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Sex Differences in Outcomes of Percutaneous Pulmonary Artery Thrombectomy in Patients With Pulmonary Embolism

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BACKGROUND: The sex differences in use, safety outcomes, and health-care resource use of patients with pulmonary embolism (PE) undergoing percutaneous pulmonary artery thrombectomy are not well characterized.

RESEARCH QUESTION: What are the sex differences in outcomes for patients diagnosed with PE who undergo percutaneous pulmonary artery thrombectomy?

STUDY DESIGN AND METHODS: This retrospective cross-sectional study used national inpatient claims data to identify patients in the United States with a discharge diagnosis of PE who underwent percutaneous thrombectomy between January 2016 and December 2018. We evaluated the demographics, comorbidities, safety outcomes (in-hospital mortality), and health-care resource use (discharge to home, length of stay, and hospital charges) of patients with PE undergoing percutaneous thrombectomy.

RESULTS: Among 1,128,904 patients with a diagnosis of PE between 2016 and 2018, 5,160 patients (0.5%) underwent percutaneous pulmonary artery thrombectomy. When compared with male patients, female patients showed higher procedural bleeding (16.9% vs 11.2%; $P <$ .05), required more blood transfusions (11.9% vs 5.7%; $P <$ .05), and experienced more vascular complications (5.0% vs 1.5%; $P <$ .05). Women experienced higher in-hospital mortality (16.9% vs 9.3%; adjusted OR, 1.9; 95% CI, 1.2-3.0; $P =$ .003) when compared with men. Although length of stay and hospital charges were similar to those of men, women were less likely to be discharged home after surviving hospitalization (47.9% vs 60.3%; adjusted OR, 0.7; 95% CI, 0.50-0.99; $P =$ .04).

INTERPRETATION: In this large nationwide cohort, women with PE who underwent percutaneous thrombectomy showed higher morbidity and in-hospital mortality compared with men.

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KEY WORDS: disparities; hospitalizations; outcomes; pulmonary embolism; sex; sex differences; thrombectomy

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ABBREVIATIONS: ICD-10 = International Classification of Diseases, Tenth Revision; NIS = Nationwide Inpatient Sample; PE = pulmonary embolism; PERT = Pulmonary Embolism Response Team

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Take-home Points

Study Question: What are the sex differences in outcomes for patients with a diagnosis of pulmonary embolism (PE) undergoing percutaneous pulmonary artery thrombectomy?

Results: Women were found to have higher rates of procedural bleeding, to require more blood transfusions, to have more vascular complications, to have higher in-hospital mortality and were less likely to be discharged home after surviving hospitalization when compared with men.

Interpretation: This large nationwide cohort study suggests that women with PE who underwent percutaneous thrombectomy showed higher morbidity and mortality compared with men, highlighting the need for future studies characterizing the factors contributing to this disparity and implementation of clinical protocols and policies that aim to mitigate this outcome gap.

Pulmonary embolism (PE) accounts for nearly annual 100,000 deaths in the United States and is among the top three causes of cardiovascular death after myocardial infarction and stroke.[1] In patients with intermediate and high-risk PE, in addition to anticoagulation, therapeutic escalation with interventions such as systemic thrombolysis, catheter-directed thrombolysis, surgical embolectomy, and percutaneous pulmonary artery thrombectomy have garnered interest.[2] Since the first case report of Greenfield embolectomy in 1971, catheter-based percutaneous pulmonary artery thrombectomy therapies have been developed and used rapidly.[3-6]

Female patients hospitalized for PE have been shown to experience adverse outcomes when compared with male patients.[7-9] However, sex-based differences in outcomes for those undergoing advanced interventional therapies such as percutaneous pulmonary artery thrombectomy currently are unknown. We hypothesized that women undergoing catheter-based thrombectomy had a higher risk of complications, in-hospital mortality, and health-care resource use.

Study Design and Methods

Study Data

We conducted a retrospective cross-sectional study using the Nationwide Inpatient Sample (NIS) database to derive patient-relevant information from January 1, 2016, through December 31, 2018. This study period was selected because International Classification of Diseases, Tenth Revision (ICD-10), procedure codes for pulmonary thrombectomy were introduced on October 1, 2015. The University of California, Los Angeles, Institutional Review Board exempted this study for de-identified data of minimal risk to patients because the NIS is a publicly available de-identified database. We obtained data from a national cohort of patients with PE who were hospitalized between 2016 and 2018 to determine sex differences in safety outcomes (in-hospital mortality) and health-care resource use (length of stay, discharge to home vs nonhome disposition such as nursing home) for women and men.

The NIS is part of the Healthcare Cost and Utilization Project, sponsored by the Agency for Healthcare Research and Quality, and is the largest publicly available all-payer claims-based database in the United States (www.hcup-us.ahrq.gov/nisoverview.jsp). The database contains hospital inpatient stays derived from billing data submitted by hospitals to statewide data organizations across the United States. These data include clinical and resource use information typically available from discharge abstracts. Researchers and policy makers use the NIS to make national estimates of health-care use, access, charges, quality, and outcomes. The NIS sampling frame includes data from 47 statewide data organizations, covering more than 97% of the US population. The annual sample encompasses approximately 8 million discharges, which represent 20% of inpatient hospitalizations across different hospital types and geographic regions. The national estimates of the entire US hospitalized population are calculated using a standardized sampling and weighting method provided by the Healthcare Cost and Utilization Project. The NIS has been used extensively to assess national trends in the use, disparities, and outcomes of PE and other cardiopulmonary diseases.[7,10-14]

Study Population

Patients 18 years of age or older with a diagnosis of PE who underwent percutaneous pulmonary artery thrombectomy between 2016 and 2018 were identified using ICD-10, Clinical Modification, diagnosis and procedure codes (e-Table 1). Previously validated ICD-10, Clinical Modification, codes were used to identify patients with a discharge diagnosis of PE.[15,16] ICD-10 procedure codes for pulmonary artery thrombectomy had to be present in addition to PE diagnostic codes for the study cohort. NIS variables were used to identify patients' demographic characteristics, including age, sex, race or ethnicity, insurance status, median socioeconomic status, insurance type, length of stay, hospital charges, and discharge disposition (such as death and routine discharge to home) (Table 1). The comorbidities were identified using ICD-10, Clinical Modification, diagnoses (e-Table 1). The procedures were identified using ICD-10 procedure codes (e-Table 1). All ICD-10 codes were obtained from Center for Medicare and Medicaid Services website.[17]

Outcomes

The primary outcome was in-hospital death. We also studied procedural bleeding, vascular complications, and transfusion procedures (identified using ICD-10 codes as listed in e-Table 1), as carried out previously.[18] In addition, to assess health-care resource use, we analyzed length of stay and discharge disposition to home vs nonhome facilities such as nursing homes or similar facilities.

TABLE 1] Baseline Demographics and Overall Hospitalization Characteristics for Women vs Men

Characteristic	Overall (N = 5,160)	Women (n = 2,520)	Men (n = 2,640)	*P* Value
Age, y	61.3 (60.4-62.2)	62.0 (60.5-63.5)	60.7 (59.5-61.8)	.16
Age groups, y				< .001
18-40	9.5 (7.9-11.4)	11.7 (9.2-14.8)	7.4 (5.5-9.9)	
40-65	43.6 (40.7-46.6)	36.5 (32.5-40.7)	50.4 (46.3-54.5)	
> 65	46.9 (43.8-50.0)	51.8 (47.4-56.2)	42.2 (38.1-46.5)	
Race				.37
White	69.7 (66.5-72.7)	66.9 (62.5-71.1)	72.3 (67.8-76.4)	
Blacks	21.1 (18.6-23.8)	22.5 (19.0-26.4)	19.8 (16.3-23.7)	
Hispanic	6.8 (5.3-8.6)	8.1 (5.9-11.0)	5.5 (3.8-8.0)	
Asian or Pacific Islander	1.0 (0.5-0.8)	1.10 (0.5-2.2)	1.0 (0.4-2.3)	
Native American	0.1 (0.01-0.7)	0.0	0.2 (0.02-1.4)	
Others	1.3 (0.8-2.2)	1.5 (0.7-3.0)	1.2 (0.5-2.6)	
Payer status				< .001
Medicare	46.7 (43.6-49.7)	51.7 (47.3-56.0)	41.8 (37.7-46.0)	
Medicaid	12.1 (10.2-14.2)	14.3 (11.5-17.7)	9.9 (7.7-12.6)	
Private	35.2 (32.2-38.2)	30.6 (26.7-34.9)	39.5 (35.5-43.8)	
Self-pay	3.7 (2.7-5.1)	2.2 (1.3-3.8)	5.1 (3.5-7.6)	
No charge	0.01 (0.01-0.7)	0.0	0.2 (0.02-1.3)	
Other	2.3 (1.6-3.3)	1.2 (0.5-2.6)	3.4 (2.3-5.1)	
Median socioeconomic status by national quartiles				.03
0-25th	30.0 (26.9-33.3)	33.4 (29.2-37.9)	26.9 (22.9-31.2)	
25th-50th	26.7 (24.0-29.6)	27.5 (23.8-31.6)	25.9 (21.9-29.5)	
50th-75th	24.2 (21.6-27.1)	22.9 (19.5-26.7)	25.5 (21.9-29.5)	
75th-100th	19.0 (16.6-21.8)	16.2 (13.2-19.7)	21.7 (18.4-25.5)	
Admission status				
Nonelective admission	92.2 (90.2-93.7)	93.1(90.2-95.1)	91.3 (88.5-93.5)	.32
Comorbidities				
Hypertension	59.2 (56.1-62.2)	58.9 (54.6-63.1)	59.5 (55.2-63.6)	.86
Hyperlipidemia	32.9 (30.2-35.7)	30.2 (26.4-34.2)	35.4 (31.4-39.6)	.08
Diabetes	24.8 (22.3-27.6)	23.0 (19.6-26.8)	26.5 (22.9-30.5)	.19
Obesity	33.4 (30.6-36.4)	36.7 (32.7-40.9)	30.3 (26.6-34.3)	.03
History of PE	6.7 (5.3-8.4)	6.2 (4.4-8.5)	7.2 (5.2-9.9)	.49
History of DVT	10.0 (8.3-12.0)	9.3 (7.2-12.1)	10.6 (8.1-13.7)	.50
Coronary artery disease	17.8 (15.6-20.3)	16.9 (13.9-20.4)	18.8 (15.5-22.6)	.45
Heart failure	20.2 (17.8-22.7)	20.2 (16.9-24.1)	20.1 (16.9-23.7)	.95
Atrial fibrillation	15.7 (13.7-18.0)	15.1 (12.2-18.5)	16.3 (13.4-19.6)	.60
Cerebrovascular disease	8.0 (6.6-9.8)	8.7 (6.7-11.3)	7.4 (5.5-9.9)	.41
Chronic pulmonary disease	11.1 (9.4-13.2)	10.1 (7.7-13.1)	12.1 (9.7-15.1)	.31
Chronic renal disease	33.6 (30.9-36.5)	32.5 (28.5-36.9)	34.7 (30.8-38.7)	.49
Chronic liver disease	10.0 (8.2-12.0)	10.5 (8.2-13.4)	9.5 (7.2-12.4)	.57
Pulmonary hypertension	23.2 (20.7-26.1)	25.2 (21.5-29.3)	21.4 (18.1-25.1)	.14
Cancer	16.9 (14.8-19.2)	17.1 (14.1-20.6)	16.7 (13.8-20.0)	.86
Pneumonia	7.9 (6.3-9.9)	8.9 (6.6-11.9)	7.0 (5.1-9.5)	.25
Shock	19.1 (16.8-21.6)	23.4 (19.9-27.4)	15.0 (12.1-18.3)	< .01
Acute respiratory failure	50.2 (47.1-53.3)	53.8 (49.4-58.1)	46.8 (42. 5-51.1)	.03

(Continued)

TABLE 1] (Continued)

Characteristic	Overall (N = 5,160)	Women (n = 2,520)	Men (n = 2,640)	P Value
Concomitant advanced PE treatment				
Catheter-directed thrombolysis	31.5 (28.6-34.5)	31.0 (27.1-35.1)	32.0 (28.0-36.3)	.71
Systemic thrombolysis	11.6 (9.8-13.8)	11.5 (9.0-14.6)	11.7 (9.1-15.0)	.91
Surgical embolectomy	1.0 (0.5-1.7)	0.8 (0.3-1.8)	1.1 (0.5-2.5)	.54
Cardiopulmonary mechanical supportive therapies				
ECMO	2.8 (1.9-4.1)	3.0 (1.8-4.9)	2.6 (1.4-4.7)	.77
Mechanical invasive ventilation	19.7 (17.4-22.1)	21.0 (17.8-24.7)	18.4 (15.2-21.9)	.29
Thrombectomy-specific characteristics				
Time from admission to thrombectomy, d	1.7 (1.5-1.9)	1.8 (1.5-2.1)	1.7 (1.4-2.0)	.63
Admission day same as day of thrombectomy	41.2 (37.9-44.5)	41.7 (37.2-46.3)	40.8 (36.2-45.4)	.77

Data are presented as percentage or mean (95% CI), unless otherwise indicated. ECMO = extracorporeal membrane oxygenation; PE = pulmonary embolism.

Statistical Analyses

All analyses accounted for the NIS cluster design and survey weights. We then compared baseline characteristics (demographics, comorbidities) of women vs men for patients undergoing percutaneous pulmonary artery thrombectomy during hospitalization for PE. Descriptive statistics are presented as mean (95% CI) for continuous variables or percentage (95% CI) for categorical variables. Between-group differences were analyzed using Pearson χ^2 test for categorical variables and the *t* test for continuous variables. Significance testing was performed with multivariate unconditional logistic regression with female as a categorical variable for the outcome of in-hospital mortality. To evaluate the association between female sex and mortality, we fit an incremental multivariate regression model in the following sequence: (1) unadjusted and (2) adjusted for all variables (demographics, clinical comorbidities or complications) into the regression model regardless of their statistical significance on univariate analysis to study the association of female sex with the outcome of in-hospital mortality (Table 2). Similar analyses also were performed for the outcome of discharge to home for those who survived hospitalization.

Sensitivity Analyses

We performed several sensitivity analyses to test the robustness of our findings. The association of in-hospital mortality with female patients in different subgroups is shown in e-Table 2. First, we focused on those who underwent thrombectomy on the same day as hospital admission (42.0%). Second, we excluded those who had elective admission status (8.0%). Third, we excluded those who received additional therapies such as systemic thrombolytics (11.6%) and catheter-directed thrombolysis (31.5%). Fourth, we studied the outcomes of women vs men for those who had a diagnosis of PE but did not undergo percutaneous pulmonary artery thrombectomy (e-Table 3). Finally, we analyzed the patient characteristics by in-hospital vital status (e-Table 4). For all analyses, two-sided *P* values of $< .05$ were considered to be statistically significant. All statistical analyses were performed with Stata version 17.0 software (StataCorp, LLC).

Results

As shown in Figure 1, between January 2016 and December 2018, among 90,879,560 adult US hospitalizations, 1,124,619 patients (1.2%) had a discharge diagnosis of PE. Among these, 5,160 patients (0.5%) were treated with percutaneous thrombectomy (n = 2,520 [0.4%; 95% CI, 0.4%-0.5%] in women and n = 2,640 [0.5%; 95% CI, 0.4%-0.5%] in men; *P* = .09) (Fig 1). The proportion of overall patients with PE undergoing percutaneous thrombectomy increased from 0.4% in 2016 to 0.6% in 2018 (men, increase from 0.4% to 0.6%; women, increase from 0.4% to 0.5%) (Fig 2). Table 1 shows baseline demographics and clinical characteristics. When compared with men, women were more likely to be older than 65 years, be Black or Hispanic, and have lower socioeconomic status. Women were more likely to have a diagnosis of shock, acute respiratory failure, or procedural bleeding complications; to receive blood transfusions; and to experience vascular complications. The proportion of common vascular complications is listed in e-Table 5. When compared with men, women experienced higher procedural bleeding (16.9% vs 11.2%; $P < .05$), required more blood transfusions (11.9% vs 5.7%; $P < .05$), and experienced more vascular complications (5.0% vs 1.5%; $P < .05$) (Fig 3).

TABLE 2] Association of Female Sex With In-Hospital Mortality in Patients With Pulmonary Embolism Undergoing Catheter Thrombectomy

Variable	Adjusted OR[a] (95% CI)	P Value
In-hospital mortality	1.9 (1.3-3.0)	.003

[a]Regression model adjusted for all characteristics listed in Table 1 (age, sex, race, median socioeconomic status, insurance, comorbidities, admission status, concomitant advanced treatment, mechanical support therapies, and thrombectomy characteristics).

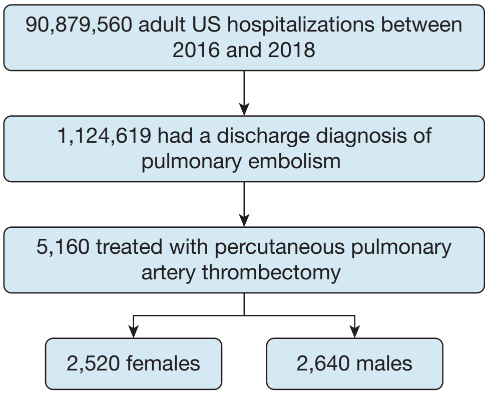

Figure 1 – *Flowchart showing the study population.*

As shown in Figure 3 and Table 2, women undergoing percutaneous pulmonary artery thrombectomy showed higher in-hospital mortality (16.9% vs 9.3%; adjusted OR, 1.9; 95% CI, 1.2-3.0; $P = .003$), and among those who survived hospital stay, women were less likely to be discharged to home (47.9% vs 60.3%; adjusted OR, 0.70; 95% CI, 0.50-0.99; $P = .04$) (Table 3). The length of stay and hospital charges was similar in both groups (Table 3). The sensitivity analyses results were consistent with the original analyses (e-Tables 2-4).

Discussion

In this nationally representative descriptive study evaluating percutaneous pulmonary artery thrombectomy use in PE, we noted that female sex was associated with higher in-hospital mortality. This report using a national administrative data is the largest description of sex disparities in outcomes of patients hospitalized with PE undergoing percutaneous thrombectomy. To account for possible confounding from multiple factors that could influence mortality, we adjusted our findings for age and other demographic factors as well as comorbidities. The persistence of substantially increased risks of poorer outcomes associated with female sex, despite such adjustments, strengthens the overall validity of our findings. Overall, considerable sex-based differences were present in the outcomes of patients with PE who underwent percutaneous pulmonary thrombectomy. The explanation for such differences in outcomes for women is not clear, but findings from this study will help to raise awareness and to elucidate potential contributors to the disparity. This observation emphasizes the need for further sex-focused research and strategies to understand better and to improve health-care outcomes. The overall use of catheter thrombectomy was low (approximately 0.5%) among the overall PE cohort. However, as the proportion of patients with PE undergoing catheter-based pulmonary thrombectomy increases, identifying sex differences in outcomes potentially could help to create sex-specific approaches with respect to patient selection and procedure-related aspects.

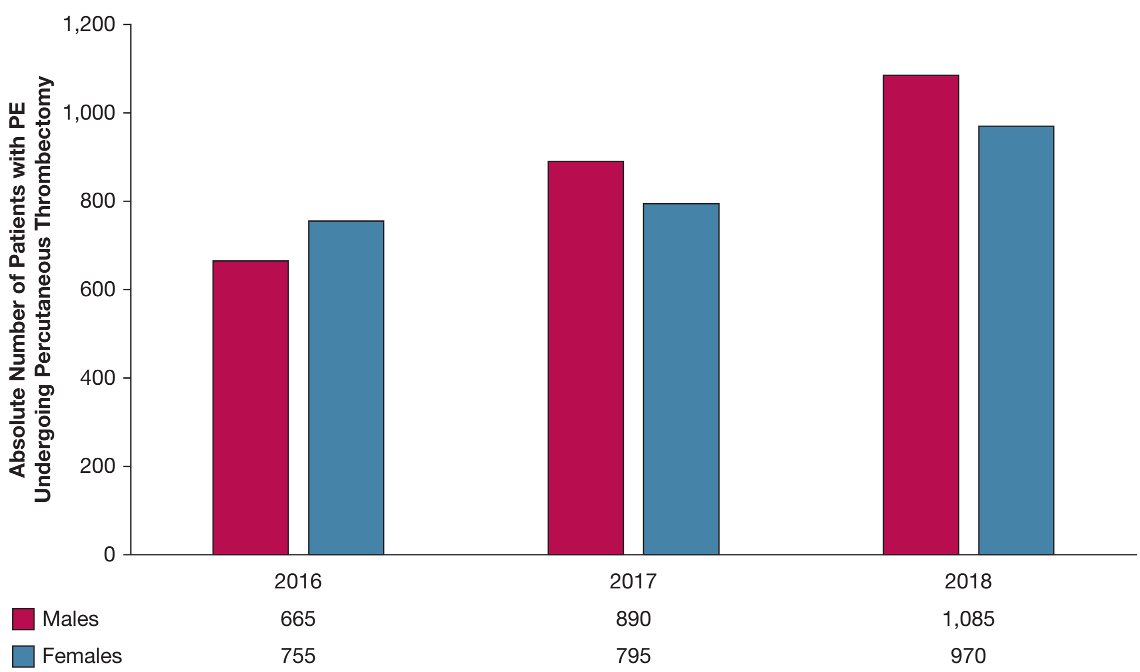

Figure 2 – *Bar graph showing the annual absolute number of patients with pulmonary embolism undergoing percutaneous pulmonary artery thrombectomy between 2016 and 2018.*

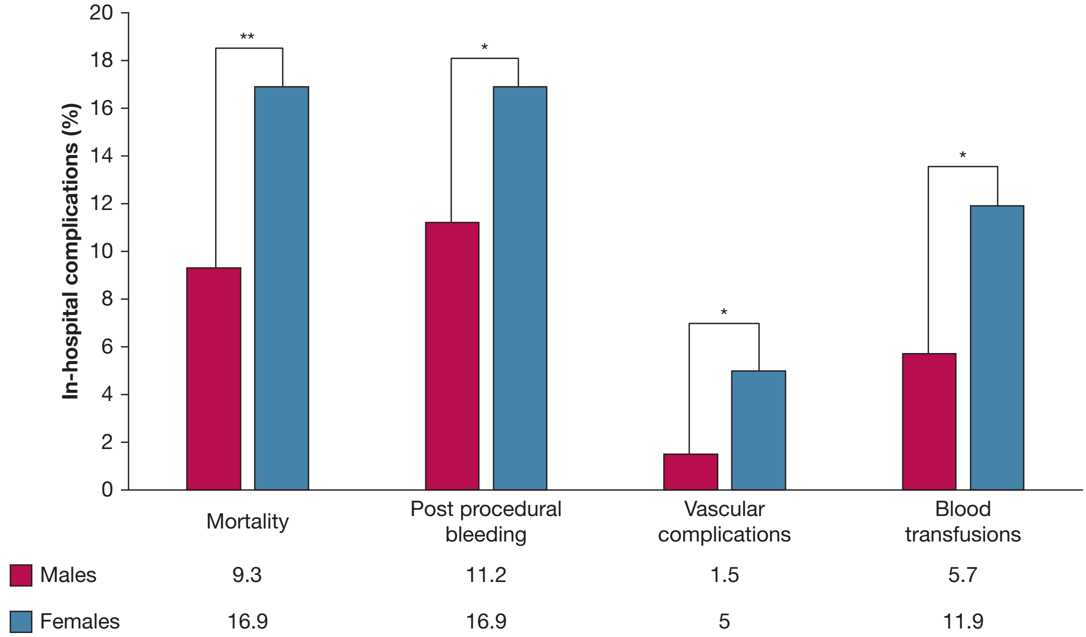

Figure 3 – *Bar graph showing in-hospital complications for men and women undergoing percutaneous pulmonary artery thrombectomy. *P < .01 and **P < .05, women vs men.*

We described sex-based differences in outcomes of patients with PE undergoing percutaneous pulmonary artery thrombectomy. This observation is similar to those observed in non-PE thrombectomy procedures such as in ischemic stroke.[19] Although studies with smaller sample sizes have described overall outcomes of percutaneous pulmonary artery thrombectomy, data focusing on sex disparities do not exist.[6,20-28] In a single-center study of 14 patients, in-hospital mortality of 14% was reported, similar to that seen in our study.[27] A multicenter analysis of the Pulmonary Embolism Response Team Consortium studied short-term 30-day outcomes for 475 patients with PE who were treated by different strategies, including a small proportion by percutaneous thrombectomy.[29] They reported a mortality of 16% and major bleeding rate of 13%, similar to that seen in our study.[29] Kuo et al,[21] in a systematic review of 594 patients from studies conducted before 2010, reported complications rates ranging between 2% and 8%. In another review of patients undergoing thrombectomy, a clinical success rate of 81% to 95% was reported.[22] Bunc et al[28] reported in-hospital mortality of

TABLE 3] Health Care Resources Use for Men vs Women

Variable	Overall (N = 5,160)	Women (n = 2,520)	Men (n = 2,640)	*P* Value
Mean length of stay, d	8.4 (7.7-9.0)	8.8 (7.8-9.7)	8.0 (7.2-8.8)	.23
Total charges, USD	183,375 (169,720-197,030)	180,408 (163,429-197,387)	186,162 (164,888-207,435)	.68
Routine discharge to home[a]	54.5 (51.0-57.9)	47.9 (42.9-52.8)	60.3 (55.7-64.2)	< .001
Unadjusted OR	. . .	0.6 (0.5-0.8)	Reference	< .001
Adjusted OR	. . .	0.7 (0.5-0.99)	Reference	.04

Data are presented as mean (95% CI), unless otherwise indicated. USD = US dollars.
[a]For those who survived hospitalization.

approximately 32% among a small sample of 25 patients who were treated at a single center with percutaneous pulmonary artery thrombectomy. In a more contemporary retrospective analysis of 34 patients undergoing aspiration thrombectomy, in-hospital mortality of 3% was reported, with even lower complication rates reported in clinical trials.[25] These dissimilarities in overall outcomes from the present study can be attributed to differences in study sample size, type of device used, inclusion and exclusion criteria, patient characteristics, publication bias (for case reports), and different study periods. Nevertheless, in our analysis of real-world experience for patients with PE who underwent pulmonary thrombectomy, the differences in outcomes based on sex clearly are notable at a national level.

We found that when compared with men, women constituted a higher proportion of major bleeding and blood product transfusion events. Bleeding complications can be secondary to factors surrounding the procedure such as use of non-sex-based anticoagulation strategies,[30] large sheath size, access site bleeding, and postprocedure bleeding, as described in non-PE procedural studies.[31] To our knowledge, this is the first study to report higher bleeding rates in women undergoing percutaneous pulmonary artery thrombectomy. Such higher adverse bleeding rates in women are similar to that reported in previously published VTE studies.[32,33] In our study, blood transfusion rates were higher in women than in men, plausibly because of lower baseline hemoglobin levels before the procedure in women that can lower the threshold for blood transfusion.[34] Similarly, sex has been shown to predict the vascular complications and mortality independently after vascular access procedures.[35-38] The higher vascular complications rate in women undergoing procedures plausibly can be the result of smaller iliofemoral vessels when compared with men that potentially could account for higher risk of complications.[31] Finally, women might have had a delayed time to intervention, leading to complicated presentation, as seen in other acute conditions such as myocardial infarction and ischemic stroke.[39,40] Although our study does not contain information regarding symptom onset to presentation time, a higher proportion of women experienced shock and acute respiratory failure.

Extensive literature exists describing differences in outcomes based on socioeconomic and insurance status in the United States.[16,41-44] In our study, more women belonged to lower socioeconomic status strata and fewer had private insurance. Although it is unclear whether these income and insurance disparities contributed to the worse outcomes in women, similar results have been published by studies focusing on medical treatment of VTE, thrombectomy in ischemic stroke, and myocardial infarction.[14,43-45] Potential explanations include delays in hospital presentation resulting from geographical locations with decreased access to hospitals, differences in use of standard practice, health care delivery systems, and performance of emergency services. Additionally lower literacy levels contributing to lag in self recognition of symptoms leading to a more complicated presentation.

Interestingly, despite a higher proportion of women with shock, acute respiratory failure, blood transfusions, bleeding, and vascular complications, no sex differences were found in length of hospital stay and related charges. Hence, although in-hospital resource use for women seems to be similar to that for men, it is not clear why such statistically significant differences in comorbidities and complications were not carried over into hospital length of stay and hospital charges characteristics between the two groups. Further, for those who survived hospital stay, women were less likely to be discharged to home and had higher use of nursing home and similar ancillary facilities, suggesting higher overall health-care resource use in women when compared with men. Female sex previously was shown to predict discharge to nonhome facilities and nursing home placement after hospitalization.[7,46,47] Such observations support the notion that women undergoing pulmonary thrombectomy for PE may represent a vulnerable patient population.

In summary, our study evaluated sex-based differences in outcomes of patients with PE undergoing percutaneous pulmonary artery thrombectomy and reported higher adverse outcomes in women when compared with men. Further dedicated studies evaluating these disparities and the integration of sex-based approaches into the comprehensive care of patients with PE undergoing percutaneous thrombectomy are warranted.

Study Limitations

Our findings are limited by the inherent biases of retrospective, observational analyses involving large administrative databases, including selection bias, confounding factors, and coding inaccuracies. We used procedure codes to identify study cohort that have been shown to improve sensitivity and specificity.[48] However, this could lead to an underestimation of hospitalizations, given that it relies on discharge codes for identifying patients.[49] Although the entire study cohort underwent pulmonary thrombectomy, the reasons for admission might have been non-PE-related causes. To address this, when we limited analysis to only those who underwent thrombectomy on the same day as hospital admission (approximately 42%), we found similar results as in the original analysis (e-Table 2). Given the high risk that patients with PE are more likely to undergo thrombectomy procedures as a nonelective (urgent or emergent) procedure, we analyzed nonelective admissions separately (approximately 92%) and found similar results (e-Table 2). We were not able to assess PE severity given the lack of available data, such as vital signs, hemodynamics, laboratory markers, echocardiographic and CT scan details (right ventricle to left ventricle ratio), and angiographic details from pulmonary angiography. However, given that we focused our analysis on patients with PE undergoing pulmonary thrombectomy, this group is more likely to reflect intermediate or high-risk patients with PE. Additionally, the overall in-hospital mortality was similar to that of previously published data from registries such as the Pulmonary Embolism Response Team.[29] The anticoagulation-related pharmacotherapeutic details are not available in this dataset. We used specific postprocedural complication codes for bleeding and vascular complications and blood transfusion procedure codes to increase the accuracy for identification of in-hospital complications. However, the dataset is not able to distinguish comorbidities from actual hospital-related complications. In addition, we were not able to assess if the patients underwent Pulmonary Embolism Response Team discussion to guide management. We also were unable to assess the type of percutaneous thrombectomy catheters used, and a variety of devices and approaches likely were used in clinical practice during the period of study. The outcomes are limited to in-hospital events, and the exact cause of death is not available. We were not able to study the relevance of patient's physical characteristics (such as height) with vascular complications because of a lack of such details in the database. We identified vascular and bleeding complications using previously used ICD-10 codes (e-Table 5).[18] However, they lack validation, predisposing the analysis to inherent errors. It is critical to emphasize that the study cohort was highly selected, focusing on only those patients with PE who underwent thrombectomy. Although it is plausible that such aggressive therapies may lead to adverse outcomes in women, our study lacks power and is limited to analyze such associations appropriately because of inherent database limitations. Nevertheless, our study provides important insight into the real-world data to study the sex disparities in outcomes of patients with PE treated with percutaneous pulmonary artery thrombectomy.

Interpretation

In conclusion, female sex is associated with higher in-hospital clinical events and a substantially higher use of nursing home or similar ancillary facilities after discharge compared with male sex. Our data suggest that female patients undergoing percutaneous pulmonary artery thrombectomy represent a particularly vulnerable patient population. Further studies are needed to validate our findings and to determine the causes of the increased adverse events and health-care resource use that we observed in this cohort of patients with PE undergoing percutaneous thrombectomy. Efforts then can be directed toward decreasing these events and optimizing health-care resource use.

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Additional information: The e-Tables are available online under "Supplemenary Data."

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