0.885	-0.043	0.552	-0.101	0.159
Heart Rate	0.258	0.001	0.166	0.028	0.223	0.003
SBP	-0.134	0.075	0.042	0.575	-0.013	0.862
SpO2	-0.194	0.006	-0.130	0.070	-0.152	0.033
sPESI Score	0.396	0.000	0.224	0.002	0.274	0.000
Bilateral	0.021	0.765	0.050	0.488	0.050	0.489
Main Pulmonary Artery	-0.040	0.576	-0.019	0.794	-0.020	0.785
Lobar	-0.073	0.311	-0.016	0.823	-0.069	0.336
Segmental	-0.086	0.231	-0.066	0.355	-0.044	0.542
Subsegmental	-0.082	0.255	-0.053	0.457	-0.069	0.338

In our study, sPESI was found to be significant in estimating 30-day and 90-day mortality (n = 303). In different age groups, while sPESI is significant in estimating 30-day and 90-day mortality in young patients, it is not sensitive in estimating 30-day mortality in the elderly group (Table 4). In the elderly group, the predictive value of mortality was found to be decreasing and only significant for 90-day mortality. We also observed that sPESI was not significant in the estimation of mortality or survival time in our patients who died after 90 days, which we evaluated over a four-year period. Friz et al. also stated that along with the Charlson index, the sPESI is not significant in the estimation of long-term mortality among the elderly and that comorbidity was more significant in the deaths in this age group (12).

Radiologically, segmental, subsegmental, or lobar pulmonary artery diameter held by the thrombus was not found to be associated with mortality, but survival time was found to be longer in subsegmental pulmonary embolisms in patients who died. In addition, echocardiographically measured sPAP value was found to have no additional contribution to mortality and survival time estimates.

Consequently, our study found that the sPESI is valuable in estimating 30-day and 90-day mortality in patients under 65 years of age; however, the sensitivity of sPESI in estimating 30-day mortality in patients over 65 years of age is reduced. We found that it does not contribute to the estimation of late mortality in our patients who survived longer than 90 days.

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