The Interhospital Transfer Project of The PERT Consortium®: A Call to Action for Pulmonary Embolism

Addressing the gap in knowledge in interhospital transfer of patients with pulmonary embolism.

By Charles B. Ross, MD, DFSVS; Parth Rali, MD; and Belinda N. Rivera-Lebron, MD, MS, FCCP

Interhospital transfer (IHT) for critically ill patients is an established area of clinical research that spans the discipline of medicine.[1-8] Areas like trauma, stroke, and ST-segment elevation myocardial infarction (STEMI) have well-established protocols for IHT. Each critical illness has been studied to understand differences in patient characteristics and outcomes between patients transferred to institutions more capable of providing advanced comprehensive care. Processes of care have been studied with laudable goals of improvements in early recognition of the need for transfer, avoidance of delays, safe conduct of patients in transfer, and regionalization of care. Resource utilization and complications comparing patients directly admitted to comprehensive centers versus those transferred, such as intensive care unit (ICU) length of stay, costs, and rates of readmission, have been studied. A recent Pubmed search (April 25, 2021) documents the degree of scientific investigation of IHT: 458 citations for "interhospital transfer" and "mortality"; 314 citations for "interhospital transfer" and "trauma"; 140 citations for "interhospital transfer" and "stroke"; 99 citations for "interhospital transfer" and "STEMI"; 40 citations for "interhospital transfer" and "sepsis"; and 33 citations for "interhospital transfer" and "pregnancy." However, the search strategy for "interhospital transfer" and "pulmonary embolism" yielded only one citation, which was a case report.[9]

The National Pulmonary Embolism Response Team (PERT) Consortium®, founded in 2015, is dedicated to promoting multidisciplinary care of patients with pulmonary embolism (PE).[10,11] Presently, there are more than 125 member institutions in the United States and seven internationally, with professional membership representing at least 10 different specialties.[12] PE is the third most common cardiovascular cause of death and is estimated to be responsible for 60,000 to 100,000 deaths in the United States annually.[13,14] Over the past decade, there has been rapid evolution in advanced care, including critical care support and interventional therapies for PE patients.[15] However, many patients with PE first present to hospitals that are incapable of providing such care, making the process of IHT a potential barrier to their outcome. The key here is process, which represents the continuum from first diagnostic consideration of PE to safe arrival at the receiving center. Within this continuum, especially in the case of high- and intermediate–high-risk PE, there are points of critical decision-making and rapid execution that must be managed correctly and decisively to improve chances of survival. Unlike trauma and STEMI for which advanced trauma life support and advanced cardiac life support exist to guide practitioners, no such guidance has been developed and disseminated for PE.

IHT AND PE: A CRITICAL GAP IN KNOWLEDGE AND EFFORT

As noted, there has been little IHT research in PE. In 2015, a group at Vanderbilt presented an early report of the structure and function of their PE network.[16] They reported 31 patients, comparing 14 transferred from network hospitals and 17 directly admitted to Vanderbilt University Hospital. No mortality differences were reported. Recently, a group from Beth Israel Deaconess Medical Center reported 1,994 patients with acute PE, 682 (34.2%) of whom were transferred.[17] PE-related and overall mortality were higher in transferred patients, and advanced therapies were more commonly used in transferred patients. However, there was no statistical difference in mortality in the subgroup of submassive and massive PE patients who received care in the ICU. These data still form an early and incomplete picture about the importance of well-executed transfer for critically ill PE patients. The number of deaths that occur between PE diagnosis and arrival at the destination center is unknown. PE-related mortality due to transfer delays, for reasons ranging from initial failure to recognize the need for transfer, bed unavailability at receiving hospitals,

lack of extracorporeal membrane oxygenation (ECMO) circuit availability, and even suboptimal weather, has not been defined.

With the multidisciplinary collaboration within The PERT Consortium®, the gap in evidence, research, and education of frontline practitioners targeted toward IHT of PE as compared to other critical illnesses has been recently recognized. In 2019, support for initial research was awarded in the form of an unrestricted, investigator-initiated grant from Boston Scientific Corporation to begin the process of investigation and quality improvement in IHT for PE. The IHT project (IHTP) became the work of the clinical protocols committee (CPC) of The PERT Consortium®. Its primary goal was to develop a step-by-step guide to the stabilization and transfer of critically ill PE patients. Additional goals included identification of existing barriers in the IHT process and increasing awareness and education on definitive PE care.

THE IHTP

The IHTP is organized into work groups (WGs) and subcommittees to address the following four needs:

- WG 1: Identify and review critical processes and issues associated with IHT for PE
- WG 2: Identify problems and barriers to transfer of PE patients by surveying both transferring and receiving providers through a structured interview process
- WG 3: Analyze data from The PERT Consortium® database to compare characteristics and outcomes of transferred versus directly admitted PE patients
- WG 4: Disseminate findings to frontline practitioners as well as receiving physicians

WGs 1, 2, and 3 mainly include members of the CPC. WG 4 collaborates with the education committee of The PERT Consortium® and will include webinars, podcasts, and development of teaching materials. WG 1's project was felt to be especially critical to the overall IHTP and has been completed in partnership with members of the CHEST Pulmonary Vascular Disease Network.[18] Progress made to date includes manuscript preparation, submission, review, and revision for WG 1. WG 2 and WG 3 have manuscripts currently in development. The IHTP is recognized by all participants as a call to action to begin investigative and quality improvement research in IHT for PE. The IHTP is the beginning—not the end.

GENERAL CONSIDERATIONS FOR IHT FOR PE

After a PE patient is diagnosed and risk stratified, initiation of anticoagulation is the first step in PE management. Then, the frontline clinician must decide if the patient needs to be admitted to that presenting institution, transferred to another institution, or discharged home. That clinician may consider transfer if the patient has been diagnosed with an intermediate- or high-risk PE, the patient has complex medical problems, the facility lacks advanced PE treatment options, the facility lacks beds or expertise to treat for such a patient, or a patient has a high bleeding risk. Transfer of a critically ill patient begins with a call from the transferring facility to the receiving institution's call/transfer center.

Each receiving institution has a protocol in place to stimulate the call center, such as the activation of the institution's PERT or other accepting provider. Physician-to-physician communication will be promptly initiated. In most receiving centers, a single physician is the point person and triages the call with subsequent involvement of the PE interventionalist, ECMO service provider, and/or cardiac surgeon depending on the situation. Important basic patient information must be obtained in the call, such as vital signs including trends in heart rate, blood pressure, and respiration; oxygenation status and support; mentation and patient comfort or distress; historical features such as syncope and presence or absence of visible trauma; comorbidities; bleeding risks and review for contraindications to thrombolysis; and available family support. It is of utmost importance to establish if systemic anticoagulation has been administered. If it has not, the receiving physicians will help advise the transferring team to do so promptly.

Requests for transfer may differ depending on the status of the patient. The type of transport (air vs ground) will also depend on the severity of illness and availability of transport crew. Patients presenting to and being transferred from an emergency department differ from those transferred from an ICU. Additionally, hemodynamic optimization prior to transfer is key in achieving a safe and successful transfer.

An example of a difficult transfer call would be as follows:

> A woman in her early 40s with obesity collapses after rising from her hospital bed on postoperative day 2 after a total abdominal hysterectomy. After a brief period of cardiopulmonary resuscitation, return of spontaneous circulation is achieved. PE is strongly suspected. She is moved to the ICU where a transthoracic echocardiogram shows a markedly dilated right ventricle with a positive McConnell's sign. She is awake and alert but seems to be in distress. She has a small laceration and hematoma on the back of her scalp from the fall. Blood pressure is 90/50 mm Hg and heart rate is 130 bpm. Two vasopressors have been initiated for hemodynamic support. Her $Sa0_2$ on high-flow oxygen is 90%. The resuscitating physician and team have done an excellent job and call for transfer with strong suspicion of PE.

Management of this patient is affected by many factors. Some considerations that transferring and receiving practitioners may encounter include: Is the transferring physician willing to start systemic anticoagulation? If the patient experiences cardiac arrest again and given no other available recourse, will systemic thrombolysis be administered?

If the patient cannot be adequately oxygenated, is the transferring physician able to manage her airway and perform a hemodynamically neutral intubation? Is the transferring physician willing to try a intravenous fluid bolus while awaiting transfer? Can the patient be safely transferred? Should it be by air or by ground? What's the weather? What's the condition of metro traffic? Can you dispatch your mobile ECMO team to the patient to initiate ECMO prior to transfer?

In this sample case, there is a contraindication to administration of systemic tissue plasminogen activator (tPA). However, what if the scenario was different and there were no contraindications? Every PERT receiving team has encountered frontline physicians who are hesitant to administer tPA. The same frontline physicians who readily administer tPA for stroke (which has become standard practice) are often unsure about its use for high-risk PE. This may serve to unnecessarily raise the risk of deterioration in transfer and highlights the rudimentary state of our education and support of frontline providers of PE care as compared to stroke.

Although the most dramatic transfer dilemmas often arise in cases of high-risk PE, patients with intermediate–high-risk PE also require careful consideration. Conundrums arise when transfer is delayed, and patient care must ensue at the facility requesting transfer.

Finally, what about issues of futile care? Frequently, PERTs at advanced centers are asked to accept transfer of patients critically ill with PE, only to later learn that the patient in question is terminally ill from other causes such as a widely metastatic tumor. Bed shortages exist, and especially during the pandemic, such transfers could consume critical resources for patients in greater need. Issues of end-of-life care arise frequently with PE, and these need to be dealt with in a more forthright and appropriate manner.

CONCLUSION

Management of PE through multidisciplinary PERTs has often been called the "coalition of the willing." The importance of the multidisciplinary nature of a PERT on the call with a frontline provider during a PE crisis cannot be overemphasized. The PERT receiving specialists may be especially helpful in guiding frontline physicians away from high-risk intubation or toward appropriate administration of systemic thrombolysis. Experience and collaboration are key, but research, data, and education are ultimately needed to clarify and improve the systems process. Above all, education is fundamental to advance the IHT of PE patients into the future, and The PERT Consortium®'s IHTP represents only the beginning. ■

1. Heincelman M, Gebregziabher M, Kirkland E, et al. Impact of patient-level characteristics on in-hospital mortality after interhospital transfer to medicine services: an observational study. J Gen Intern Med. 2020;35:1127-1134. doi: 10.1007/s11606-020-05659-8
2. Shannon EM, Zheng J, Orav EJ, et al. Racial/ethnic disparities in interhospital transfer for conditions with a mortality benefit to transfer among patients with Medicare. JAMA Netw Open. 2021;4:e213474. doi: 10.1001/jamanetworkopen.2021.3474
3. Arthur KR, Kelz RR, Mills AM, et al. Interhospital transfer: an independent risk factor for mortality in the surgical intensive care unit. Am Surg. 2013;79:909-913. doi: 10.1177/000313481307900929
4. Mueller SK, Fiskio J, Schnipper J. Interhospital transfer: transfer processes and patient outcomes. J Hosp Med. 2019;14:486-491. doi: 10.12788/jhm.3192
5. Van Diepen S, Widimsky P, Lopes R, et al. Transfer times and outcomes in patients with ST-segment-elevation myocardial infarction undergoing interhospital transfer for primary percutaneous intervention: APEX-AMI insights. Circ Cardiovasc Qual Outcomes. 2012;5:437-444. doi: 10.1161/CIRCOUTCOMES.112.965160
6. Vora AN, Holmes DN, Rokos I, et al. Fibrinolysis use among patients requiring interhospital transfer for ST-segment elevation myocardial infarction care: a report from the US National Cardiovascular Data Registry. JAMA Intern Med. 2015;175:207-215. doi: 10.1001/jamainternmed.2014.6573
7. Grotta JC. Interhospital transfer of stroke patients for endovascular treatment. Circulation. 2019;139:1578-1580. doi: 10.1161/CIRCULATIONAHA.118.039425
8. Holena DN, Kaufman EJ, Hatchimonji J, et al. The impact of interhospital transfer on mortality benchmarking at level III and IV trauma centers: a step toward shared mortality attribution in a statewide system. J Trauma Acute Care Surg. 2020;88:42-50. doi: 10.1097/TA.0000000000002491
9. McDonald C, Laurie J, Janssens S, et al. Successful provision of inter-hospital extracorporeal cardiopulmonary resuscitation for acute post-partum pulmonary embolism. Int J Obstet Anesth. 2017;30:65-68. doi: 10.1016/j.ijoa.2017.01.003
10. Rosovsky R, Borges J, Kabrhel C, Rosenfield K. Pulmonary embolism response team: inpatient structure, outpatient follow-up, and is it the current standard of care? Clin Chest Med. 2018;39:621-630. doi: 10.1016/j.ccm.2018.04.019
11. Rosovsky R, Zhao K, Sista A, et al. Pulmonary embolism response teams: purpose, evidence for efficacy, and future research directions. Res Pract Thromb Haemost. 2019;3:315-330. doi: 10.1002/rth2.12216
12. The PERT Consortium. Accessed July 13, 2021. http://www.pertconsortium.org
13. Centers for Disease Control and Prevention. Blood clots: a serious but preventable medical condition. Accessed May 2, 2021. http://www.cdc.gov/ncbddd/dvt/documents/blood-clots-fact-sheet.pdf
14. Rivera-Lebron B, McDaniel M, Ahrar K, et al. Diagnosis, treatment, and follow-up of acute pulmonary embolism: consensus practice from the PERT Consortium. Clin and Appl Thromb Hemost. 2019;25:1076029619853037. doi: 10.1177/1076029619853037
15. Giri J, Sista AK, Weinberg I, et al. Interventional therapies for acute pulmonary embolism: current status and principles for the development of novel evidence: a scientific statement from the American Heart Association. Circulation. 2019;140:e774-e801. doi: 10.1161/CIR.0000000000000707
16. Bloomer TL, Thomassee EJ, Fong PP. Acute pulmonary embolism network and multidisciplinary response team approach to treatment. Crit Pathw Cardiol. 2015;14:90-96. doi: 10.1097/HPC.0000000000000049
17. Beyer S, Secemsky E, Carroll B. Outcomes of patients with acute pulmonary embolism who undergo interhospital transfer. J Am Coll Cardiol. 2021;77(18 suppl 1):1821.
18. Rali P, Sacher D, Rivera-Lebron B, et al. Interhospital transfer of patients with acute pulmonary embolism (PE): challenges and opportunities. Chest. Published online July 13, 2021. doi: 10.1016/j.chest.2021.07.013

Charles B. Ross, MD, DFSVS
Chief of Vascular and Endovascular Services
Piedmont Heart and Vascular Institute
Atlanta, Georgia
Disclosures: None.

Parth Rali, MD
Associate Professor, Thoracic Medicine and Surgery
Lewis Katz School of Medicine
Temple University
Philadelphia, Pennsylvania
Disclosures: Consultant to Janssen.

Belinda N. Rivera-Lebron, MD, MS, FCCP
Associate Professor of Medicine
Division of Pulmonary, Allergy and Critical Care Medicine
Department of Medicine
University of Pittsburgh School of Medicine
Pittsburgh, Pennsylvania
riveralebronbn@upmc.edu
Disclosures: Board of Directors, PERT Consortium®; consultant, Janssen, Bayer, Bristol-Myers Squibb.