ROUNDTABLE DISCUSSION

PE Response Teams:

Evolution Within the Revolution

Early adopters of the PERT concept share practical insights on forming an effective team.

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Pulmonary embolism (PE) is a worldwide health care problem, and pulmonary embolism response teams (PERTs) have emerged to provide immediate multidisciplinary care to patients who present with acute PE. By bringing together multiple specialists simultaneously and in real time who can assess, risk stratify, formulate, and implement an individualized plan for each patient, PERTs are changing the paradigm of care for PE patients worldwide. How PERTs are structured, organized, and function varies from institution to institution and depends on the local clinical demands and resources of each institution.

For this piece, I have invited health care providers who represent different specialties and have been integral in creating and implementing their PERTs. I have asked them to share their insights and tips on how they successfully formed an effective team, as well as the challenges and barriers they faced during the process.

—Dr. Rosovsky

Dr. Rosovsky: What was the impetus behind starting your PERT?

Dr. Ní Áinle: We were very much inspired by a meeting we had with you as a team in 2016 at the VTE Dublin Conference. Leading up to that time, the value of multidisciplinary care for venous thromboembolism (VTE) and for PE in particular had become apparent to us, but we hadn't conceptualized or formalized it. When we heard what you and your colleagues had achieved and were already delivering on back then, which was so impressive, we moved soon afterward to formalize our own embryonic PERT. Really, what was key was the inspiration we got from you and the team at Massachusetts General Hospital (MGH) that what we were already conceptualizing was possible to deliver on.

Dr. Rosovsky: Thank you for sharing that, Dr. Ní Áinle. I think you may have been one of first PERT Partners, although we had not formalized the process or named it at that time. Dr. Horowitz, can you share how you started your PERT, some of the key challenges and barriers that you and your team faced, and some of the ways that you overcame them?

Dr. Horowitz: It always goes back to what Dr. Kenny Rosenfeld says, "It's a coalition of the willing"; so we looked at who we had available. The first PERT we started was around 2013 at Cornell, with Drs. Akhi Sista and Oren Friedman. Basically, we strategized and looked for who was available, in-house 24/7, and wanted to help. That ended up being the medical intensive care unit (MICU), which is essentially the first line of defense.

We set up a ghost pager that forwarded to the MICU fellows' pager, which was available 24/7. If the patient was submassive, above, or sicker, they would call the rest of the folks because we had no communications technology. We would meet in person or just talk on the phone, before Zoom was available.

One of the best practices when you start your PERT is to ensure people are responding. If your consultants aren't getting the service they want, they're not going to call back, so I would get the pager logs every week and make sure that everyone had received a response. Because Dr. Sista was part of radiology, we could also have the department send an automated email of every CT pulmonary angiogram that was done that day. I monitored those every morning, scrolling through the CTs to make sure in the electronic medical record (EMR) that anybody who had reported a substantial PE had actually been called. If they hadn't called the PERT, I would call them and explain the service, and I think that was very helpful in growing it. We also educated the chest radiologists, and in their reports, they would even say, "Recommend calling the PERT."

Dr. Rosovsky: Dr. Horowitz, you beautifully highlight how you considered the needs and resources of your institution and created your PERT based on those. Can you talk about the importance of having a PERT champion, what that role comprises, and what kind of support is required of that position?

Dr. Horowitz: That's a great question. It's interesting because I was neither the first responder (that was MICU) nor doing the procedures (that was interventional radiology [IR]). I was the cardiologist and ostensibly there to help with triaging, echocardiograms, and things like that, but I was a former chief resident and a chief fellow, so I was like an operations person. The key is having someone who's really interested in operations who can do the legwork to make sure the technology works and then troubleshoot it afterward—someone who wants to look at those aspects in the day to day and, importantly, get buy-in from others. The cham-

pion should ensure the team is working well together, people are satisfied with the responses, and cases are not missed. That's not exactly sustainable in the long term, but it also wasn't as necessary after the team was established and had shown that we were effectively catching all the cases.

The goal is not to drive patients to procedures—it is to ensure the catchment identifies and triages every PE effectively, regardless of where they are found.

Dr. Rosovsky: We saw something similar at MGH in the effects of getting the word out and educating others about our team. Every July, with new residents and fellows coming on board, we went to every department meeting and would ask for 5 to 10 minutes to explain the PERT service line. When we looked at the first 30 months after starting our PERT, we observed that every 6 months, the number of calls increased by 16%, and after a while, we didn't have to put as much time into spreading the word.

What were some of the early experiences others had in starting your PERTs?

Dr. Naydenov: We started a PERT at our institute in 2015. The first National PERT Consortium meeting played a significant role in jump-starting our PERT. We started small, knowing that this was unfamiliar territory and also because we wanted to mold and adapt as we learned our process. We were fortunate to have interventional radiology, pulmonary critical care, emergency department (ED), and cardiothoracic surgery physician representatives who were interested in PE management, so this gave our PERT a very solid foundation. We have grown in many ways since that time.

Our core group, including myself, took all PERT calls for the first 2 years of our PERT launch. We developed an algorithm for how to activate our PERT and made ourselves available to those calls. Our top goal was to go to the patient and provide recommendations, including mobilization of resources, in a timely manner. Communication with other subspecialty teams and education played a very significant role in our PERT launch. We approached it like a campaign and took every opportunity for teaching as a group in grand rounds, noon conferences, regional talks, etc. I'd say that our efforts were well received.

Dr. Keeling: PE care had previously been fragmented in our hospital, and once we coalesced around this team-based approach, we wanted everybody to buy into a shared decision-making model. One of the biggest struggles we had early on was identifying whom to involve. Initially, there was not a lot of interest. A few months after we got started, interest started to increase, and the team formed around the people who bought into the concept and saw their role in it.

Dr. Moriarty: We've had two iterations of our PERT here, and the first time, we weren't so successful. We tried to go too big too fast. We had grand aspirations and tried to get everybody all together and on the same page at the start, with input from stakeholders in medicine, cardiology, pulmonology, emergency, radiology (both interventional and diagnostic), surgery, transport—everybody. It was unwieldy, and we could never get anything approximating consensus on how to actually function, so it died.

But that experience informed our second approach to building a PERT, which we did on the backs of a smaller core group of very willing, very involved physicians who were happy to be on calls, take questions, and work through problems together. With that small core group of interventional radiologists, cardiologists, and pulmonologists, we then expanded slowly over the course of a few years to mix and match the same group that we had originally. We've just approached it in a different way.

Dr. Ross: When I arrived at Piedmont in 2012, there was no programmatic approach to PE care and intervention. At that same time, a pulmonology group was also entering the Piedmont system. Their pulmonary hypertension leader, Dr. Chad Miller, and I worked together on one case, successfully using ultrasound-assisted, catheter-directed thrombolytic therapy, and from there, our collaborative approach just grew and grew. We became champions for the evolving program and gathered all the stakeholders that were obvious at that time—including cardiac surgery, the ED, and our hospitalists. We had a number of organizational meetings over the course of about 18 months to discuss our approach to submassive and massive PE, including utilization of venoarterial extracorporeal membrane oxygenation led by cardiac surgeons Drs. David Dean and Peter Barrett, surgical embolectomy versus catheter-based techniques, etc. At the end of 18 months, we formalized our PERT program with our multispecialty team using the algorithms we had developed. My partners and I provided catheter-based intervention alone until 2015. At that time, we welcomed Dr. Andrew Klein, adding interventional cardiology to our team. One of the greatest strengths for our program has been multidisciplinary teamwork and sharing of call responsibilities.

Ms. McNally: During the initial stages of our PERT program, the greatest challenges were identifying key players, obtaining buy-in from hospital leaders and administration, and standardizing the treatment of our PE patients, similar to what the other panelists have said. Dr. Terry Bowers, the Founder and Director of our PERT program, took on these challenges in 2014, and after several years of championing, the program was officially launched in 2017. Our core PERT includes interventional cardiologists, interventional radiologists, emergency medicine physicians, and our rapid response team (RRT).

After the team was established, the focus shifted to the day-to-day management of these patients, including standardizing and operationalizing the process and care. Our RRT comprises advanced practice providers who are in-house 24/7 already responding to a variety of different urgent and emergent consults, so it was the perfect opportunity for the initial PERT to have a clinician immediately at bedside triaging our patients. When the program launched in 2017, I was brought over from the RRT to take on the PERT coordinator role and was responsible for defining and streamlining the process and making the program function smoothly and effectively. We have come so far from those early days, but there is always more room to improve the program as new challenges are brought forward.

Dr. Rosovsky: We're hearing a lot about the importance of effectively building your initial team—perhaps starting small and expanding slowly, identifying who is already there and doing the work and who will be the champions, and understanding that the specialties of those champions may vary from place to place. Dr. Davis, as a pharmacist and leader in your PERT, what did you observe in your team's initial experience? What were some of the challenges you encountered?

Dr. Davis: Ours was unique in that it originated from hospital administration, which was in a phase of trying to minimize variation to optimize care. One of the first areas to make that list was PE. They wanted an algorithm for managing patients as they came into the hospital and minimizing variation of care. This started before we even knew the concept of a PERT. We got a multispecialty group together to develop an algorithm, and as we were researching it, we started coming across the early literature describing the concept of a dedicated PERT.

When we developed this algorithm, we built in certain criteria (ie, if it is a submassive or massive PE, activate the PERT), and we developed it from there. Although we didn't have issues with hospital administration, we did face the other typical barriers of how to define the team, put it together, and logistically carry it out, as well as all of the communication around that process. Also, how do we assess what we're doing? To be honest, we're still struggling with that to an extent, even though we participated in the PERT registry and we got some benchmarking back from it.

GAINING BUY-IN FROM ADMINISTRATION

Dr. Rosovsky: Dr. Davis, it's great that you had that support from the beginning from your administration. Not everyone may have that initial support from leadership. For others, what did it take to gain buy-in from your administration or from other team members? What challenges and opportunities did you encounter?

Dr. Ní Áinle: We have been supported 100% by our administration. The chief executives in our system listened to patient stories, evaluated our business plans, and supported what has now grown into our Center for Integrated Thromboembolism Care, where we have recently welcomed a consultant in VTE and secured funding for an advanced nurse practitioner.

Management at any institution can buy into the concepts of quality of care and excellence. But we also need to address the financing and sustainability, and, of course, it will be jurisdiction specific. It is important to highlight the potential cost savings in the context of limited resources, both from avoiding additional hospital bed days and long-term complications by investing in excellent PE care. We have data from Europe that billions are spent every year on both direct and indirect costs of VTE in general.

The expenditure on staff and administrative resources can be balanced against the benefits in terms of long-term cost savings to the institution, the health care system, and, most importantly, quality of care.

Dr. Naydenov: Gaining buy-in from administration took some convincing. Overall, it has been a great experience to launch a new service for the hospital. It is important to find common ground with the hospital administration. The challenge at that time was that we did not have a clear criterion for a center of excellence for PE like we did for myocardial infarction (MI) or stroke. But we embraced the challenge and were very persistent in communicating and showing patient examples of how we were making a difference and why this concept of multidisciplinary team approach for PE care is prudent.

Dr. Rosovsky: Another way to help get buy-in from leadership is to share information about the potential value of PERT. There's an increasing amount of literature showing that PERTs can decrease time to PE diagnosis as well as decrease time to starting anticoagulation, both of which are important as we know that early anticoagulation saves lives. Some reports also demonstrate that PERTs led to reduced ICU stay, lower costs, and, more recently, a decrease in not only 30-day and in-hospital mortality but also 6-month mortality.

Dr. Rosovsky: When creating a business plan, we now have the literature I just mentioned that shows the possible benefits of a PERT in terms of quality, care, and cost. Dr. Horowitz, what have you seen in this regard, and what is new since the early days of your PERT?

Dr. Horowitz: Besides the data that have been published and the PERT database, one of the big things that I think will help convince administrators is the PERT Centers of Excellence program, which includes the standard criteria a PERT needs to meet. Back in 2012 and 2013, there was no common language, as well as no data. The perception was that PE was something that happened as a complication of being hospitalized, in contrast to stroke and MI, as Dr. Naydenov mentioned.

BUILDING A TEAM

Dr. Rosovsky: We have heard already how important it is to identify the participants in one's PERT, build relationships, and communicate effectively. I'd like to ask each of you: What are some of the keys and the challenges to building a successful team?

Dr. Naydenov: First and foremost is to identify an individual or a group who is passionate about PE care and is willing to take the lead. Once that part is addressed, the formation of the PERT is next. Individuals in the group can be invited based on interest and need. We picked our team based on interested people from different subspecialties, but we also invited additional members based on need. To give an example, we realized very early that the ED was where we were getting the majority of the PERT alerts. We gave an open invite to our ED physicians, and they identified an ED representative who joined the PERT and helped with that collaboration. We were open minded and, by keeping our focus clear and communication open, were successful in building our team.

Dr. Horowitz: I agree, and this gets back to the concept of building a coalition of the willing. A PERT needs to be consistent, which is a challenge due to the variable practice interests of who's on call on a given day. If the interventionalist on call has primary focus in oncology and only a cursory focus in PE, the champions and other engaged team members need to be available for questions.

The other thing that I've heard recently, which really makes me very happy, is some people who were skeptical are now buying in because there are randomized controlled trials (RCTs) starting. After a decade with little data, seeing multiple trials set to begin is encouraging.

Dr. Ní Áinle: That's an excellent summary Dr. Naydenov, and I couldn't agree with Dr. Horowitz more—the emergence of clinical trials that are well-designed and powered for clinically important outcomes has been deeply inspiring. Not only is it an enormous scientific and academic achievement to have RCTs set up, Dr. Horowitz is quite right, it has amplified the enthusiasm and status of PE in the community.

Dr. Moriarty: The drivers for us were, number one, we had a group of physicians in pulmonary, vascular, interventional, and then also in our ICU who were all very interested and had already worked in PE care. And then when the PERT idea spread through The PERT Consortium, there was a willing audience who wanted to work together and build it. The second driver was our involvement in trials. As different trials came about, as a research endeavor, we wanted to be involved in as many of them as possible. That gave us the impetus to work together and the ability to go to people who perhaps weren't as positive about interventional PE therapy for example and say, "Look, this is part of a trial, this is to build the evidence for decisions," and that gave us a good background to build and grow.

Dr. Keeling: We are also very focused on trying to get as many of our patients into trials as we can as well, looking to screen them for enrollment right away. After that, it becomes relatively simple as to who will take care of the patient.

Dr. Rosovsky: I agree; in the very beginning, we didn't have any data, and it was reasonable to ask, "How do you make these decisions, and what are the data behind them?" I also love the emphasis on bringing in people who are going to be thinking about these problems and issues differently than you because that's the whole point. Until these RCTs are completed and we discover whether one modality is better than another in a certain patient, it is a discus-

sion. We need to engage experts who may each have different opinions.

IF I'D KNOWN THEN...

Dr. Rosovsky: Looking back, what do you know now that you wish you had known when you were starting your PERT? What advice would you give a colleague looking to develop or join a PERT?

Dr. Moriarty: Having the resources of The PERT Consortium, whether it's the human resources of knowing people who do the same thing as you in different parts of the country you can touch base with or the institutional resources that are being put together from partners through videos, webinars, and pro formas. Having all those things available when we were getting started would've made the growth phase a lot easier.

Dr. Ross: I agree—having all those things at the very beginning would've meant that we didn't each have to invent the wheel, and we could have devoted our resources into building better infrastructure. But, I would say that having the service coordinator is most important. If we could have gathered support and maintained support for the coordinator, that would've helped all of us in our PERT program with both patient care and program administration.

Ms. McNally: There are many resources to help assist in making your program successful and other providers willing to help support you along the way. The PERT Consortium, the Anticoagulation Forum, StopTheClot.org, and many other resources are easy to access and make a significant difference in establishing a great program. Specifically, The PERT Consortium has made it very easy to connect with other PERT programs for support. Knowing these resources were available from day 1 would have been huge when we were just starting our program. We could have saved time and effort in utilizing what was already effective for others.

Another piece of advice is making sure all of the team providers are invested in the program and truly want what is best for the patients. They must be willing to put in the dedicated time and effort to make sure that PE patients have the right care at the right time.

Dr. Davis: The importance of having everyone invested has been articulated very well, and I'd also say that programs change and hospital systems expand. A PERT's leadership needs to be able to adapt through these changes to ensure its longevity and sustainability.

Dr. Moriarty: I'd add that recording our data in a consistent fashion would've been a good thing to do. Looking back, one of the most important things for us has been our dedicated EPIC note (EMR), so I would say having that front and center earlier. I would also reinforce the importance of continually advertising your services to make sure anyone in the hospital who might have heard it once several years ago hears it on a regular cadence.

Dr. Ross: Collecting data and tracking our experience from the beginning was very helpful. If I were advising someone starting right now, it would be to join PERT Partners and participate in The PERT Consortium database from the very beginning. The quality database and the feedback we get from The PERT Consortium are powerful and helpful. It breeds enthusiasm, and it shows us what we might do better and how we're stacking up compared to other PERT programs in the country.

Dr. Horowitz: Finding a great partner early on is really important. You can start the whole thing with two interested people—someone to see the consults and someone to do the procedures. You grow it from there, adding more opinions. As Dr. Rosovsky said, you're accessing pockets of knowledge to get a better opinion about how to help a patient when the guidelines are not necessarily that granular. Consistency is also key; you'll lose people if you're inconsistent, so focusing on a consistent response time, whether it's 5 minutes or 30 minutes, is important and considerate of their time.

Involvement in a PERT is how I've met more people in other specialties than anything else I've done in my career, working with them on their consults and seeing their patients. Reaching out to someone senior in another division and asking how they made their program successful can go a long way.

Dr. Rosovsky: It's a great point, the access to experience and mentorship, and it's something that has really grown within The PERT Consortium. We have over 100 registered PERTs through The PERT Consortium, and having the opportunity to learn from experts and have mentors guide you as to what the challenges and barriers are and how to overcome them can be enormously helpful.

Dr. Naydenov: I consider time the most valuable resource, so I'd say, please be very respectful and mindful of asking for someone else's time. Be very clear and up front of what your ask is. The focus and goal of the

PERT should be very clearly laid out to the team. It is important to listen to your colleagues' concern and feedback. Cherish the variety of opinions but have a process to solve conflicts so decision-making remains effective. Keep meetings structured and timely and adjourn when the agenda is discussed; filling the entire hour is not necessary.

Dr. Ní Áinle: I agree, for all of us, time and money constraints can be challenging, but you can do so much with very little in the beginning if you respect, cherish, and admire the relationships you have with your colleagues. Respect their individual capabilities, and what they bring to the table. It's incredibly powerful.

SUMMARY FROM THE MODERATOR

Thank you all for sharing your practical insights, what helped you in the initial stages of starting your PERT, what you struggled with, how you dealt with setbacks and challenges, and what advice you would give health care providers who are just starting on this journey. I think the last sentiments are the most powerful: PERTs would not exist without people feeling passionate about combating the problem of PE, but working together, communicating effectively, and respecting, cherishing, and admiring one another are the keys to success.

To help clinicians develop their own PERTs, The PERT Consortium has created PERT Partners, a program that connects existing PERTs to interested parties to assist in this process. Any health care provider who is interested in starting or expanding a PERT can go to pertconsortium.org and sign up for more information. ■

Disclosures
Dr. Davis: None.
Dr. Keeling: Consultant to AngioDynamics, Inc. and Penumbra, Inc.
Dr. Horowitz: Clinical trials with Penumbra and Inari Medical.
Ms. McNally: None.
Dr. Moriarty: Consultant to Penumbra, AngioDynamics, Auxetics, Innova Vascular, Retriever Medical, Pavmed, and Argon Inc.; National Principal Investigator, Penumbra STRIKE-PE trial.
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