Achieving Multidisciplinary Collaboration for the Creation of a Pulmonary Embolism Response Team: Creating a “Team of Rivals”

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Semin Intervent Radiol 2017;34:16–24

Abstract

Keywords

- pulmonary embolism response team
- pulmonary embolism
- deep vein thrombosis
- interventional radiology
- thrombolysis

Pulmonary embolism response teams (PERTs) have recently been developed to streamline care for patients with life-threatening pulmonary embolism (PE). PERTs are unique among rapid response teams, in that they bring together a multidisciplinary team of specialists to care for a single disease for which there are novel treatments but few comparative data to guide treatment. The PERT model describes a process that includes activation of the team; real-time, multidisciplinary consultation; communication of treatment recommendations; mobilization of resources; and collection of research data. Interventional radiologists, along with cardiologists, emergency physicians, hematologists, pulmonary/critical care physicians, and surgeons, are core members of most PERTs. Bringing together such a wide array of experts leverages the expertise and strengths of each specialty. However, it can also lead to challenges that threaten team cohesion and cooperation. The purpose of this article is to discuss ways to integrate multiple specialists, with diverse perspectives and skills, into a cohesive PERT. The authors will discuss the purpose of forming a PERT, strengths of different PERT specialties, strategies to leverage these strengths to optimize participation and cooperation across team members, as well as unresolved challenges.

Objectives: Upon completion of this article, the reader will be able to discuss pulmonary embolism response teams (PERTs) and how to achieve multidisciplinary collaboration when forming a PERT.

Accreditation: This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of Tufts University School of Medicine (TUSM) and Thieme Medical Publishers, New York. TUSM is accredited by the ACCME to provide continuing medical education for physicians.

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The rapid activation and deployment of a multidisciplinary team of medical and surgical specialists to care for a critically ill or injured patient has the potential to improve outcomes.^{1,2} The concept of such rapid response teams is not new. Since the 1980s, the American College of Surgeons has advocated the care of acutely injured patients by trauma teams, although the origins of the trauma team concept likely pre-date the formal establishment of such teams by decades.^{3–5} With the development of catheter-based interventions for acute ST-elevation myocardial infarction (STEMI) in the 1980s, STEMI teams were developed to mobilize the cardiac catheterization laboratory for angioplasty and, in time, stent placement.^{6,7} Stroke teams were established in the 1990s to facilitate appropriate and time-sensitive delivery of thrombolytic therapy for acute strokes.^{8,9} More recently, in the 2000s, the concept of rapid response teams was developed for

inpatients with impending shock, cardiovascular collapse, and airway or respiratory compromise. These teams have been shown to reduce mortality in both adults and children.^{1,2,10-16}

Pulmonary embolism (PE) is the third most common cause of cardiovascular death, and the single most common cause of preventable in-hospital death in the United States.^{17,18} Recently, novel medical, percutaneous, and surgical treatments have become available for the treatment of intermediate- and high-risk PE.¹⁹⁻³³ However, data comparing these treatment options are sparse, and the risks and benefits for an individual patient are difficult to assess. Moreover, different treatment options are favored by different specialties, and in some cases physicians from different specialties can perform the same procedure. As a result, clinical decision making for the sickest patients with PE has been uncoordinated, time consuming, and recommendations have often been conflicting. To address this, in 2012, a group of interested physicians at Massachusetts General Hospital (MGH) came together to form the first response team dedicated to the care of patients with life-threatening PE.³⁴⁻³⁶

The MGH Pulmonary Embolism Response Team (PERT) includes specialists in cardiology, cardiac surgery, echocardiography, emergency medicine, hematology, pulmonary/critical care, diagnostic and interventional radiology, and vascular medicine. The MGH PERT is organized in accordance with consensus conference guidelines for rapid response teams.¹ ▶**Fig. 1** displays the PERT model. While PERTs function differently at other institutions, our PERT can be activated by any clinician caring for a patient with PE and high-risk features (e.g., abnormal vital signs, right heart strain). Our PERT also provides advice on diagnostics and the management of lower-risk PE in otherwise complex patients. When the PERT is activated, a team member quickly responds and gathers clinical information. When appropriate, the entire team convenes for an online multidisciplinary meeting where they review the patient's history, laboratory data, and radiologic images. Once a consensus opinion is reached, the PERT feeds back diagnostic and treatment recommendations to the referring provider. If a therapeutic intervention is recommended, the PERT mobilizes the required resources. This process has been described in detail elsewhere,³⁴ and variations on this process now exist at numerous institutions. Since inception, the MGH PERT has responded to more than 600 activations and the team's experience with the first 30 months of activations has been published.³⁵

The PERT concept has now expanded throughout the United States, and internationally. In 2015, a national consortium of PERTs held its inaugural meeting in Boston (www.pertconsortium.org). More than 100 clinicians from more than 30 medical centers attended—representing PERTs with diverse structures and in varying stages of development. A second meeting of the PERT consortium took place in June 2016, represented by more than 75 institutions including several from Europe and South America. The momentum of the PERT concept appears to be increasing, and it seems likely that PERTs, like stroke teams, STEMI teams, and trauma teams, will become a new standard of care in hospitals with the staff and resources to create them.

While there are certainly similarities between PERTs and other types of multidisciplinary teams, there are also important distinctions. Trauma teams, for example, are similar to PERTs in that they bring together a wide variety of specialists (e.g., trauma surgeons, emergency physicians, orthopedic surgeons, neurosurgeons, plastic surgeons) to care for a broad array of potential injuries. However, specialists in a trauma team are typically tasked with addressing injuries within the body system corresponding to their specialty training. In other words, orthopedic surgeons treat musculoskeletal injuries, general surgeons treat thoracoabdominal injuries, and neurosurgeons treat neurological injuries. The team leader coordinates and prioritizes these diverse efforts, but the work of each specialist falls within their traditional purview. Stroke and STEMI teams are similar to PERTs in that they are focused primarily on a single disease entity. As such, they are primarily designed to expedite the decision to intervene with either systemic thrombolysis or catheter-directed interventions when appropriate. However, stroke and STEMI teams are typically composed of specialists from a single specialty (neurology or cardiology), sometimes with the addition of specialists in emergency medicine who are trained to rapidly identify and assess stroke or STEMI patients and others (e.g., interventional radiologists) trained to perform procedures when needed. Thus, these teams are less notable for their multidisciplinary nature than their ability to expedite diagnosis and treatment.

In contrast, PERTs bring together a multidisciplinary team of medical and surgical specialists to expedite the treatment of a single disease entity: PE. These specialists each bring their own expertise and perspectives to the case, forming a kind of “*Team of Rivals*” that, as a unit, decides whether and which

Fig. 1 The PERT model of pulmonary embolism care. PE, pulmonary embolism; PERT, pulmonary embolism response team.

interventions are indicated. The fact that PERT members work together toward a single decision requires that these different specialists approach consensus. This represents a unique challenge of the PERT process. In addition, different specialists may be qualified to provide the same therapy. For example, interventional radiologists and interventional cardiologists may both perform catheter-directed thrombolysis (CDT) at a given institution. This has the potential to introduce conflict among team members that must be overcome for the sake of patient care.

The purpose of this seminar is to discuss ways to integrate multiple specialists, with diverse perspectives and skills, into a cohesive PERT. We will discuss the purpose of forming a PERT, strengths of different PERT specialties, strategies to leverage these strengths to optimize participation and cooperation across team members, as well as unresolved challenges.

Creating a Multidisciplinary PERT

Despite the challenges of logistics, team cohesion, and competition, those who have experienced the PERT process first hand are easily convinced of the value of the model. Consider the situation from the patient's perspective. Given the option, would any patient prefer to make a decision regarding treatment of an acute life-threatening illness based on a discussion with a single physician when a multidisciplinary team of experts was available in real time to review their case and weigh the various options with them? The PERT process invites discussion and disagreement among team members, and therefore has the potential to reduce individual biases that any one physician or specialty might bring to a case. The challenge, in many cases, is identifying the best members of this "*Team of Rivals*" and getting them to agree to come to the table to form a PERT in the first place.

One of the most important issues to consider when forming a PERT is determining which specialties, and individual specialists, to include. This not only influences the range of treatments a PERT can offer, but the acceptance/adoption of the PERT at the institution, and the "culture" and cohesiveness of the team. The importance of team chemistry should not be underestimated, as this is the glue that holds a PERT together.

At MGH, we take a very inclusive approach to our PERT. We generally welcome all qualified physicians who want to participate. This creates a culture of inclusiveness, and also builds enough redundancy into staffing that multidisciplinary calls typically include 5 to 15 PERT physicians. If a physician needs to miss a particular call due to schedule conflicts or clinical work, the patient will still be cared for by a full complement of experts. However, it is important that all participants understand what being part of a PERT entails. At MGH, approximately 40% of PERT activations occur outside of normal business hours. Thus, active PERT participation requires departments and specialists willing to offer on-call services 24 × 7, 365 days a year. A "Just-say-yes" attitude is critical as physicians will call on the services or individual specialists who provide the best, most expeditious service to their patients. This is especially important for interventionalists, whose specialized expertise may be required on short notice.

Of course, it is difficult to achieve multidisciplinary collaboration if team members feel that PERT will dominate their schedules and inhibit them from doing their other work. Therefore, at MGH, a physician is assigned to be on call for PERT each day; typically this is a vascular medicine or pulmonary/critical care physician. However, the lead physician could come from any PERT specialty and systems vary widely among institutions in the PERT consortium.³⁷ The lead physician is officially responsible for the consultation and writes the PERT consult note on behalf of the team. This physician typically also bills for the consult, although when specific procedures (e.g., surgery) or services are performed, separate bills may be submitted. Other members of the team, including those from traditionally nonconsultative services (e.g., emergency medicine), join the call and provide advice that is incorporated into the team's recommendations. Our system assumes that PERT physicians will participate in every PERT consultation that they can, but recognizes that sometimes non-PERT clinical duties, vacation, etc., will take priority, so not every multidisciplinary PERT meeting will include every member of the team.

Issues Related to Interventional Specialists

When multiple specialties offer similar interventional procedures (e.g., when CDT can be performed by either an interventional radiologist or an interventional cardiologist), it can lead to tension that undermines the creation or function of a PERT. This tension may center on clinical responsibility, therapeutic approach, compensation, or other issues. If two "competing" specialties are both participating in a PERT, it is important that they offer the same level of service and commitment. For example, it is difficult to sustain multidisciplinary collaboration if one service bears the burden of off-hours call while another is only available during working hours. PERT members must make a plan to distribute call and procedures equitably. Similarly, the responsibility of nonprocedural PE management must be shared. In this regard, interventional radiologists can be at a disadvantage. Although cardiology, vascular medicine, and pulmonology typically run admitting services that encompass the management of patients with acute submassive or massive PE, interventional radiology may not.^{38–42} The same disparity may arise when patients are scheduled to follow up in clinic after discharge from the hospital. When forming a PERT, it is advantageous if these issues are discussed in advance. Interventional radiologists may want to make arrangements with hospitalists or intensivists to follow up patients on the floor or in the intensive care unit (ICU), if needed.

Although PERTs do rely on their interventionalists, it is also important to remember that the vast majority of PERT patients do not undergo an intervention (►Fig. 2). In the initial 30 months of PERT at MGH (394 activations), only 12% received CDT, surgical thromboembolism, or suction thromboembolism and 15% had an inferior vena cava filter placed.^{35,43} Anticoagulation alone was the recommended treatment for the large majority (69%) of patients. Thus, most PERT management involves *medical* decision making. With this in mind, it is critical that PERT members recognize the contributions of both interventional and

Fig. 2 Percentage of PERT patients undergoing different treatments, among patients with confirmed pulmonary embolism. AC, anticoagulation; CDT, catheter-directed thrombolysis; IV tPA, intravenous thrombolysis; PERT, pulmonary embolism response team; Suction, percutaneous suction thrombo-aspiration; Surgery, open surgical thromboemblectomy.

noninterventional specialists. To promote understanding across specialties, we engage in both formal didactic sessions and informal discussions (often during PERT calls) about the latest scientific evidence, professional society guidelines, as well as the technical aspects and limitations of procedures. This cross-training and coeducation promote a sense of cohesion and shared mission among team members.^{43,44}

Specialties Involved in PERT

While the composition of PERTs varies across institutions, all PERTs are composed of a multidisciplinary group of clinicians.³⁷ Each participating specialty brings skills that can be leveraged for the care of patients and the function of the team as a whole. However, as with any multidisciplinary effort, PERTs may need to overcome organizational and interpersonal challenges to ensure the continued success of the team. The following is a brief list of specialties (in alphabetical order) that may be included when forming a PERT, along with examples of strengths of the specialty (relevant to PERT) and ways to leverage those strengths to promote multidisciplinary cooperation and team cohesion.

This list is not intended to be all inclusive, is for the purposes of this seminar, and is focused primarily on physician members of a PERT. However, it is important to acknowledge the role nonphysician PERT members play. Nonphysician PERT members may include administrative staff and management, pharmacy, nursing, case-management, social work, and research coordinators and managers, among others. These specialists are critical to the function of PERT, and should be involved in the team's creation and daily function. However, the specifics of their involvement will not be discussed here.

Cardiology (Interventional) and Vascular Medicine (Interventional)

Interventional cardiologists and vascular medicine physicians are skilled at managing critically ill cardiac patients and represent a core specialty in most PERTs.³⁷ Like interventional radiologists, these physicians are technically proficient at

procedures central to the modern treatment of PE—such as CDT. In addition, interventional cardiologists are often involved in the care of acute ST-elevation myocardial infarction, and are therefore likely to have experience setting up and working within systems designed to mobilize a team rapidly. They may have experienced in setting up activation systems, call schedules, etc. This experience should be leveraged.

Cardiology and Vascular Medicine (Noninterventional)

Noninterventional cardiologists and vascular medicine physicians are experts in the management of PE. They are invaluable, not only in managing the acute phase of illness but also during long-term follow-up. Vascular medicine physicians and cardiologists, in addition to hematologists and pulmonologists, manage patients in the PERT follow-up clinic at MGH. This team determines the intensity and duration of anticoagulation and screens for long-term complications of PE and deep vein thrombosis (DVT).

Emergency Medicine

Emergency physicians are experts in the diagnosis, risk-stratification, and stabilization of patients with acute cardiovascular disease, including PE. The broad breadth of knowledge emergency physicians possess can also be helpful in managing other conditions that may coexist with PE. Most PERT activations occur in the acute period after (or even before) the diagnosis of PE, when an efficient, evidence-based approach to diagnosis and risk stratification is especially useful. Emergency physicians constantly work at the intersection between multiple medical and surgical specialties, and are therefore comfortable coordinating and working within multidisciplinary teams. Since the majority (~60%) of PERT activations originate in the emergency department (ED),³⁵ it is also very helpful to engage emergency physicians who understand how to mobilize resources in this complex clinical setting. The fact that emergency physicians do not admit patients, perform CDT, or perform surgery can also imbue them with neutrality when it comes to interventions.

Hematology

Hematologists are knowledgeable about the hypercoagulable states that lead to thromboembolism, as well as the acute management of PE and anticoagulation. Because hematology training is typically concurrent with oncology training, hematologists are also expert in the malignancies that frequently coexist with PE. At MGH, the hematologist affiliated with PERT was responsible for creating the PERT follow-up clinic. This has expanded the reach of the PERT beyond the care of emergent patients and has enabled us to screen for chronic complications of PE.

Interventional Radiology

Like interventional cardiologists, interventional radiologists are technically proficient at procedures central to the modern treatment of PE and the PERT model. This includes CDT, clot maceration, and newer techniques including aspiration thromboemblectomy. Interventional radiologists are often involved in the care of trauma^{45–47} and acute stroke patients,^{48–50} and

are able to mobilize a team rapidly. In addition, the training in diagnostic radiology that interventional radiologists bring to a PERT can be invaluable during multidisciplinary calls. On numerous occasions at MGH, the iterative discussion about a case turned on a relatively subtle finding noticed by one of our team's radiologists.

Pulmonary/Critical Care

Pulmonary and critical care physicians are experts in both the acute and chronic care of patients with PE. In addition, patients in many ICUs are managed primarily by pulmonary/critical care physicians. At MGH, more than 50% of PERT patients are admitted to an ICU, so establishing a strong relationship with critical care specialists in the ICU is very important.³⁵ Involving ICU physicians in PERT also helps streamline the movement of critically ill patients to the ICU from the ED or other floors. It also keeps lines of communication open between the PERT and the ICU staff so that everyone remains informed about decisions that affect care. Pulmonologists have also been especially important in the long-term management of PERT patients at MGH. While the incidence of chronic thrombotic pulmonary hypertension (CTEPH) is estimated to be approximately 4% after PE, the true incidence is unknown due to variability in screening and diagnostic practices.^{51,52} Leveraging expertise in pulmonary hypertension has allowed us to better standardize testing and follow-up for PERT patients, and hopefully to identify cases of CTEPH early.

Radiology (Diagnostic)

Diagnostic radiologists, especially those subspecializing in chest radiology or emergency radiology, can provide invaluable insights during multidisciplinary PERT calls. While most of the PE cared for by PERTs are large and obvious on imaging, our experience has been that more subtle findings (e.g., occult malignancy, pulmonary hemorrhage) may only be noticed by a trained radiologist, and clinical decision making often turns on these findings. Being part of a multidisciplinary discussion also provides the radiologist with detailed clinical information that informs their interpretation of the images. Thus, the PERT gets much more information about imaging findings than might normally be included in a written report. In addition, the diagnostic radiologist is often the first physician to know that a patient has a large PE. The ability to activate the PERT as soon as a PE is diagnosed has the potential to improve the efficiency of the PERT response and save lives.

Surgery (Cardiac and Vascular)

For certain patients with PE, surgical intervention is the most appropriate intervention. Open thromboembolectomy can be lifesaving for patients who are unstable but cannot tolerate thrombolysis and in patients with clot-in-transit.^{22,33,53} In addition, the ability to rapidly stabilize a patient pending definitive treatment for PE with extracorporeal membrane oxygenation (ECMO) is a major tool in the PERT armamentarium.³¹ Surgeons are expert in all of these procedures, and are comfortable responding to emergent situations where decisions need to be made rapidly.

Leveraging the Strengths of Each Specialty to Promote Team Cohesion

A lack of coordination or, worse, competition between specialists can threaten cohesion in a PERT. Threats to cohesion may apply to a particular specialty, but many, such as concerns about fairness and mistrust of motives, are not specialty specific. The following sections address several potential threats to team cohesion and how a successful PERT can leverage the strengths of the various PERT specialists to overcome them.

Performing and Fairly Distributing Procedures

Occasionally, noninterventional physicians express concerns that the PERT process leads to more procedures being performed by interventionalists, and that the benefit of these procedures is unproven. Other specialists outside of the PERT may hold this perception as well. Whether this comes from individuals affiliated with the PERT or not, any perception of ulterior motives can threaten team cohesion, especially if noninterventionalists feel pressured into accepting an interventional approach or sense that their opinion is not valued. While we did see an increase in the number of CDT procedures performed after implementing our PERT, only a small minority of patients (9%) underwent CDT and fewer (5%) had surgery (→ Fig. 2).³⁵ Moreover, we have seen no increase in the number of interventions performed over the 4 years that our PERT has been functional.³⁵ While, at MGH, we collect data primarily for research purposes, we also use these data to monitor our performance and for quality assurance. It is beneficial to be able to refer to data describing the number of PERT activations, the number of procedures performed, and even some record of discussions that occur during multidisciplinary meetings. This helps us frame the debate about how aggressively to intervene for PE and counter false perceptions that PERT is designed to increase procedures. For these reasons, we recommend collecting data simultaneously with the formation of a PERT.

Questions about who "owns" a procedure can also threaten cohesion and multidisciplinary collaboration in a PERT. PERTs that include both interventional cardiologists and interventional radiologists may find team members competing for procedures, especially when the decision to perform thrombolysis is not clear cut and individuals have different thresholds to intervene. In these cases, a PERT benefits from established processes for reaching consensus during multidisciplinary calls. It may be helpful to assign a team member who can be the deciding vote. A hematologist or emergency physician can be useful in this role, as they do not have a "horse in the race" with regard to intervention. In rare cases where we have been unable to reach a consensus recommendation, MGH PERT members have found that involving the patient and their family in treatment decisions (i.e., shared decision making) can be both helpful and informative.

Expanding Scopes of Practice

Asking any specialist to practice outside their comfort zone can limit their desire to participate in PERT, and can threaten team cohesion. For example, emergency physicians do not

usually assume a consultative role; therefore, other specialists on the PERT may be unsure how to incorporate them into inpatient care. Emergency physicians may not be comfortable in this position themselves, and may be unsure how to take on the responsibilities that come with acting as a consultant. We find that this tends to improve with time and experience on the team. Initially reinforcing the different contributions made by each specialty in the PERT can help. For example, because many PERT patients are still in the process of completing the diagnostic and risk-stratification process, an emergency physician's fundamental understanding of how to efficiently gather data to inform time-sensitive decisions is valuable. Tapping into this expertise can both keep emergency physicians engaged and benefit patients.

Conversely, interventional radiologists who serve primarily as procedural consultants without a dedicated inpatient service may be perceived as extraneous by other interventional services that have more of an inpatient presence.^{40–42} To avoid any perception that work is disproportionately distributed, interventional radiologists may need to establish a standard of practice that is consistent with other proceduralists on the PERT. As an example, at MGH we request that PERT patients with intermediate- and high-risk PE with the potential to need a procedure be admitted to the medical ICU—where the attending critical care physician manages the patient's care. Thus, the responsibility for managing PERT patients postprocedure is consistent and fair.

Acknowledging Diverse Approaches

Whether in the clinic setting or in the hospital, different specialists approach VTE treatment differently. This is a fundamental strength of PERTs, but can threaten team cohesion. For example, hematologists may favor hypercoagulability testing or different screening tests than other specialists. To address this, our PERT crafted guidelines for follow-up testing, but did so in a way that allows for some practice variation in areas of legitimate disagreement. In general, we find that allowing for some flexibility promotes sustainable, multidisciplinary collaboration. In addition, creating an environment that encourages respectful academic debate among team members is consistent with the spirit of the PERT model.

Similarly, some specialists may be more skeptical about the benefits of intervention for PE than others. For example, the most recent guidelines from the American College of Chest Physicians recommend against thrombolysis in most cases, and recommend systemic thrombolysis over CDT for PE when indicated.²³ Pulmonologists may therefore be reluctant to participate in PERT, especially, if it is viewed as a mechanism to promote interventions. It is therefore critical to reinforce the idea that the PERT system is designed to promote open and free discussion of various therapeutic options with a full understanding that, in many circumstances, there are insufficient comparative data to support one approach over another. Anecdotally, we have had many cases where an initial preference to intervene was overturned during a multidisciplinary PERT meeting, just as we have had many cases where an initial preference for conservative management was overturned in favor of intervention. We have also

found that previously skeptical specialists who join our calls ultimately discover the discussions are measured and evenly balanced. We actively encourage physicians who are not convinced of the benefits of intervention for acute PE to bring their perspective to PERT discussions.

Embracing Redundancy on the Team

Specialists with similar backgrounds, or who offer similar procedures (e.g., noninterventional and interventional cardiologists; diagnostic and interventional radiologists) may perceive their role on the PERT as redundant. This may threaten cohesion if one group feels their skills are not necessary or valued. At MGH, we find there is great value added having several representatives with similar backgrounds, or even from the same specialty, on multidisciplinary calls. Individuals often offer different perspectives, despite similar training. Ultimately, whether team members feel valued depends on the “culture” of the team, and the tone set by the PERT leadership. Physicians who lead PERT at MGH are very careful to be inclusive and openly ask for the opinions of everyone on the team. If not properly directed, PERT discussions can feel like a single decision to perform a procedure or not. It requires unselfish leadership to broaden the discussion and leverage the strengths of all of the PERT members for the betterment of these very complex patients.

Maximizing the Efficiency of Participation

To be effective, a PERT must be able to rapidly bring all of its resources to bear quickly. This includes the ability to perform surgery or initiate ECMO. However, very few (3–5% at MGH) PERT patients require operative intervention.³⁵ Surgeons may therefore question the value of their participation on routine calls, where surgical intervention is unlikely to be indicated. To be sustainable, a PERT must not become a burden to its members. At MGH, we recognize that not every member of the team will be available for every call. This applies equally to surgeons in the operating room, emergency physicians caring for unstable patients, interventionalists in the catheterization laboratory, and noninterventionalists in the clinic. Building redundancy into the PERT, so that there are multiple members of each specialty involved, can insure that at least one member of each PERT specialty is available. Also, alerting specialists that their skills are required for a particular case can help PERT members prioritize activations where their input is most needed. For example, at MGH, if the clinician who initially responds to the activation identifies a potentially surgical case, they will often add text to the PERT activation page alerting the surgeons that their presence is required. We have done the same thing for hematologists and radiologists when their particular expertise was needed. This avoids having to make separate phone calls to various specialists, which would essentially recreate the old, inefficient system, but does ensure that appropriate specialists are on every call.

PERT Is a Process, Not a Protocol

If patients with massive and submassive PE were homogeneous, and robust data were available for each of the potential

treatments to guide decision making, the PERT process might be unnecessary. Unfortunately, patients with PE are complex. Most have multiple comorbidities. Clinical presentations vary widely, and many patients have conditions that put them at risk for bleeding due to anticoagulation or thrombolysis. Further complicating matters, novel treatments have emerged, and continue to emerge, with little data to guide clinical decision making. Clinicians disagree about the need, timing, and type of interventions that should be used. Because of this uncertainty, some physicians will question the value of the model and may actively oppose forming a PERT.

The most important message to convey is “PERT is a process, not a protocol.” The real benefit of PERT comes from the process of activating the team, discussing each case in multidisciplinary fashion, mobilizing resources as needed, feeding back recommendations to referring providers, and collecting data for research and quality improvement. While the PERT triggering mechanism and response associated with activating PERT is “protocolized,” the treatment of patients is not. At MGH, we have actively resisted the temptation to create an over-riding protocol for clinical decision making. Perhaps this will change in the future, but we feel that these data simply do not support such a one-size-fits-all approach at this time. Communicating this to skeptical colleagues can be reassuring. While proposing the creation of a clinical protocol that dictates systemic thrombolysis or CDT for all patients with certain characteristics may be a nonstarter, proposing a multidisciplinary discussion about the treatment of a critically ill patient is generally widely accepted. The PERT process gives each specialty a chance to voice their opinion and to have a seat at the table when treatment decisions are made. Physicians who decline to participate in PERT risk missing the opportunity to have their perspectives heard.

—Fig. 3 shows one example of roles that each individual care provider member of the PERT team may play. It is important to understand that the roles for each individual team member will vary depending on the institution, and within any institution may also vary over time.

Unresolved Challenges

Compensation

While many physicians are loathe to discuss compensation, potential PERT members—especially those who are not acting as consultants or proceduralists—may be concerned about their ability to be compensated for their time. Emergency physicians, for example, do not provide consultative services or perform CDT or surgery for PERT patients. Nonetheless, we have found that emergency physicians are highly motivated to participate and are an integral part of the majority of PERTs.³⁷ This, in part, stems from a realization that a system that expedites clinical decision making and the mobilization of resources for sick patients with PE can simplify communication and relieve some of the stress on an overstretched ED system. Other specialists, such as hematologists or pulmonary hypertension specialists, for example, enjoy contributing to the care of PERT patients during their acute illness, but

Fig. 3 Composition and contributions of PERT specialties. CDT, catheter-directed thrombolysis; CTEPH, chronic thrombotic pulmonary hypertension; ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit; PERT, pulmonary embolism response team; US, ultrasound.

may make even more of an impact during long-term follow-up. PERT participation can help direct patients to clinics where appropriate workups for thrombophilia, occult malignancies, and CTEPH will occur. Thus, for some clinicians, highlighting the ways in which a PERT can improve the work experience and satisfaction may promote participation in the daily activities of the team.

Ultimately, however, the best solution is to identify individuals who are more interested in creating cross-specialty relationships and improving patient care than their own compensation. This is, after all, why most physicians entered the profession.

If compensation is still viewed as a barrier to forming a PERT, shared compensation models and hospital support for clinician efforts on a PERT may relieve concerns about fairness. Consultative fees, for example, can be placed in a fund that is used to pay for administrative or research support for the team. In addition, to the extent that PERT increases referrals for CDT, it may represent a growth opportunity. PERT should not be viewed as “taking procedures away” from any one clinician or specialty, assuming team leadership ensures fair distribution of procedures among qualified specialists.

Scientific Consensus

One of the driving motivations for creating the PERT model is the lack of scientific consensus around the treatment of patients with intermediate- and high-risk PE. Given the influx of novel treatments of late, comprehensive comparative data are unlikely to be available any time in the near future. Certainly, it is difficult to make high-consequence decisions without clear data, but doing so as a physician practicing in isolation is even more challenging. We find that bringing together a team of experts, a “Team of Rivals,” makes this

decision making easier. Whether the decision is to intervene or simply observe, the intellectual reassurance one gains from having discussed a patient's case with colleagues increases one's comfort with difficult decisions and likely eases the emotional difficulty when things do not go as planned. This kind of iterative, scientific discourse is rare in modern practice, but is one of the great pleasures of clinical medicine.

Ultimately though, having hard data to guide our decision making is preferred to expert consensus. Thus, we incorporated research data collection into the structure of our PERT from the beginning. The PERT consortium is also leading several initiatives designed to gather data and improve our understanding of the treatments and outcomes of PERT patients. Participation in a PERT thus offers individuals the opportunity to gather data and publish results that inform our decision making in the future.

Conclusion

The treatment of intermediate- and high-risk PE requires complex decision making and rapid mobilization of resources. However, few comparative data exist to guide clinicians choosing among different treatment options. PERTs bring together a multidisciplinary "*Team of Rivals*" who can discuss cases in real time, weigh the risks and benefits of different therapeutic approaches, efficiently communicate a treatment plan, and mobilize the resources required. However, to create a functioning PERT, one must sustain collaboration and cooperation across specialties. This can be challenging. For interventional radiologists and other PERT specialists, threats to team cohesion can include the belief that PERT is biased toward increasing procedures, competition across specialties for procedures that are performed, and a perception that work is not distributed fairly. Each PERT specialty has strengths that can be leveraged to overcome these threats to team cohesion. In addition, the idea that "*PERT is a process, not a protocol*" encourages specialists to bring their perspectives to the team, and unify around the goal of improving the care of patients with PE.

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