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# **Introductory Chapter: Embolic Diseases - Unusual Therapies and Challenges**

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Additional information is available at the end of the chapter

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## **1. Introduction**

Embolic problems are a well-established cause of substantial morbidity and mortality. The challenging aspect of management is recognition of the multi-factorial events that ultimately result in an embolic problem. First and foremost in management is often the acute events that bring the patient to medical attention. While such events, in themselves, can be dramatic in their morbidity and/or mortality—and, therefore, require immediate attention—emphasis must also focus on the precipitating factors that precipitate the embolism. When possible, and reasonable, it is important to identify the source of the embolism, the destination (or destinations) of the embolic material, and the characteristics that might have contributed to the development of the primary source. Management is often structured around controlling the embolism and its clinical consequences.

## **2. Principles of care**

One of the most common thrombo-embolic complications is stroke. Cerebrovascular consequences can span the spectrum of clinical presentations from events that can be minor, self-limited, and potentially asymptomatic events to those that are catastrophically debilitating or fatal. Common causes include thrombotic material from a cardiac source—typically clots from the left atrial appendage in patients with atrial fibrillation [1]. Other cardiac sources include left ventricular thrombus in patients with significant wall motion abnormalities or apical aneurysms/dysfunction in the setting of previous myocardial infarctions or a depressed ejection fraction, infectious sources from endocarditis (also typically intra-cardiac), paradoxical emboli from intra-cardiac shunts (such as a patent foramen ovale), and less common cardiac causes—including benign and malignant tumors [2]. While much energy is focused on cardiac

source and systemic effects, it is critical to recognize that there are many others—and often less common or unusual causes. In addition, the foundations for embolic therapy include [3]:

- (1) Anticoagulation or anti-platelet therapies to potentially minimize the impact of the initial event.
- (2) Interventions—either pharmacologic or mechanical to try to dissolve or remove the distal embolism.
- (3) Control or management of the primary source to reduce the risks for recurrence.
- (4) Long-term therapies to control the circumstances that resulted in the initial primary sources.

Even though neurologic complications tend to be the most fear, it is important to realize that systemic complications to visceral organ (i.e., hepatic, renal, intestinal) and the extremities can be just as morbid or potential fatal [4, 5]. The focus of many chapters in this text is an update and review of some of these unusual embolic sources. While it is important to recognize that many common clinical problems and their treatments, can lend themselves to the development of protocols and guidelines, some of the more uncommon or unusual presentations and problems can present as considerable diagnostic and therapeutic challenges. The purpose of many of the chapters in this text is to review the data and collective experiences of some of the different types of embolic diseases and to serve as a guide to therapy.

### 3. Project focus

In addition, even though there are extensive reviews of some of the more common embolic problems—such as left atrial appendage clots, stroke in the setting of either cardiac or non-cardiac sources, and the diagnosis and medical management of the full spectrum of acute and chronic pulmonary thromboembolic disease, these important clinical topics are not considered, other than rarely discussed surgical management, in the contents of this book. The reasons for their exclusion are simple—each topic can clearly be a book in outright (and there are already entire texts devoted to each topic) and even a basic review would overwhelm the primary purpose of this project. Furthermore, the fields in these areas are changing so quickly in terms of diagnostic tools, medical therapies, interventional options, and the standards of care and professional society guidelines that inclusion of some of those topics would only quickly result in an out-of-date reference [6]. Nevertheless, there are some principles that are evolving in the management of embolic disease that are comment regardless of the etiologies. The common principles are echoed as themes throughout this text, but warrant specific discussion.

### 4. Team-base care

As with many other contemporary disease management guidelines—such as cancers and structural heart disease—the focus is on a multi-disciplinary team approach to the diagnosis and

management [7, 8]. The purposes and goals of a team approach should be inherently obviously, but developing and maintaining them often requires substantial leadership in bringing together various disciplines with a patient-centered focus. Professional and disease centric “silos” and traditional models of patient care, including sometimes one-way, fragmented, and ill-coordinated referrals have evolved in the team-based care. Often such teams will have a coordinator—aptly called a “navigator”—whose primary purpose is to help navigate and coordinate the care of the individual patients [9]. As with all journeys, the Navigator will ensure a safe and effective travel, through what is often a complex and challenging path from initial diagnosis to cure. While a Navigator might not be the first healthcare provider a patient encountered when entering into a disease management process, they ultimately serve as the focal point person for care. Even as a patients is individually evaluated by members of the Team, internal referral to the Navigator can help organize the clinical data and help track and coordinate a management plan. Navigators can arrange for testing and follow-up appointments to help not only insure a timely and efficient work-up, but also insure that team-defined care plans are maintained. Typically, a Navigator will help compile all of the relevant diagnostic testing, including critical components of the history and physical exams and provide a framework such that each patient’s unique presentation is discussed in a timely manner by all of the disciplines represented by the team. Disciplines represented on such teams can vary, but are often comprised of the core specialties that traditionally manage either the organ systems or the diseases in question. However, there are some key disciplines that often serve as critical team members:

1. Medical specialists (i.e., cardiologists, pulmonologist, oncologists).
2. Surgical specialists (i.e., oncologic surgeons, cardiothoracic surgeons, general surgeons).
3. Therapy-specific specialists (e.g., interventional cardiology/radiology, radiation/medical oncology).
4. Palliative care and hospice medicine.
5. Primary care, hospitalists, or geriatric specialists.
6. Imaging specialists.
7. Advanced practice healthcare providers (e.g., nursing, respiratory therapy, pharmacy, perfusionists, imaging technicians)

In addition, such teams need to be open to all healthcare providers who would be interested in attending and participating. Additional specialists, in specific cases, should be asked to participate to lend their expertise and insights when patients present with a more advanced set of circumstances—such as a nephrologist might be asked to participating in the discussion of a patient who also immunosuppressed from a kidney transplant, or a neurologist and infectious disease experts might be called upon to discuss a patient with a stroke from infectious endocarditis. The overriding principle behind such team-based care is that each case is presented with a focus on evidence based medicine guidelines, local or regional experiences or expertise, objective review of all of the key tests, and a unified consensus as to “best” approach to the management of the patient and their problems. The management of a patient with embolic diseases should also follow such a framework. While the acuteness of a presentation

and need for immediate or emergent therapy might preclude a “weekly team conference,” it should not change from the borrowing of an established institutional structured approach to the problem. A physical or virtual meeting and discussion of the core disciplines can occur at any time, and hopefully with an existing algorithm in place for disease triage and manage, such meetings can be arranged and effective care-plans determined at any time—even in the absence of a formal “on-call” schedule provided the members are committed to the principles of such team-based care. The current models that are used for Structural Heart Disease or Acute Pulmonary Embolism Teams, throughout of the scope of this text, are being written about more extensively in the literature and might help provide a structure [10, 11].

Important concepts that represent themes throughout this text are that include:

1. Not all sources of embolic disease reflect in here patient co-morbidities—such as atrial fibrillation, atherosclerotic vascular disease, endocarditis, or deep vein thrombosis—just to name a few common intrinsic causes. Some sources may be initially extrinsic to the patient or iatrogenic, such as retained foreign bodies (e.g., guide wires lost during central line placement) or objects that erode into the vascular system after trauma (i.e., bullet fragments).
2. However, it is important to also realize—as emphasized in several chapters—that the pathophysiologic consequences of several chronic disease states, such as liver and renal disease, might predispose patients to increased risks for complex embolic problems. An understanding of the complex biology is a cornerstone to effective management.
3. Similarly, when evaluating a patient with an embolic problem, it is important to consider that not all embolisms are “organic” in nature. While most embolic material consists of biologic material such as clot, atherosclerotic debris, infectious material (i.e., vegetations)—or typically, a combination of one or more components, it is important to consider (as mentioned above) that some embolic material might not be organic, or biologic.
4. Another important concept that is addressed in some of the chapters in this text is that management might vary based upon not only the patient’s clinical status, but also the nature of the embolic material. While anti-coagulation or anti-platelet agents still represent a cornerstone to treatment of most embolic complications with the underlying principle that such therapies might minimize the consequences of vascular occlusion with propagation or worsening thrombotic material, acute or definitive treatment might require more invasive therapies. Several of the chapters in this text outline the role and specific techniques for surgical management of embolic complication. With so much emphasis on therapies that focus on manipulations of the clotting cascade—such as anticoagulation, fibrinolysis, or anti-platelets agents—as with all multi-disciplinary approach to complex problems, surgical management options must be considered.

## 5. Conclusions

It is important to recognize that when faced with a patient with an embolic complication, management can be complexed. Clearly, early and aggressive diagnostic and therapeutic

initiatives are critical to prevent further complications. As with many problems, a multi-disciplinary team approach to care is an evolving foundation that is important for optimizing outcomes. Unusual embolic complications, thought far less common than atherosclerotic or those of an intrinsic cardiac source, must be considered and managed using a similar paradigm of care. It is the fundamental purpose of this text to hopefully outline some of the more unusual causes of embolic diseases and emphasize the experiences and data that can guide therapy.

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## References

- [1] January CT, Wann LS, Alpert JS, Calkins H, Cigarroa JE, Cleveland JC, Conti JB, et al. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: Executive summary: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. *Journal of the American College of Cardiology*. 2014;**64**(21):2246-2280
- [2] Bang OY, Ovbiagele B, Kim JS. Evaluation of cryptogenic stroke with advanced diagnostic techniques. *Stroke*. 2014;**45**(4):1186-1194
- [3] Powers WJ, Derdeyn CP, Biller J, Coffey CS, Hoh BL, Jauch EC Johnston KC, et al. 2015 American Heart Association/American Stroke Association focused update of the 2013 guidelines for the early management of patients with acute ischemic stroke regarding endovascular treatment. *Stroke*. 2015;**46**(10):3020-3035
- [4] Shahreyar M, Dang G, Bhandari S, Hanif A, Bashir MW Muppidi V, Bhatia A, Sra J, Tajik AJ, Jahangir A. Predicting outcomes in patients with atrial fibrillation and acute mesenteric ischemia. *Journal of the American College of Cardiology*. 2016;**67**(13S): 717-717.
- [5] Geller BJ, Giugliano RP, Braunwald E, Murphy SA Hanyok JJ, Jin J, Mercuri M, Antman EM, Ruff CT. Systemic, noncerebral, arterial embolism in 21,105 patients with atrial fibrillation randomized to edoxaban or warfarin: Results from the Effective Anticoagulation With Factor Xa Next Generation in Atrial Fibrillation-Thrombolysis in Myocardial Infarction Study 48 trial. *American Heart Journal*. 2015;**170**(4):669-674
- [6] Catanese L, Tarsia J, Fisher M. Acute ischemic stroke therapy overview. *Circulation Research*. 2017;**120**(3):541-558



- [7] Holmes DR, Rich JB, Zoghbi WA, Mack MJ. The heart team of cardiovascular care. *Journal of the American College of Cardiology*. 2013;**61**(9):903-907
- [8] Taylor C, Munro AJ, Glynne-Jones R, Griffith C, Trevatt P, Richards M, Ramirez AJ. Multidisciplinary team working in cancer: What is the evidence? *British Medical Journal*. 2010;**340**:c951
- [9] Wells KJ, Battaglia TA, Dudley DJ, Garcia R, Greene A, Calhoun E, Mandelblatt JS, Paskett ED, Raich PC. Patient navigation: State of the art or is it science? *Cancer*. 2008;**113**(8):1999-2010
- [10] Lancellotti P, Rosenhek R, Pibarot P, Iung B, Otto CM, Tornos P, Donal E, et al. ESC Working Group on valvular heart disease position paper—heart valve clinics: Organization, structure, and experiences. *European Heart Journal*. 2013;**34**(21):1597-1606
- [11] Kabrhel C, Jaff MR, Channick RN, Baker JN, Rosenfield K. A multidisciplinary pulmonary embolism response team. *CHEST Journal*. 2013;**144**(5):1738-1739