ASK THE EXPERTS

What Does PE Intervention Look Like in 2034?

Experts consider the role of PERTs, technologic advances, and the state of research and data in the next 10 years.

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The care of patients with pulmonary embolism (PE) has dramatically changed over the past decade. Local PE response teams (PERTs) have spearheaded a multidisciplinary approach for PE patients and, in selected centers, have shown to improve processes of care as well as patient outcomes. Moreover, the technology associated with the treatment of PE has greatly improved over the past decade, and further data accrual is ongoing to determine which patients will benefit from specific therapies.

The care of PE patients in 2034 will undoubtedly look different than it does today. In the future, most patients will be diagnosed by an artificial intelligence (AI)–driven scheme. PERTs will be notified in real time via an AI-driven algorithm, and timely therapies will be planned virtually. Risk stratification schemes will be more streamlined and precise, and clinicians will have better data detailing which patients will clinically deteriorate. Large databases (like the one housed at The National PERT Consortium) will drive informed therapeutic decisions for both catheter-based and medical treatments. There will also be an increased utilization of mechanical circulatory support for PE patients as these therapies become more widely available and safer.

Patients with a PE in 2034 will stay in the intensive care unit less frequently and for shorter durations. All follow-up care will be multidisciplinary and patient centered. There will be greater awareness among the PE community of physicians and patients alike regarding the variety of post-PE syndromes and their proposed treatments.

The care of PE patients will indeed look very different in 2034, but the vast majority of the differences will be to the benefit of the patient. As increased attention will be focused on the third-leading cause of cardiovascular death, the future of PE care is bright.

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First and foremost, we need to transform the culture in the United States and globally into one focused on prospective research. We have made great efforts in the last 6 years to advance this, but there is much more work to do. Currently, there are six prospective randomized trials underway evaluating the role of endovascular therapy and fibrinolytics versus anticoagulation alone for intermediate-risk PE patients. We are collectively optimistic that one of these endovascular trials at least will be favorable and will rapidly accelerate the field toward consensus and level 1 recommendations for endovascular therapy for certain at-risk populations.

There have been tremendous technologic advancements in endovascular devices in the last several years. The questions that remain yet unanswered include: (1) What is the ideal size profile of an endovascular system? (2) What is the role, if any, for intraprocedural hemodynamic pressure measurements? and (3) Is thrombectomy alone adequate to stabilize and support the intermediate- and high-risk patient populations that we see in routine clinical practice?

Hopefully, the prospective studies will allow comparative effectiveness data to emerge in the next wave of prospective research to guide us in our decision-making process.

A critical clinical question that is currently being debated not only in the United States but around the world is the concept of centralized care. Many of the newer thrombectomy systems are highly advanced technologies that require centers of excellence for routine safe use. There is another class of products that lend themselves to a broader distribution, including the potential to be used in smaller community hospitals. We have yet to identify which patients require transfer to a centralized referral center of excellence versus which patients are adequately treated at their local community hospital. This is another area of tremendous opportunity for prospective comparative effectiveness research.

Ultimately, I believe we will have level 1 evidence to support the endovascular therapy for specific at-risk populations. I believe endotherapy will take on an increasing role in the management of high-risk patients. I also believe that we will start to embrace the idea of combination therapy or the use of a thrombectomy system, combined with the intraprocedural administration of a fibrinolytic agent. This is a very exciting time for minimally invasive therapy for acute PE.

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The field of PE intervention is currently in evolution, with substantial investment in device innovation and evidence formation. What practice looks like now will likely appear very differently 10 years from now. The majority of PE intervention in current practice is focused on treating intermediate-risk patients to prevent short-term adverse events. Prospective trials are underway to examine the role of PE intervention in those with very high-risk PE (ie, massive PE) as well as lower-risk patients, with an emphasis on long-term function and outcomes. If these trials prove to support early PE intervention, the expected population of candidate patients for treatment will grow exponentially.

Furthermore, the catheter-based devices currently in use are continuously being iterated, incorporating new features that are critical for safe thrombectomy or thrombolysis. With mechanical thrombectomy, there is an ongoing shift to smaller-bore systems to avoid mechanical complications related to access site and cardiopulmonary trauma. This will also democratize access to these devices and procedures, as physicians not trained in vascular intervention will likely have a shorter learning curve with lower-profile devices. Device systems will also incorporate more than just aspiration

to remove clot, moving toward a dual mechanistic approach. Conversely, thrombolysis protocols will likely be shorter, with a focus on on-table treatment alone, and offer more capabilities to monitor real-time hemodynamic response to thrombolysis.

As supportive guidelines are generated and the market outside the United States grows, PE intervention will become a large proportion of endovascular-based procedures performed and draw strength on the multidisciplinary group of specialties that are both involved in managing these patients and performing these procedures. PERTs are increasing in frequency, and development of PE Centers of Excellence is underway. Rapid triage and transport infrastructures are being generated in some communities and will protocolize the timely management of these patients to optimize outcomes. Most critical is the continued investment in evidence formation. With more than five prospective randomized trials underway, PE intervention is gearing to look much like the trial investment generated to support percutaneous coronary intervention. As we now are working to train practicing proceduralists, dedication to early career and fellow training will create a formidable workforce to support the growth and infrastructure of PE intervention.

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From the Surgeon General's "Call to Arms" in 2008, the creation of the first PERT team in 2012, new therapeutic options, and a growing body of literature, so much has changed in PE care in the previous 10 years.[1,2] As a noninterventionalist, my response focuses on advancements other than catheter-based therapeutic options. It is exciting to know that with the current scientific momentum, major advances will be made in the areas of risk stratification, understanding the post-PE syndrome, and fibrinolytic therapies.

Identifying patients at highest risk of PE remains a major challenge in PE care. The European Society of Cardiology/European Respiratory Society guidelines stratify risk groups in terms of low, intermediate-low, intermediate-high, and high risk.[3] However, there are additional independent risk factors that must be considered when evaluating patients. The HI-PEITHO trial will provide guidance on the role of MEWS (Modified Early Warning Score) to predict clinical decompensation, a clinical tool that has been used to predict mortality and need for intensive care unit care in several studies.[4]

As we continue to understand the post-PE impairment syndrome that exists beyond the development of chronic thromboembolic pulmonary hypertension, several clinical trials are underway that include patient-centered outcomes.[5] PE-TRACT is a National Institutes of Health–sponsored clinical trial in which patients are randomized to catheter-directed therapy versus anticoagulation.[6] The outcomes largely focus on objective and subjective long-term functional indicators such as cardiopulmonary exercise testing, New York Heart Association scale assessment, 6-minute walk distance, and a qualify-of-life metric among others. Several other trials are underway that include patient-centered, long-term functional outcomes, which are of utmost importance in determining best treatment options for our patients in the future.[4,6-9]

Another major field of study in PE involves thrombolytic therapy, which remains the first-line therapeutic option for patients with high-risk (massive) PE and decompensated intermediate-risk PE without contraindications.[3] There have been several small studies evaluating the effectiveness of reduced-dose thrombolytics in an attempt to mitigate adverse major bleeding events. The PEITHO-3 trial is underway and will randomize patients to receive either reduced-dose alteplase (0.6 mg/kg up to 50 mg) or placebo.[10] The results of this trial will help guide the effective dose of thrombolytic therapy for patients with intermediate- and high-risk PE, as well as identify the rate of major adverse events. Additionally, newer-generation thrombolytic agents are in late stages of development with the goal of improved risk profile, and I expect that we will see some later-phase clinical data emerging over the new decade. Furthermore, an intelligent DNA nanodevice has been developed to provide precision dosing of thrombolytic agents; it is exciting to think how this nanotechnology may be incorporated into patient care in the future.[11]

Overall, the future of PE care is exciting to think about as we anxiously await the results of clinical trials and development of new catheter-based therapies and pharmaceutical agents. I am honored to contribute to organizations such as The PERT Consortium, which accelerates this process by furthering scientific discovery in the realm of PE research. ■

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Disclosures

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