ORIGINAL ARTICLE

Implementation of a regional multidisciplinary pulmonary embolism response team: PERT-POZ initial 1-year experience

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KEY WORDS
pulmonary embolism, pulmonary embolism response team, catheter-directed thrombectomy, systemic thrombolysis, anticoagulation

ABSTRACT

BACKGROUND Pulmonary embolism (PE) is the third most common potentially life-threatening cardiovascular disease. A new approach of pulmonary embolism response teams (PERTs) has been introduced to provide rapid multidisciplinary assessment and treatment of patients with PE. However, detailed data on institutional experience and clinical outcomes from such teams are missing.

AIMS The aim of this study was to report our experience with the management of PE guided by the PERT-POZ within the first year of operation.

METHODS We performed a prospective study of PERT-POZ activations at a university care center between October 2018 and October 2019. Patient characteristics, therapies, and clinical outcomes were evaluated.

RESULTS There were 86 unique PERT-POZ activations, and PE was confirmed in 80 patients including: 9 patients (11.25%) classified as low-risk PE, 19 (23.75%) as intermediate-low risk, 38 (47.5%) as intermediate-high, and 14 (17.5%) as high-risk. Sixty patients (75%) received anticoagulation only, 28 (35%) direct oral anticoagulant, 7 (8.75%) vitamin K antagonist, 23 (28.75%) low-molecular-weight heparin, and 2 (2.50%) unfractionated heparin. Ten patients (12.5%) were treated with catheter-directed thrombectomy, 6 (7.5%) received systemic thrombolysis, 2 (2.5%) underwent surgical embolectomy, 2 (2.5%) were on extracorporeal membrane oxygenation support, and 2 (2.5%) underwent pharmacomechanical venous thrombectomy. There were 7 (8.75%) in-hospital deaths, and 2 (2.5%) deaths during a 3-month follow-up. Bleeding complications were rare: only 3 patients (3.75%) had major bleeding events, but none after administration of systemic thrombolysis.

CONCLUSIONS Our study demonstrated that after the creation of PERT-POZ with a precise activation protocol, patients with intermediate and high-risk PE received most optimal treatment strategies.

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INTRODUCTION Pulmonary embolism (PE) is one of the most common cardiovascular diseases, with an estimated global incidence rate of 39 to 115 per 100 000 person-years.[1,2] Pulmonary embolism may be life-threatening with an estimated 30-day mortality rate of 10% to 30%.[3] According to the current European Society of Cardiology guidelines, it is mandatory to initially assess the risk of early death based on clinical and hemodynamic criteria to determine management strategy.[4]

Depending on estimated patients' mortality risk, a variety of therapeutic approaches are now

WHAT'S NEW?

Pulmonary embolism (PE) represents one of the leading causes of cardiovascular-related mortality. Depending on the estimated risk of mortality, guidelines provide numerous treatment strategies including anticoagulation, systemic thrombolysis, catheter-directed therapies, and surgical embolectomy. Nevertheless, there is significant dissent regarding the optimal therapeutic approach for PE, peculiarly for patients in intermediate-risk group. In order to assure rapid and expert-based individualized care, a strategy of multidisciplinary pulmonary embolism response team has been developed. To the best of our knowledge, this is the first European study reporting the implementation of multidisciplinary team approach in the management of PE.

available for PE management in the acute setting including anticoagulation, systemic thrombolytic therapy, catheter-directed therapy, embolectomy, inferior vena cava (IVC) filter placement, extracorporeal membrane oxygenation (ECMO), temporary mechanical support, or a combination of these strategies.[5-14]

Current guidelines recommend a multidisciplinary approach to PE management with the creation of a pulmonary embolism response team (PERT).[4] It is a group of specialists from different disciplines including cardiology, interventional cardiology, cardiothoracic surgery, vascular medicine, anesthesiology or intensive care, radiology, pulmonology, and hematology who rapidly evaluate, coordinate diagnosis, and offer full range of most advanced therapeutic options for patients with PE to rescue and prevent further deterioration.[15-17] Since it first emerged in the Massachusetts General Hospital in 2013, the PERT-based model of PE management has gained ground not only throughout the United States, but also across Europe and all over the world.[16-19] Nevertheless, detailed data on institutional experience and preliminary outcomes from PERTs are sparse, especially from Europe. To address this need, we described our experience of the first full year of PERT action at a university hospital.

METHODS

Logistics of the pulmonary embolism response team

The PERT in our center in Poznań, Poland (PERT-POZ) was established in 2018. The algorithm of PERT-POZ activation for everyday practice was created. A referring physician activates the PERT-POZ by calling a 24-hour, 7-day-a-week telephone number. A PERT-POZ representative quickly responds and gathers clinically relevant information including symptoms, medical history, clinical status, hemodynamic parameters (blood pressure, heart rate, respiratory rate), laboratory parameters (troponin level, natriuretic peptides levels, blood gases parameters), radiological data (location and size of PE, presence of right ventricle [RV] dysfunction, and location of concomitant deep vein thrombosis) and presence of RV dysfunction on echocardiography, if available. When appropriate, the team members are notified of a new PE case via mobile phone or communication application, and a conference call is arranged. Members of the PERT-POZ review data and the representative feeds back diagnostic and treatment recommendations to the referring provider within 30 minutes. If a therapeutic intervention is recommended, the PERT-POZ also provides the required resources. In all cases, the PERT-POZ recommends reassessment 24 to 48 hours after the initial presentation. The PERT activation algorithm is presented schematically in FIGURE 1.

Patient enrollment and data collection

We performed a prospective analysis of all consecutive PERT-POZ activations between October 2018 and October 2019—the first full year of our institutional PERT registry—in a university hospital to determine impact of PERT-guided therapy. The study protocol was approved by the institutional bioethics committee (decision no. 879/19). We analyzed the frequency of team activation, patient characteristics, PE severity, treatments delivered, outcomes with in-hospital mortality, major bleedings as defined by the International Society of Thrombosis and Hemostasis, and clinical 1-month and 3-month follow-up.[20]

Severity of pulmonary embolism Pulmonary embolism was categorized as low risk, intermediate-low risk, intermediate-high risk, or high risk in accordance with the current guidelines of the European Society of Cardiology. In all PE cases, the Pulmonary Embolism Severity Index (PESI) and simplified Pulmonary Embolism Severity Index (sPESI) were calculated.[4,21,22] For each normotensive patient, the modified Bova score was also calculated.[23] High-risk PE was defined as confirmed PE with clinical instability (defined as persistent hypotension or cardiac arrest) or obstructive shock. Intermediate-high-risk PE was defined as confirmed PE without clinical instability, but with RV dysfunction confirmed by both imaging (computed tomography pulmonary angiography [CTPA] or transthoracic echocardiography) and biomarkers (elevated troponin or brain natriuretic peptides [B-type natriuretic peptide or N-terminal proB-type natriuretic peptide]) as well as PESI class III or higher or at least 1 point in sPESI. Intermediate-low-risk PE was defined as confirmed PE without clinical instability but with RV dysfunction strain confirmed either by imaging or biomarkers, and PESI class III or higher or at least 1 point in sPESI. Low-risk PE was defined as confirmed PE without any of the above criteria.[4,21]

Treatment and outcomes All therapeutic interventions guided by the PERT-POZ were recorded for each patient. The PERT-POZ recommendation

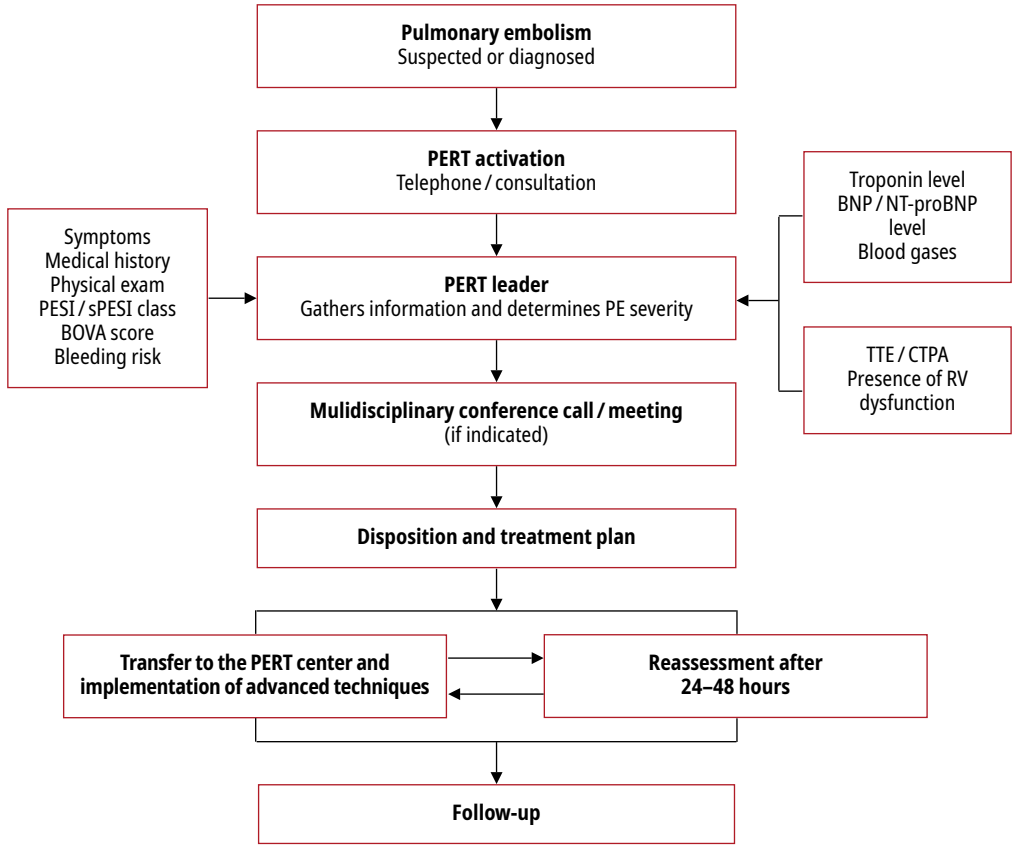

FIGURE 1 Pulmonary embolism response team activation algorithm
Abbreviations: BNP, B-type natriuretic peptide; CTPA, computed tomography angiography; NT-proBNP, N-terminal proB-type natriuretic peptide; PE, pulmonary embolism; PERT, pulmonary embolism response team; PESI, pulmonary embolism severity index; RV, right ventricle; sPESI, simplified pulmonary embolism severity index; TTE, transthoracic echocardiography

included anticoagulation alone or implementation of advanced strategies together with anticoagulation approach. To clarify PERT-POZ operation, we present the final PERT-POZ recommendations (as opposed to the first recommendation). Anticoagulation alone included administration of one of the specific antithrombotic drugs: low-molecular-weight heparin (LMWH), unfractionated heparin (UFH), direct oral anticoagulant (DOAC; rivaroxaban, apixaban or dabigatran), or vitamin K antagonist (VKA; warfarin or acenocoumarol). Systemic thrombolysis (ST) was defined as the administration of a full dose (100 mg) of recombinant tissue plasminogen activator (rtPA) infused intravenously over 2 hours. A half-dose ST (50 mg of rtPA) was administered in patients with cardiac arrest. Catheter-directed mechanical aspiration thrombectomy (CDT) was performed with the use of the Indigo CAT8 XTORQ system (Penumbra, Alameda, California, United States). Catheter-directed thrombolysis was implemented in a single patient before mechanical thrombectomy. The rate of surgical embolectomy (SE), ECMO, IVC filter placement, and venous pharmacomechanical thrombectomy were also recorded. Pharmacomechanical thrombectomy was defined as a rheolytic thrombectomy performed with the use of the AngioJet system (Medrad Inc., Warrendale, Pennsylvania, United States) inserted into the thrombus lesion with concomitant low-dose rtPA infusion. To compare with previous studies, we evaluated in-hospital outcomes as well as outcomes 30 and 90 days after the PERT-POZ activation. The outcomes included all-cause mortality, recurrent venous thromboembolism, and bleeding complications, especially major bleeding complications defined according to the International Society on Thrombosis and Hemostasis criteria.[20] Additionally, the Charlson Comorbidity Index score was calculated for each patient.[24]

Statistical analysis Descriptive characteristics are reported as number and percentage of cases for categorical variables or median and interquartile range (IQR) for continuous variables without normal distribution. Statistical analysis was performed using Statistica 13.7 version (StatSoft Inc., Tulsa, Oklahoma, United States).

RESULTS There were 86 unique activations of the PERT-POZ in the initial 12 moths of operation. The number of PERT-POZ activations increased each 3-month period (quarter) during

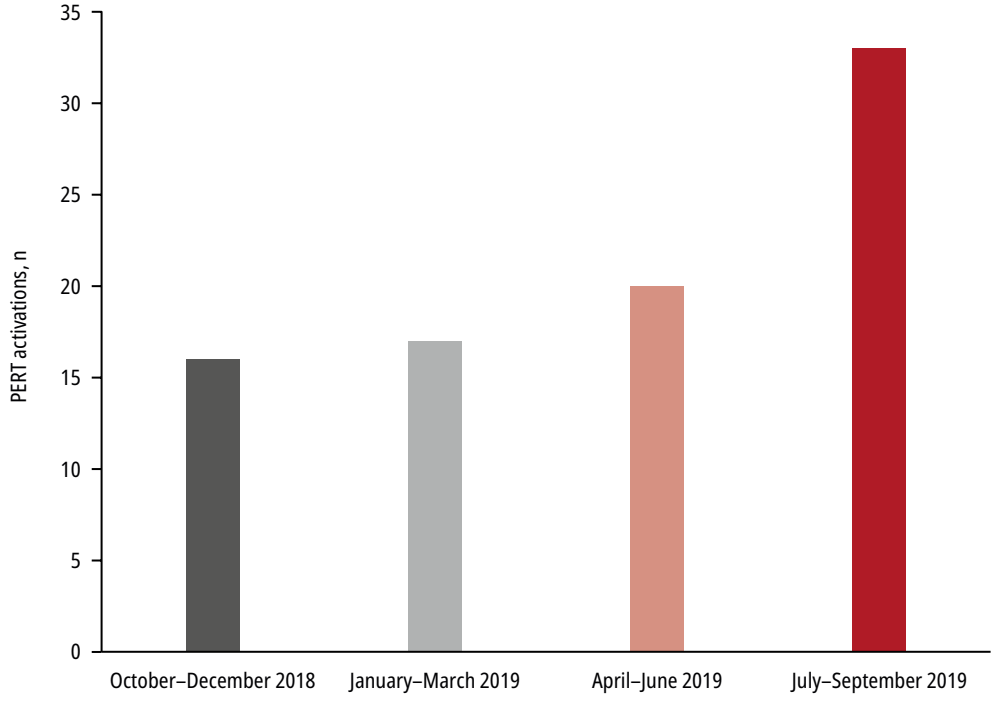

FIGURE 2 Pulmonary embolism response team activations in the initial year of action (divided into quarters)
Abbreviations: see FIGURE 1

the first year (FIGURE 2). Pulmonary embolism was diagnosed in 80 patients, in 4, PE was excluded on CTPA, and in 2, PE was neither confirmed nor excluded since they died before the final diagnosis. Among all patients with confirmed PE, there were 14 high-risk PE cases (17.5%), 38 intermediate high-risk PE cases (47.5%), 19 intermediate low-risk PE cases (23.75%), and 9 low-risk PE cases (11.25%). Detailed data are presented in FIGURE 3.

Patient characteristics Baseline clinical characteristics of patients with PE, including PE risk factors and symptoms, are presented in TABLE 1. The median (IQR) age was 65 (47–73) years and more than half of the patients were women (53.75%). Median (IQR) body mass index was 27.54 (23.87–30.82) kg/m^2. The median (IQR) Charlson Comorbidity Index score was 3 (1–5), which indicates that patients were moderately ill prior to PE occurrence. The most frequent presenting symptoms were dyspnea at rest (New York Heart Association [NYHA] functional class IV) in 66.25% of all patients or dyspnea on minimal exertion (NYHA functional class III) in 27.5%, followed by pleuritic chest pain in 11.25% and syncope in 11.25%. The leading PE risk factor was recent hospitalization (within 3 weeks prior PE diagnosis) in 30% of patients, which was due

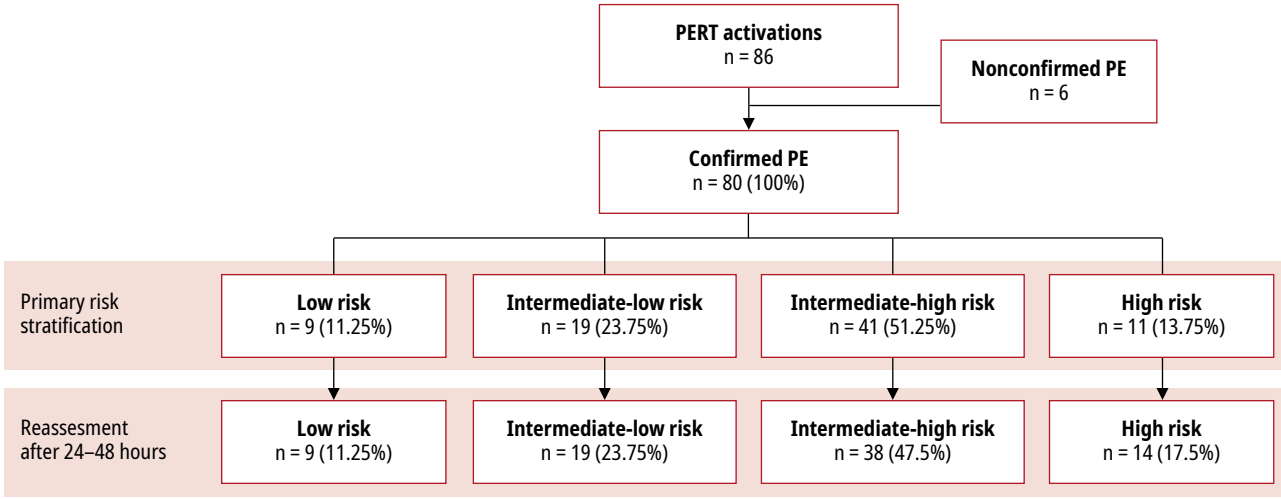

FIGURE 3 All pulmonary embolism response team activations
Abbreviations: see FIGURE 1

TABLE 1 **Demographics, comorbidities, and risk factors among all patients with pulmonary embolism** **(continued on the next page)**

Characteristics		Patients (n = 80)
Sex	Female	43 (53.75)
	Male	37 (46.25)
Age, y, median (IQR)		65 (47–73)
Body mass index, kg/m^2, median (IQR)		27.54 (23.87–30.82)
Symptoms		
Dyspnea (NYHA functional class)	I–II	4 (5)
	III	22 (27.5)
	IV	53 (66.25)
Chest pain		9 (11.25)
Syncope		9 (11.25)
Cough		1 (1.25)
Unilateral lower extremity pain		8 (10)
Comorbidities		
Previous PE		6 (7.5)
Previous DVT		6 (7.5)
Congestive heart failure		8 (10)
Coronary artery disease		11 (13.75)
Atrial fibrillation		10 (12.5)
Chronic obstructive pulmonary disease		2 (2.5)
Asthma		4 (5)
Connective tissue disease		2 (2.50)
Arterial hypertension		37 (46.25)
Gastrointestinal bleeding		1 (1.25)
Diabetes		15 (18.75)
Malignancy	Total	22 (27.5)
	Solid localized	4 (5)
	Metastatic	15 (18.75)
	Gastrointestinal	7 (8.75)
	Genitourinary system	4 (5)
	Reproductive system	5 (6.25)
	Hematologic	3 (3.75)
	Other	3 (3.75)
Active treatment	Chemotherapy	16 (20)
	Other	3 (3.75)
Renal failure (glomerular filtration rate <60 ml/min/1.73 m^2)		10 (12.5)
Stroke		8 (10)
Cerebrovascular disease		3 (3.75)
Charlson Comorbidity Index, median (IQR)		3 (1–5)
Smoking		2 (2.5)
Recent hospitalization		24 (30)
Recent surgery or invasive procedure		12 (15)
Recent trauma		14 (17.5)

TABLE 1 **Demographics, comorbidities, and risk factors among all patients with pulmonary embolism (continued from the previous page)**

Characteristics	Patients (n = 80)
Indwelling catheter	1 (1.25)
Hormonal therapy (oral contraceptive)	3 (3.75)
Reduced mobility	15 (18.75)
Depression	5 (6.25)
Known thrombophilia	2 (2.5)
Family history of venous thromboembolism	1 (1.25)

Data are presented as number (percentage) of patients, unless otherwise indicated.

Abbreviations: DVT, deep vein thrombosis; IQR, interquartile range; NYHA; New York Heart Association; others, see FIGURE 1

to the recent surgery in 15%. Presence of active malignancy was revealed in 27.5%, and most frequently it was gastrointestinal cancer (8.75%).

Characteristics of patients with pulmonary embolism Indicators of PE severity among patients with confirmed PE stratified by the category of mortality risk are presented in detail in TABLE 2. The majority of patients (75%) with confirmed PE presented signs of RV dysfunction on transthoracic echocardiography or on CTPA, 68.75% had elevated troponin level, and 81.25% had elevated B-type natriuretic peptide or N-terminal proB-type natriuretic peptide levels. Concomitant deep vein thrombosis was diagnosed in 47.5% of all patients with PE. Extracorporeal membrane oxygenation was implemented in 2 high-risk patients with PE (2.5%), and 12 patients (15%; 10 high-risk PE and 2 intermediate-high risk PE) were admitted to the intensive care unit.

A total of 64 patients (80%) had central PE located in the main pulmonary artery (saddle), right or left pulmonary arteries, lobar arteries, or right heart (FIGURE 4). The vast majority of central PE cases was revealed in high-risk (100%) and intermediate-high risk (86.84%) patients with PE. Only 4 (44.44%) central PE cases were found in the low-risk group, and 13 (68.42%) central PE cases were detected in the intermediate--low risk group.

Anticoagulation alone was the most common final treatment approach recommended by the PERT-POZ members and was administered in 60 patients (75%). Out of those patients, 28 (35%) received DOAC, 23 (28.75%) LMWH (22 of those patients had coexistent malignancy, 1 had a hemorrhagic stroke), 7 (8.75%) VKA, and 2 (2.5%) UFH (these patients had had contraindications to ST and died before CDT implementation). Systemic thrombolysis was

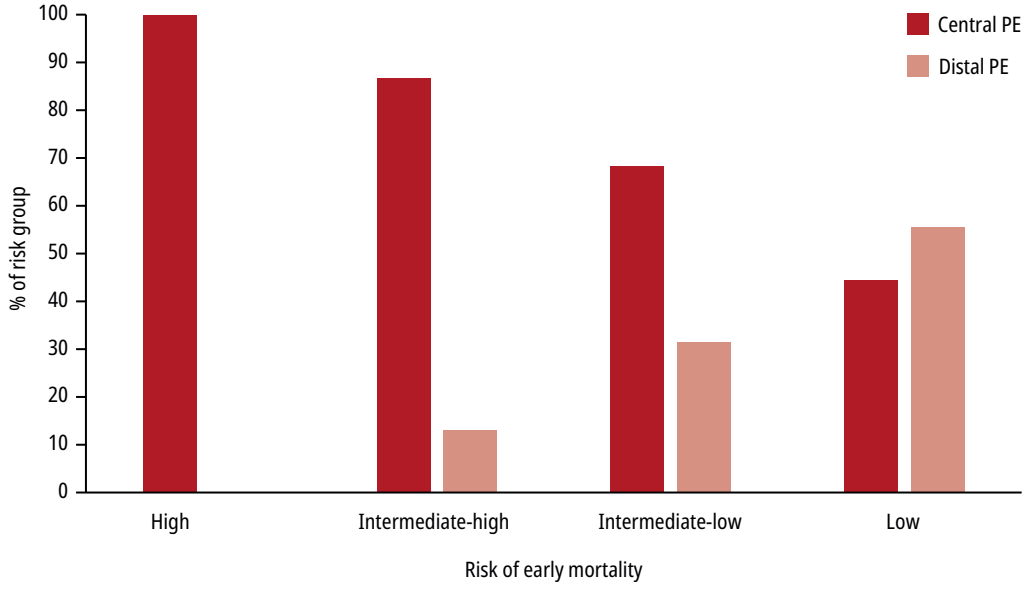

FIGURE 4 Distribution of pulmonary embolism within groups categorized according to risk of early mortality. Central PE is defined as saddle, left or right pulmonary artery, lobar pulmonary artery.
Abbreviations: see FIGURE 1

implemented in 6 high-risk patients with PE (7.5%). Ten patients (12.50%) were treated with CDT—in one case (1.25%) CDT was performed in a patient on ECMO support. Two (2.50%) patients with high-risk PE underwent SE, one of them (1.25%) was also placed on ECMO support. Adjunctive therapies were also applied, 2 patients (2.5%) underwent pharmacomechanical thrombectomy. None of the patients received IVC filter (FIGURE 5).

TABLE 2 Pulmonary embolism characteristics of patients with confirmed pulmonary embolism stratified according to risk category

PE risk category		All (n = 80)	Low risk (n = 9)	Intermediate-low risk (n = 19)	Intermediate-high risk (n = 38)	High risk (n = 14)
PE location						
Bilateral		67 (83.75)	8 (88.9)	11 (57.9)	34 (89.47)	14 (100.00)
Unilateral		13 (16.25)	1 (11.11)	8 (42.1)	4 (10.53)	–
Saddle		20 (25)	–	4 (21.05)	8 (21.05)	8 (57.14)
Pulmonary artery		1 (1.25)	–	–	–	1 (7.14)
Lobar		41 (51.25)	4 (44.44)	9 (47.37)	25 (65.79)	3 (21.43)
Segmental		13 (16.25)	4 (44.44)	5 (26.32)	4 (10.53)	–
Subsegmental		2 (2.5)	1 (11.11)	1 (5.26)	–	–
Combined proximal and distal		3 (3.75)	–	–	1 (2.63)	2 (14.29)
Extra-pulmonary thrombus (intracardiac)		3 (3.75)	–	–	2 (5.26)	1 (7.14)
Clinical parameters of PE severity						
Right ventricle dysfunction on echocardiography		60 (75)	–	8 (42.1)	38 (100)	14 (100)
Right ventricle dysfunction on CTP		54 (67.5)	–	5 (26.32)	35 (92.10)	14 (100)
Troponin (>cutoff)		55 (68.75)	–	3 (15.79)	38 (100)	14 (100)
BNP or NT-proBNP (>cutoff)		65 (81.25)	4 (44.44)	15 (78.95)	32 (84.21)	14 (100)
DVT	Total	38 (47.5)	6 (66.67)	10 (52.63)	18 (47.37)	4 (28.57)
	Proximal	29 (36.25)	4 (44.44)	5 (26.31)	16 (42.1)	4 (28.57)
	Distal	7 (8.75)	1 (11.11)	5 (26.31)	1 (2.63)	–
Upper extremity		2 (2.5)	1 (11.11)	–	1 (2.63)	–
PESI Class						
I–II		21 (26.25)	9 (100)	9 (47.37)	3 (7.90)	–
III		21 (26.25)	–	9 (47.37)	12 (31.58)	14 (100)
IV		11 (13.75)	–	–	11 (28.95)	–
V		28 (35)	–	1 (5.26)	12 (31.58)	14 (100)
PESI Score, median (IQR)		103 (81–134)	45 (33–64)	58.5 (55–60)	112 (98–113)	192 (175–231)
sPESI						
Low risk		16 (20)	9 (100)	5 (26.31)	2 (5.26)	–
High risk (>1 point)		64 (80)	–	14 (73.69)	36 (94.74)	14 (100)
BOVA Score, median (IQR)		5 (2–5)	0	1 (1–1)	4.5 (4–5)	7 (7–7)
Clinical severity						
Endotracheally intubated		11 (13.75)	–	–	2 (5.26)	9 (64.28)
ECMO support		2 (2.5)	–	–	–	2 (14.28)
Admitted to ICU		12 (15)	–	–	2 (5.26)	10 (71.43)

Data are presented as number (percentage) of patients, unless otherwise indicated.

Abbreviations: ICU, intensive care unit; others, see FIGURE 1 and TABLE 1

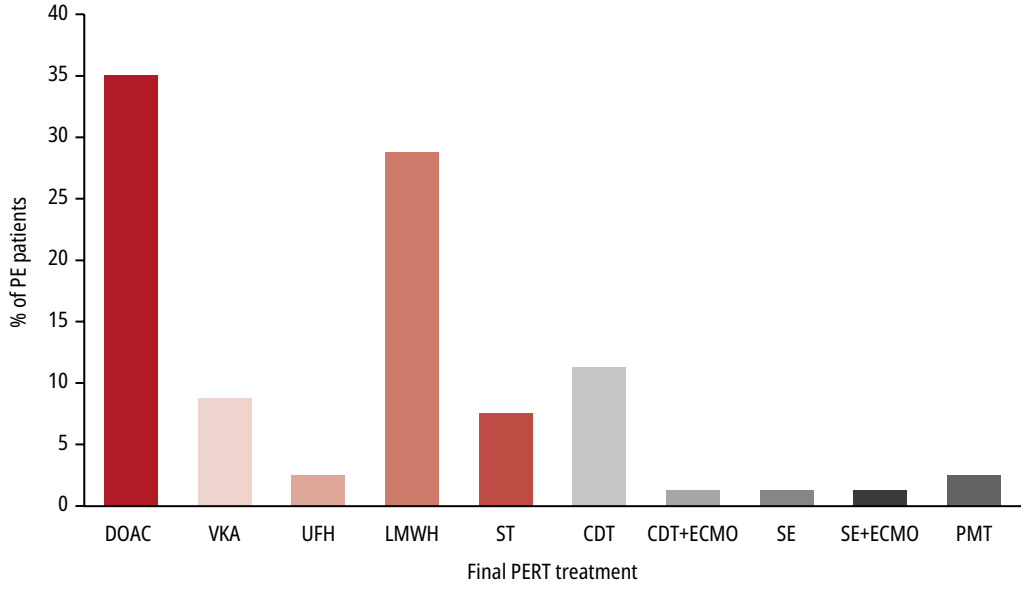

FIGURE 5 The distribution of treatment delivered by pulmonary embolism response team
Abbreviations: AC, anticoagulation; CDT, catheter-directed mechanical aspiration thrombectomy; DOAC, direct oral anticoagulant; ECMO, extracorporeal membrane oxygenation; LMWH, low molecular weight heparin; PMT, pharmacomechanical thrombectomy; SE, surgical embolectomy; ST, systemic thrombolysis; UFH, unfractionated heparin; VKA, vitamin K antagonist; others, see FIGURE 1

Patient outcomes Safety outcomes of patients treated by the PERT-POZ are presented in TABLE 3. In-hospital PE mortality was 8.75%. There were 2 deaths in the group of intermediate-high-risk patients who received only anticoagulation with UFH. Five deaths occurred in the high-risk group, in 2 cases a full-dose ST was implemented, 1 patient had CDT with ECMO support, 1 patient underwent SE with ECMO support, and 2 patients received UFH, but unfortunately died before transferring to our hospital. There were 2 deaths in the 3-month follow-up due to disseminated neoplastic disease.

Major bleedings occurred in 3 (3.75%) patients—all in the intermediate-high-risk group during the in-hospital stay. We recorded 1 hemorrhagic stroke in 1 patient on UFH anticoagulation, massive subcutaneous hematomas in 1 patient who underwent CDT with local thrombolysis, and 1 severe nasal bleeding after VKA implementation. There were no major bleedings during 1-month and 3-month follow-up.

DISCUSSION

The management of PE requires complex risk stratification and decision making.

To improve the efficiency of PE care and to optimize the treatment of PE across different specialties, the PERT approach have been established.[16,25] The PERT-guided approach brings PE care in line with other life-threatening diseases for which multidisciplinary team collaboration has improved outcomes.[26]

We provide the first analysis of PERT activity in Europe. During the first year of existence, PERT-POZ was activated 86 times. The number of consultations increased gradually each quarter, which was associated with growing acceptance of PERT activity throughout our institution and other medical centers in the region. In order to increase awareness of the PERT-POZ, team leaders have provided educational activity in the form of lectures, articles, and case presentations to various clinical groups.[10,27] Social media such as twitter (account @PertPoz) have been also used for sharing PERT-POZ experience. We have made many efforts to maintain uniformity in data collection and risk stratification with use of standardized PERT templates for medical documentation.

Majority of PERT-POZ patients initially presented with intermediate-high risk PE (51.25%), clinical management of which is challenging due to the risk for sudden clinical deterioration and death despite normal hemodynamics at initial assessment.[4,6] In our cohort, within the first 24 to 48 hours of treatment, 3 of 41 intermediate-high risk PE patients (7.32%) suddenly decompensated hemodynamically to high-risk and 2 received ST and 1 underwent successful CDT. High-risk PE was initially diagnosed in 13.75% of patients, which was comparable with previously published results of the National PERT Consortium multicenter registry and smaller single-center studies.[15,28,29]

Although low-risk PE was not the original goal of the PERT approach, several previous studies reported PERT activation as applicable.[15,16,28] In the present study, 11.25% of PERT activations were for low-risk PE patients. Our results are similar to those from the National PERT Consortium multicenter registry, where PERT was activated in 18.75% for low-risk PE.[28] The role of PERT in low-risk PE could be crucial for the management of patients with contraindications to

TABLE 3 Safety outcomes of pulmonary embolism response team treated patients

	In-hospital					1-month follow-up					3-month follow-up				
	Mortality	Major bleeding	Minor bleeding	Recurrent PE	Recurrent DVT	Mortality	Major bleeding	Minor bleeding	Recurrent PE	Recurrent DVT	Mortality	Major bleeding	Minor bleeding	Recurrent PE	Recurrent DVT
All	7 (8.75)	3 (3.75)	1 (1.25)	–	1 (1.25)	–	–	1 (1.25)	–	1 (1.25)	2 (2.50)	–	–	–	1 (1.25)
Intermediate-low risk	–	–	1 (1.25)	–	–	–	–	–	–	–	–	–	–	–	–
Intermediate-high risk	2 (5.26)	3 (7.89)	–	–	1 (2.63)	–	–	1 (2.63)	–	1 (2.63)	2 (5.26)	–	–	–	1 (2.63)
High risk	5 (35.71)	–	–	–	–	–	–		–	-	–	–		–	-

Data are presented as number (percentage).

There was no complications and mortality in the low-risk group during in-hospital stay or follow-up.

Abbreviations: see FIGURE 1 and TABLE 1

standard anticoagulation or coexisting morbidities who need complex approach. The other reason for the mobilization of PERT in low-risk PE may be central clot location on imaging studies which increases clinicians' concern despite absence of RV dysfunction. In the present study, central PE was revealed in 4 out of 9 cases (44.44%) in the low-risk PE group.

Anticoagulation was the most common final treatment delivered by the PERT-POZ. Approximately 75% of patients with PE received some form of anticoagulation. The most frequently administered anticoagulants were DOACs (35%). Of note, in the current study, 28.75% of patients with PE received LMWH chronically and a great majority of them had a concomitant malignancy.

In high-risk PE, ST is indicated, and SE is recommended when ST is contraindicated or has failed.[4,30] However, as a result of recent development of interventional cardiology, percutaneous techniques (CDT) became an important alternative to SE.[5,7-9,15,18,29,31-38] They are aimed to quickly relive obstruction and restore pulmonary blood flow, thus increasing cardiac output and immediately restoring hemodynamical stability.[39] In the present study, all patients with high-risk PE received advanced therapy: ST or, in the presence of contraindications, SE or CDT.

CDT was performed in 12.5% of all PERT-POZ patients. Recent reports demonstrated significant heterogeneity in the PERT approach to CDT across multiple institutions with the proportion of patients undergoing CDT ranging from 0 to 30.8%.[28,40] Our practice has evolved to using CDT in unstable patients with contraindications to ST or patients deemed to be at increased risk of hemodynamic deterioration. In our patients, we found a significant improvement in hemodynamic parameters using the Indigo catheter.

The overall in-hospital mortality rate in the present study was 8.75% and is comparable with data form an European multicenter cohort; however, it is noticeably lower than the 30-day mortality reported in the National PERT Consortium multicenter registry ranging from 9% to 44% in different institutions.[28,41] The highest mortality rate was observed in the high-risk PE group—35.71%. These results are in line with data from National PERT Consortium, in which the 30-day mortality was 31% in the high-risk group. These findings highlight the severity of high-risk PE.[28] Nevertheless, it is noteworthy that in the present study, there were no deaths in the high-risk PE group after discharge, which indicates the importance of very fast implementation of advanced therapies in this group of patients.

The 3-month mortality rate was 2.5% in our study, which makes it significantly lower in comparison with previous data.[42] Differences in mortality rates among PE cohorts may be due to the increased comorbidity in different PE populations and may not be related solely to acute PE.

The overall major bleeding rate in our study was 3.75% and was significantly lower than demonstrated by the National PERT Consortium multicenter registry (12%). Of note, according to the PERT Consortium findings, bleeding rate did not differ between patients receiving advanced therapy as compared with anticoagulation alone (16% vs 12%, respectively).[28]

Limitations This study has several limitations. First, this was a single-center observational study with a relatively small sample size. The study design did not allow for the assessment of long-term outcomes. Second, the observational nature of the study precludes the comparison of specific treatments among specific PE risk categories. Third, our hospital is a tertiary care center with a cancer center but without an emergency department. These factors probably affect patient characteristics, treatment, and outcomes. Additionally, while the PERT model became widely accepted in our region, it is likely that some patients with PE were not managed by the PERT-POZ and were not included in this analysis. Nevertheless, our experience may be relevant to other centers with the capability to create PERTs. It needs to be emphasized that the goal of this study was to characterize evolving PE management in detail, with an increasing role of advanced therapies after PERT implementation.

Conclusions We provide our initial experience with the management of PE guided by a PERT. The creation of the PERT-POZ at our institution provided expedited and most optimal strategy for PE treatment and reduced discrepancies in care. Although the PERT approach is relatively novel, further multicenter collaboration and research regarding the impact of PERT on PE outcomes improvement are needed.

ARTICLE INFORMATION

CONFLICT OF INTEREST None declared.

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