Considerations in Forming a PERT

With pulmonary embolism response teams gaining traction in the United States, there are pros and cons to implementing this type of team-based approach for your PE patients.

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Pulmonary embolism (PE) is the fourth leading cause of cardiovascular death and a leading cause of cardiovascular morbidity worldwide.[1] Importantly, not all PEs present in the same way. In fact, most PEs are either asymptomatic or represent low hemodynamic risk to patients. Nonetheless, an important minority of PEs will pose an immediate threat to patients' lives.[2] Accordingly, PEs are divided into low-, intermediate-, and high-risk categories.[3] Although the backbone of PE treatment is prompt and adequate anticoagulation, other treatments are often considered for patients who present with intermediate- or high-risk PE. Examples of advanced therapies for PE are outlined in Table 1. The choice and implementation of these treatments are often a matter of clinical challenge and debate among experts in the field. Examples

TABLE 1. ADVANCED THERAPIES FOR PE

Treatment	Comment
Inferior vena cava filter	Evidence suggests limited utility; should likely be used judiciously, mainly when anticoagulation is contraindicated in the acute phase
Catheter-directed thrombolysis	For intermediate-risk PE, it has been shown to result in superior acute surrogate outcomes compared to anticoagulation; however, it has not been shown to improve long-term clinical outcomes
Intravenous thrombolysis	Remains the first-line therapy for high-risk (massive) PE
Surgical embolectomy	Is often considered in patients with clot in transit or in patients who are unstable and cannot tolerate a catheter-based procedure
Extracorporeal membrane oxygenation	Should be considered in patients in severe hemodynamic compromise secondary to PE as a stabilizing method and/or bridge to definitive advanced therapy

TABLE 2. DILEMMAS AND OPEN QUESTIONS IN PE CARE

Dilemma	Comment
What is the optimal patient placement (eg, medicine floor vs intensive care unit and which unit)?	Several studies have shown that some patients will develop an early need for escalation in care
What is the optimal manner to identify patients at risk for developing adverse long-term outcomes, and what is the best way to prevent these outcomes?	There are many markers of poor outcomes; however, there are no data to suggest which patient with nonmassive PE will benefit from aggressive therapy
In which patients is catheter-directed thrombolysis safer than systemic lysis?	The cumulative dose of lytic used during catheter-directed thrombolysis is usually ≤ 25% than systemic lytics
What role does half-dose systemic lysis play in PE treatment?	Studies of half-dose systemic lysis are limited and higher-quality data are needed
Is there an advantage to one catheter-based intervention over another?	There is only a handful of comparisons between various methods for delivering thrombolysis to the pulmonary arteries
What role does percutaneous mechanical and aspiration thrombectomy play in PE treatment?	The role of such devices in the treatment of high-risk and intermediate-risk PE is still unknown

TABLE 3. ADVANTAGES AND DISADVANTAGES OF A PERT		
Advantage	**Disadvantage**	**Key Program Tools**
Expedient complex patient care	Potential to delay appropriate patient care	• Well-established and publicized call structure • Central call center • Agreed-upon benchmarks of timely care (eg, consult in the emergency department in < 30 minutes, PE protocol CTA interpretation in < 15 minutes, transthoracic echocardiogram in < 1 hour)
Coordination of complex efforts	Work-intensive process with organization and logistic demands	• Dedicated mid-level practitioners • Early program test phases to allow for program optimization and reiteration • Clearly identified program leadership
Easy to locate resources within a hospital system for expert PE care	Multiple providers for a single patient may result in confusion and delayed care	• Frequent team meetings and case discussion • Fair distribution of responsibility and involvement to engage all stakeholders

TABLE 4. POTENTIAL ROLES FOR SELECT PERT MEMBERS		
Care Role	**Practitioner Types**	**Care Location**
Early diagnosis and stabilization	Emergency department providers, hospitalists, intensivists, house staff, and mid-level practitioners	Emergency department, intensive care unit, and inpatient units
Effective anticoagulation and assessment of etiology	Hematology, internal medicine, pulmonology, and vascular medicine	All inpatient and outpatient locations
Catheter-based interventional services including catheter-based thrombolysis, mechanical embolectomy, and aspiration thrombectomy	Interventional cardiology, interventional radiology, vascular medicine, and vascular surgery	All suites capable of vascular intervention
Extracorporeal membrane oxygenation and surgical embolectomy	Cardiac surgery	Ideally, cardiac operating rooms; however, bedside implementation is possible
Management of shock as a result of acute right ventricular dysfunction and pressure overload	Cardiac, cardiothoracic, medical, and surgical intensive care specialists	Emergency department, intensive care unit, and vascular intervention locations
Effective postdischarge follow-up and management	Hematology, vascular medicine, internal medicine, or pulmonology	Outpatient setting

of dilemmas and open questions in PE treatment are outlined in Table 2.

RATIONALE FOR PULMONARY EMBOLISM RESPONSE TEAMS

Despite the high prevalence and complex nature of the disease, PE is not treated by a single discipline, but rather by an eclectic group of specialties including general internal medicine, hematology, pulmonology/critical care, cardiology/vascular medicine, cardiothoracic surgery, and more recently, vascular surgery and vascular interventional radiology. The term PERT (PE response team) has been coined to describe a team of specialties who come together to care for PE patients.[4] Theoretical advantages and disadvantages of a team-based approach to PE are outlined in Table 3. As acute and chronic PE involves many subtleties, specialty and multidisciplinary care may theoretically result in better patient outcomes by bringing an array of complementary skill sets together for the benefit of patients.[5]

MAKEUP AND FORMATION OF A PERT

To date, several dozen PERTs have been active in the United States.[6] Although they all have similar goals, their utilization and composition differ between centers. Creating the ideal PERT can be challenging

because it requires that the clinical, procedural, and surgical skills be available to patients in a variety of inpatient and outpatient sites for the extent of the patient's illness. It is our belief that, at a minimum, a PERT should be composed of representatives offering a particular set of services (Table 4). Importantly, the actual discipline of the team member is far less important than the quality of the skill provided. Despite the theoretical advantages to PERT formation, there are often obstacles when attempting to form and implement such a team-based approach to PE (Table 5).

As a general rule, it has been our experience that ensuring collaboration among all potential stakeholders in a particular health care system should offer higher chances of successful PERT implementation as compared to a narrower, specialty-based approach. Also, the triggers for PERT activation differ from center to center. A suggested protocol for PERT activation is presented in Figure 1.

CAVEATS TO IMPLEMENTING A PERT

It is worthwhile to mention that a competing approach would be to offer PE-related consultative

TABLE 5. OBSTACLES IN PERT IMPLEMENTATION

Obstacle	Potential Solution
Some hospital system stakeholders may feel that their expertise is being threatened	Involving as many relevant stakeholders as soon as possible in the process of creating a PERT
Culture may dictate that PEs are treated by a different set of experts in a system	Offer an easy-to-use paging system/number to call; arrange lectures and meetings to educate colleagues; and be responsive, open minded, and attentive
Data collection efforts may lack funds	Quality initiatives may be reasonably funded (as opposed to research, which may be harder to fund)
PERT member burnout	Involve multiple stakeholders; address only high-risk PE with the PERT

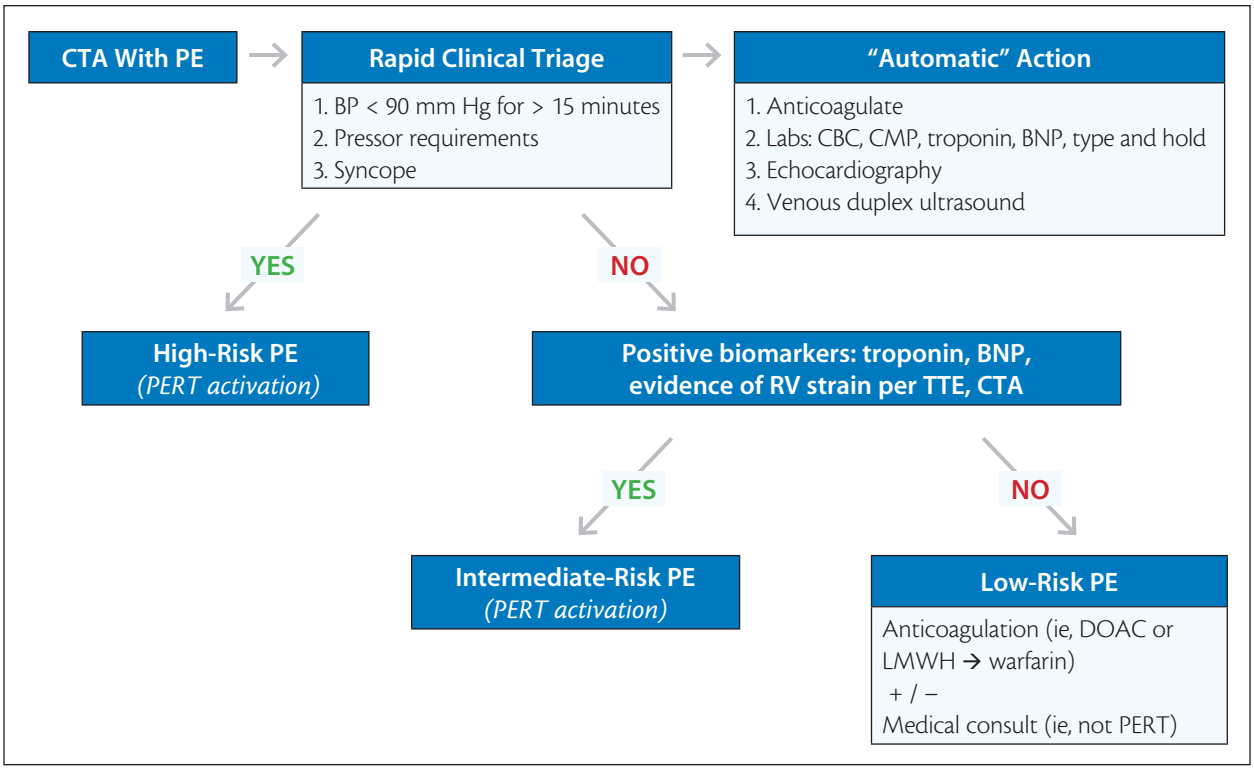

Figure 1. General approach to the treatment of acute PE. BNP, brain natriuretic peptide; BP, blood pressure; CBC, complete blood count; CMP, complete metabolic panel; DOAC, direct oral anticoagulation; LMWH, low-molecular-weight heparin; RV, right ventricular; TTE, transthoracic echocardiography.

TABLE 6. COMMON MISCONCEPTIONS ABOUT PE	
Misconception	**Evidence**
Clot burden is associated with patient outcomes	Data are contradictory, but most studies do not point toward clot burden being associated with outcome
Unfractionated heparin is the best first-line treatment for PE patients	Patients should be offered low-molecular-weight heparin or a direct oral anticoagulant, unless an immediate procedure is being considered
Early aggressive therapy will prevent long-term disability	No studies have shown this in regard to hard clinical outcomes; most have utilized surrogate outcomes, and current data suggest an early advantage for aggressive therapy with late catch-up by patients treated with anticoagulation
Catheter-based lytics are safer than systemic lytics	No randomized comparison of these two strategies has been performed; small trials with surrogate outcomes have examined catheter-based therapy for PE and suggest this modality to be safer than systemic administration
Half-dose systemic lytics are safer than full-dose systemic lytics	Minimal and potentially flawed data support the routine use of half-dose lytic agents

services to a broader PE population (ie, to include low-risk PE patients). The advantages of this approach are accumulation of knowledge and experience, as well as ensuring that high-risk patients are not missed. However, we should caution that sometimes membership in a multidisciplinary team, such as a PERT, may result in a false sense of expertise about the disease process. The rapid evolution of PE care and the complex nature of PE patients can be cognitively demanding and require constant academic and clinical engagement. Several common misconceptions about PE are outlined in Table 6. Thus, important components of appropriate patient care are data collection for internal quality assurance purposes and continued specialty-level education. Periodic educational meetings, dedicated journal clubs, and morbidity and mortality meetings should be an integral part of any PERT initiative.

CONCLUSION

It is undeniable that PERTs have gained considerable traction and favor among many practitioners who perform pulmonary artery catheter-based procedures. However, further study is necessary to understand whether a team-based approach to PE results in improved patient outcomes or rather an overutilization of resources and increased cost, clinically relevant complications, and errors in care. ■

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