Outcomes in acute pulmonary embolism (PE) and their association with adherence to international recommendations around COVID-19 pandemic-induced hospital strain before a PERT implementation in a Mexican National Institute of Health

Authors: Juan José Rodríguez-Crespo, [1,] Pedro Dammann-Beltrán,[2,] Jurhiat Alejandro Seaman-Gómez,[3,] Eduardo Gutiérrez-León, [4,] Sergio Contreras-Garduño,[5,] Erick Yasar Zúñiga-González, [6,] Thierry Hernández-Gilsoul, [1,] Luis Adrián Soto-Mota, [3, 7.] **Affiliations:** [1]Emergency Department and Continous Institutional Attention. [2] Department of Neurology & Psychiatry.[3] Metabolic Diseases Research Unit.[4] Department of Medical Education. [5] Hematology and Oncology Department. [6] Nephrology and Mineral Metabolism Department. Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, Mexico City, Mexico. [7] Tecnológico de Monterrey, School of Medicine, Mexico City, Mexico. **The authors have no conflicts of interest to declare that are relevant to the content of this article.**

BACKGROUND

Management of patients with acute pulmonary embolism continues to be a challenge for the clinician. Lack of adherence to international recommendations leads to worse outcomes [1]. During the COVID-19 pandemic, the total number and proportion of severely ill hospitalized patients raised [2], consequently straining human and material resources hindering adherence to clinical guidelines. To date, evaluation of adherence to recommendations before, during and shortly after the COVID-19 pandemic has not been evaluated.

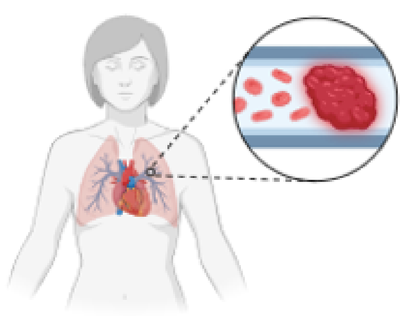
METHODS

A retrospective was performed in patients with the diagnosis of pulmonary embolism admitted to a tertiary care center in Mexico City. A balanced and randomized sample of 50 patients per year between 2019- 2022 was drawn from electronic medical records and analyzed with multivariable and logistic regression models. COVID-19 season was defined as 70% or more of general floor bed occupancy in Mexico City.

We defined adherence to international recommendations based on the compliance of the items shown in Figure 1.

The primary outcome was a composite of in-hospital death, hemodynamic decompensation at day 7, and in-hospital bleeding. Adherence with respect to the composite outcome was assessed using incidence rates and rate ratios according to the COVID-19 season and mortality risk for pulmonary embolism (PE), as well as the population attributable risk.

Figure 1. Illustration of adherence criteria



1. Systemic thrombolysis in patients with high-risk PE.
2. Any advanced treatment in patients with high-risk PE with any contraindication to systemic thrombolysis.
3. Any advanced treatment in patients with intermediate-high risk PE with evidence of possible further deterioration and low bleeding risk
4. Advanced treatment in patients with intermediate-high risk PE following hemodynamic deterioration.
5. Use of IV UFH infusion kidney dysfunction and/or severe obesity and/or high-risk or intermediate-high risk PE with subsequent use of some advanced treatment.
6. Use of LMWH in patients without neither kidney dysfunction nor severe obesity nor in high-risk or intermediate-high risk PE with subsequent use of some advanced treatment
7. Placement of inferior vena cava filter in patients with any contraindication for anticoagulation within the first 3 days of diagnosis.

RESULTS

	COVID-19 season		*P*
	No (N = 86)	Yes (N = 114)	
Age (yr), median	54.50	64.00	0.001
Woman, *N* (%)	49 (56.98)	43 (37.72)	0.007
Patient type, *N* (%)			0.08
Medical	70 (81.40)	105 (92.11)	
Surgical	7 (8.14)	4 (3.51)	
Both	9 (10.47)	5 (4.39)	
Risk factors, *N* (%)			
Obesity	22 (25.58)	41 (35.96)	0.12
Diabetes	19 (22.09)	32 (28.07)	0.34
COPD	4 (4.65)	2 (1.75)	0.23
Hypertension	29 (33.72)	48 (42.11)	0.23
Chronic Kidney Disease	7 (8.14)	10 (8.77)	0.87
Recent Major Surgery	9 (10.47)	4 (3.51)	0.05
Chronic Heart Failure	5 (5.81)	5 (4.39)	0.65
Immobilization	15 (17.44)	12 (10.53)	0.16
Previous VTE	19 (22.09)	10 (8.77)	0.008
Concomitant DVT	34 (39.53)	18 (15.79)	<0.001
Active Cancer	27 (31.40)	14 (12.28)	0.001
Mortality risk, *N* (%)			<0.001
Low	43 (50.00)	26 (22.81)	
Intermediate-low	20 (23.26)	54 (47.37)	
Intermediate-high	15 (17.44)	23 (20.18)	
High	8 (9.30)	11 (9.65)	
PESI Class, *N* (%)			<0.001
I	8 (9.30)	2 (1.75)	
II	20 (23.26)	9 (7.89)	
III	22 (25.58)	24 (21.05)	
IV	10 (11.63)	39 (34.21)	
V	26 (30.23)	40 (35.09)	
PESI score (pts)	104.59 ± 37.51	119.38 ± 29.38	0.01
Biochemical and clinical parameters			
Heart rate, beats / minute	106.13 ± 23.22	105.63 ± 22.32	0.87
Respiratory rate, breaths / minute	23.67 ± 7.18	28.45 ± 8.33	0.001
Oxygen saturation, %	87.06 ± 11.31	77.83 ± 15.66	<0.001
High-sensitivity troponin I, pg/mL	104.21 ± 382.25	126.54 ± 208.58	<0.001
Hemoglobin, g/dL	11.99 ± 2.86	13.63 ± 3.42	<0.001
Platelets, 10x10^3	229.72 ± 139.65	246.42 ± 121.09	0.37
INR	1.40 ± 0.75	1.79 ± 5.24	0.85
Creatinine, mg/dL	1.38 ± 1.74	1.47 ± 2.65	0.08
Sodium, mmol/dL	136.18 ± 5.99	136.30 ± 4.61	0.89
Electrocardiographic changes, N (%)			0.15
Without baseline electrocardiogram	32 (37.21)	51 (44.74)	
Sinus rhythm	13 (15.12)	24 (21.05)	
Changes associated with PE	41 (47.67)	39 (34.21)	
Other relevant variables, N (%)			
Stay in Intensive Care	31 (36.05)	51 (44.74)	0.22
Mechanic Ventilation	10 (11.63)	35 (30.70)	0.001
Hemodynamic Decompensation	13 (15.12)	27 (23.68)	0.13
In-hospital death	22 (25.58)	42 (36.84)	0.09
Non-adherence	29/66 (43.94)	50/108 (46.30)	0.76

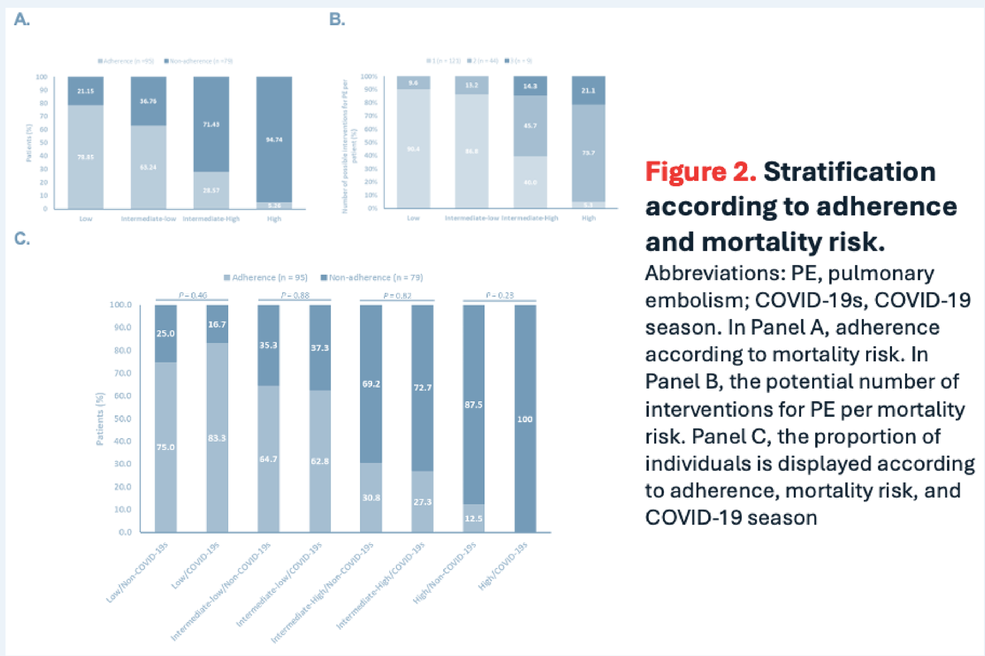
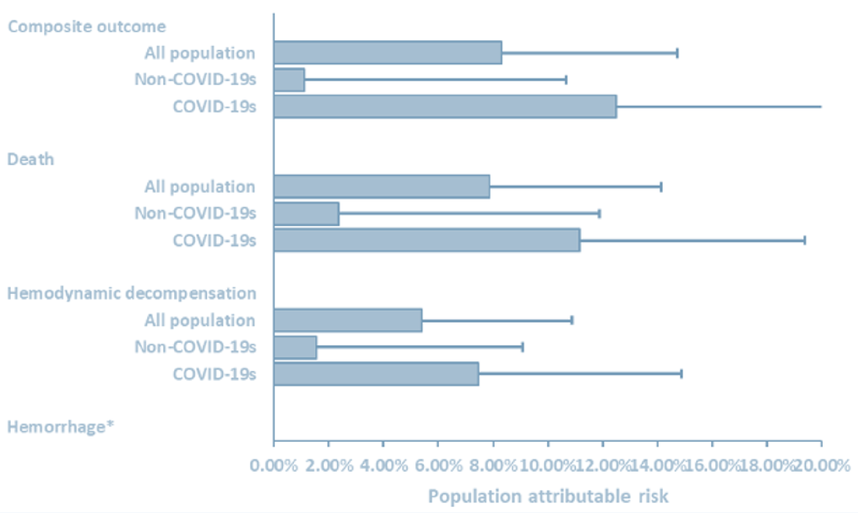


Figure 2. Stratification according to adherence and mortality risk.
Abbreviations: PE, pulmonary embolism; COVID-19s, COVID-19 season. In Panel A, adherence according to mortality risk. In Panel B, the potential number of interventions for PE per mortality risk. Panel C, the proportion of individuals is displayed according to adherence, mortality risk, and COVID-19 season

Figure 3. Population attributable risk of non-adherence by composite and individual outcomes.



DISCUSSION

Our results suggest:
1) Routine management of patients with acute pulmonary embolism at our institution presented, in many cases, a non-adherent management regarding the use of anticoagulation, use of inferior vena cava filters, and use of advanced treatmentsGuideline adherence deviations were common.
2) The major risk factors for non-adherence were the presence of a higher mortality risk classification and a higher PESI score.
3) Non-adherent management strongly correlated with adverse in-hospital outcomes, especially during the COVID-19 pandemic-induced hospital-strain.

We found that lack of adherence was mostly presented in the next three circumstances:
1) Need for any advanced treatment in patients with high-risk PE with any contraindication to systemic thrombolysis.
2) Placement of inferior vena cava filters.
3) Use of any advanced treatment in patients with intermediate-high risk PE with further risk of hemodynamic decompensation and with a low bleeding risk.

CONCLUSION

This is the largest analysis about management appropriateness of PE patients in our country, and the only one with a balanced and randomized strategy around the COVID-19 pandemic-induced hospital-strain. Guideline adherence deviations were common. The major risk factors for non-adherence were a high mortality risk classification and a higher PESI score, non-adherent management strongly correlated with adverse in-hospital outcomes, especially during the COVID-19 pandemic. Overall, our findings highlight the need of prioritizing the necessary human and material resources to warrant adherence to the current standards-of-care of PE patients.

CONTACT INFORMATION

E-mail: juan.rodriguezc@incmnsz.mx

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