JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
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PUBLISHED BY ELSEVIER

VOL. 68, NO. 24, 2016
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2016.09.958

THE PRESENT AND FUTURE

STATE-OF-THE-ART REVIEW

Prosthetic Heart Valve Thrombosis

George D. Dangas, MD, PhD,[a] Jeffrey I. Weitz, MD,[b] Gennaro Giustino, MD,[a] Raj Makkar, MD,[c] Roxana Mehran, MD[a]

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CME Objective for This Article: Upon completion of this activity, the learner should be able to: 1) describe the types of prosthetic heart valves; 2) understand the thrombogenic mechanisms of prosthetic heart valves; 3) classify types of medical therapy to prevent prosthetic heart valve thrombosis; and 4) understand clinical outcomes after heart valve replacement.

CME Editor Disclosure: *JACC* CME Editor Ragavendra R. Baliga, MD, has reported that he has no relationships to disclose.

Author Disclosures: Dr. Dangas is a consultant to Janssen Pharmaceuticals (spouse), CSL Behring (spouse), AstraZeneca (spouse), Medtronic, Abbott Vascular (spouse), Bayer, Boston Scientific, and Daiichi-Sankyo; his institution has received research grant support from Bayer, Janssen, and The Medicines Company; and reports minor stock options from Claret Medical (spouse). Dr. Weitz has served as a consultant and has received honoraria from Bayer, Janssen Pharmaceuticals, Bristol-Myers Squibb, Pfizer, Boehringer Ingelheim, Daiichi-Sankyo, Merck, Portola, and Ionis Pharmaceuticals. Dr. Makkar is the principal investigator for the St. Jude Medical Portico trial; has received research grants from Edwards Lifesciences, St. Jude Medical, and Medtronic; and has received consulting fees from Abbott Vascular, Cordis, Edwards Lifesciences, and Medtronic. Dr. Mehran has received institutional grant support from The Medicines Company, Bristol-Myers Squibb, Sanofi, Eli Lilly & Company, OrbusNeich, Bayer, CSL Behring, and Daiichi-Sankyo; is a consultant to Janssen Pharmaceuticals, Osprey Medical, Watermark Research Partners, Medscape, AstraZeneca, Abbott Vascular, and CSL Behring; is on the scientific advisory board of Abbott Laboratories; and reports minor stock options from Claret Medical. Dr. Giustino has reported that he has no relationships relevant to the contents of this paper to disclose. Deepak L. Bhatt, MD, MPH, served as Guest Editor-in-Chief for this paper.

Medium of Participation: Print (article only); online (article and quiz).

CME Term of Approval

Issue Date: December 20, 2016
Expiration Date: December 19, 2017

From [a]The Zena and Michael A. Wiener Cardiovascular Institute, The Icahn School of Medicine at Mount Sinai, New York, New York; [b]Departments of Medicine and Biochemistry and Biomedical Sciences, McMaster University, Hamilton, Ontario, Canada; Thrombosis and Atherosclerosis Research Institute, Hamilton, Ontario, Canada; and the [c]Department of Cardiology, Cedars-Sinai Medical Center, Los Angeles, California. Dr. Dangas is a consultant to Janssen Pharmaceuticals (spouse), CSL Behring (spouse), AstraZeneca (spouse), Medtronic, Abbott Vascular (spouse), Bayer, Boston Scientific, and Daiichi-Sankyo; his institution has received research grant support from Bayer, Janssen, and The Medicines Company; reports minor stock options from Claret Medical (spouse). Dr. Weitz has served as a consultant and has received honoraria from Bayer, Janssen Pharmaceuticals, Bristol-Myers Squibb, Pfizer, Boehringer Ingelheim, Daiichi-Sankyo, Merck, Portola, and Ionis Pharmaceuticals. Dr. Makkar is the principal investigator for the St. Jude Medical Portico trial; has received research grants from Edwards Lifesciences, St. Jude Medical, and Medtronic; and has received consulting fees from Abbott Vascular, Cordis, Edwards Lifesciences, and Medtronic. Dr. Mehran has received institutional grant support from The Medicines Company, Bristol-Myers Squibb, Sanofi, Eli Lilly & Company, OrbusNeich, Bayer, CSL Behring, and Daiichi-Sankyo; is a consultant to Janssen Pharmaceuticals, Osprey Medical, Watermark Research Partners, Medscape, AstraZeneca, Abbott Vascular, and CSL Behring; is on the scientific advisory board of Abbott Laboratories; and reports minor stock options from Claret Medical. Dr. Giustino has reported that he has no relationships relevant to the contents of this paper to disclose. Deepak L. Bhatt, MD, MPH, served as Guest Editor-in-Chief for this paper.

Manuscript received May 24, 2016; revised manuscript received September 19, 2016, accepted September 20, 2016.

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ABSTRACT

Although surgery was the mainstay of treatment for valvular heart disease, transcatheter valve therapies have grown exponentially over the past decade. Two types of artificial heart valve exist: mechanical heart valves (MHV), which are implanted surgically, and bioprosthetic heart valves (BHV), which can be implanted via a surgical or transcatheter approach. Whereas long-term anticoagulation is required to prevent thromboembolism after MHV replacement, its value in patients receiving BHVs is uncertain. Patients undergoing transcatheter BHV replacement are at risk for thromboembolism in the first few months, and recent data suggest that the risk continues thereafter. BHV thrombosis provides a substrate for subsequent thromboembolism and may identify a reversible cause of prosthesis dysfunction. Hereafter, the authors: 1) review the data on prosthetic valve thrombosis; 2) discuss the pathophysiological mechanisms that may lead to valve thrombus formation; and 3) provide perspective on the implications of these findings in the era of transcatheter valve replacement. (J Am Coll Cardiol 2016;68:2670–89) © 2016 by the American College of Cardiology Foundation.

PROSTHETIC HEART VALVE THROMBOSIS: BACKGROUND AND DEFINITIONS

Valvular heart disease affects more than 100 million persons worldwide, and is associated with significant morbidity and mortality (1). In the last 50 years, the epidemiology of valvular disorders has drastically changed, with a marked reduction in the incidence and prevalence of rheumatic heart disease and a substantial increase in the prevalence of degenerative valve diseases. Currently, the overall age-adjusted prevalence of mitral or aortic valvular heart disease is estimated to be 2.5% in the general population of the United States, with a prevalence exceeding 10% in subjects over 75 years of age (1). Given the aging of the population worldwide, the prevalence of such pathologies is expected to rise exponentially (1).

Surgical valve replacement (or repair of mitral valves) is currently the standard of care for treatment of valvular heart disease in patients at low and intermediate risk for surgery (2). However, in the last 10 years, a proliferation of transcatheter technologies now offers alternatives to surgery, especially in patients at high or prohibitive risk. Transcatheter valve therapies for aortic stenosis and mitral regurgitation are currently an established treatment option in patients not suitable for conventional surgical treatment (2), or of at least intermediate risk for aortic surgery.

On the basis of the leaflet material, 2 different types of surgical prosthetic heart valves exist (**Figure 1**): mechanical and biological (3). Mechanical heart valves (MHVs) are more thrombogenic, yet more durable. These valves have evolved from the early caged ball and tilting disc design to the contemporary bileaflet valves mounted on a Teflon- or Dacron-covered sewing ring (3). Bioprosthetic heart valves (BHVs) are less thrombogenic than MHV and exhibit more natural hemodynamic properties, but are less durable (3). Surgical BHVs are either of porcine origin or are synthesized from a sheet of bovine pericardium that is mounted on a frame or stent and covered by fabric, which serves as a sewing ring (3). Stentless BHVs have also been developed; these provide greater effective orifice areas and lower transprosthetic gradients than stented prosthetic valves (PVs) (3). Conversely, all of the transcatheter aortic and mitral PVs consist of a porcine or bovine pericardial tissue trileaflet mounted on a self-expandable or balloon-expandable metallic frame (4). Initial forms of these valves included equine tissue leaflets.

All foreign bodies (including PVs) implanted within the human cardiovascular system are thrombogenic, potentially implying the need for short- or long-term anticoagulation to prevent thrombosis, which can lead to disabling or fatal stroke. PV thrombosis is a pathological entity characterized by thrombus formation on the prosthetic structures, with subsequent PV dysfunction with or without thromboembolism (TE) (5). PV dysfunction is a complication of mechanical or biological prostheses, which can cause reduced leaflet motion or impaired leaflet coaptation, leaflet thickening, reduced or increased effective prosthesis orifice area (leading to either stenosis or insufficiency as the primary valve defect, respectively), increased transvalvular gradient or transvalvular regurgitation, with or without development of valve-related symptoms (6,7). At least 4 main etiologies may account for PV dysfunction: 1) PV