Trainees in a traditional 1-year training program will likely not be able to acquire the case numbers and procedural skills to perform endovascular repair of aneurysmal disease, and additional training will likely be required through non–ACGME-accredited advanced fellowships or postfellowship training through courses, proctoring, or direct mentorship. The presence of aortoiliac aneurysmal disease may pose significant challenges for the interventional management of CAD, and all interventional cardiology trainees should be skilled in addressing these challenges, including the choice of vascular access and guide-catheter support issues, as well as the potential risk of embolization from catheter manipulation.

4.2.3.7. Nonatherosclerotic Vascular Disease. Nonatherosclerotic PAD is much less common than atherosclerotic PAD. The lower extremity ischemia is often manifest by exertional lower extremity discomfort consistent with typical or atypical intermittent claudication, and there may be physical signs suggestive of arterial ischemia. Nonatherosclerotic PAD should be suspected in patients with signs or symptoms of lower extremity ischemia who: 1) are without risk factors for atherosclerosis (eg, younger age, tobacco use, diabetes mellitus, hypercholesterolemia, hypertension); 2) do not have other clinical manifestations of atherosclerosis (prior heart attack, prior stroke); or 3) lack the typical characteristics on physical examination, lesion distribution, or vascular imaging for atherosclerosis (calcification).

The etiology of nonatherosclerotic PAD includes extrinsic vascular compression, as referenced in Section 3.2.5. The trainee should also be aware of congenital anatomical variants of the external iliac artery. The treatment of these conditions is optimized by a multidisciplinary vascular team. When revascularization is deemed necessary, surgical therapies are frequently preferred with the exception of fibromuscular dysplasia, which is often amenable to balloon angioplasty.

4.2.4. Structural Heart Interventions

4.2.4.1. Aortic Valve Interventions. The trainee will acquire the knowledge and skills to manage aortic valve disease as part of a multidisciplinary team approach, including geriatric and palliative care consultations when appropriate. These include a thorough understanding of the indications for intervention and the relative benefits and risks of transcatheter techniques, surgical interventions, and medical management. The trainee will develop a working understanding of echocardiographic measurements as well as proficiency in invasive measurements of hemodynamics and understand the physiology and workup of other presentations of aortic disease, such as low-flow and low-gradient aortic stenosis, and the appropriate steps to confirm severe aortic stenosis. Central to invasive management of aortic stenosis is the ability to interpret CCT scans with specific emphasis on the appropriate choice of valve size, characteristics that may represent special challenges to implantation, and assessment of vascular features conducive to transfemoral versus alternative access sites. The trainee will obtain proficiency in the performance of balloon aortic valvuloplasty and transcatheter valve implantation in both native and prior surgical prostheses, including both balloon-expandable and self-expanding valves. The trainee must also have proficiency in the evaluation of satisfactory valve positioning, with emphasis on diagnosing paravalvular leak and high residual gradient as well as steps to address these issues. The trainee will also be proficient in diagnosing and treating immediate complications of valve implantation, including heart block, stroke, coronary obstruction, valve embolization, pericardial effusion, and disruption of annular or subannular structures. The trainee will acquire knowledge of patient management after their index hospitalization, including teamwork and communication, appropriate anticoagulation strategies, assessment for prosthetic valve dysfunction (valve thrombosis, degeneration, or infection), infectious endocarditis prophylaxis, and knowledge of techniques for coronary catheterization in the setting of a prior transcatheter valve.

4.2.4.2. Mitral Valve Interventions. The etiology of mitral valve disease, its clinical presentation, diagnosis, and progression, should be appreciated, in addition to knowledge of appropriate management strategies, including medical therapy and percutaneous or surgical intervention. Currently approved interventions for mitral valve disease include balloon valvuloplasty for mitral stenosis, TEER for mitral regurgitation, and transcatheter valve-in-valve and transcatheter valve-in-ring replacement for prosthetic structural valve dysfunction. Each of these diseases has a different pathophysiology and clinical presentation that must be understood, interpreted, and applied to the patient's clinical presentation, diagnostic workup, and management.[66]

Patients with mitral stenosis may or may not have a history of rheumatic fever, but the classic pathology and echocardiographic morphology must be appreciated. After initial medical management, the criteria for timing of intervention may include pulmonary hypertension in addition to symptoms of dyspnea. More importantly, physicians should know the impact of valve morphology, various scoring systems, and their corresponding hemodynamic and echocardiographic features that influence the short- and long-term outcomes of the valvuloplasty or valve replacement and help in informed decision-making.

For mitral regurgitation, physicians must know the insidious nature of this disease in many patients who may be asymptomatic to provide medical management and decide on the appropriate timing for percutaneous or surgical treatment. It is also essential to understand the differences in the pathophysiology of primary and secondary mitral regurgitation and the role of noninvasive imaging in monitoring asymptomatic patients. The indications for TEER in primary mitral regurgitation (in severely symptomatic patients with high or prohibitive surgical risk) and in secondary mitral regurgitation (based on the inclusion and exclusion criteria of the COAPT [Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy for Heart Failure Patients With Functional Mitral Regurgitation] trial) are key.[66] Understanding the rapid evolution of the field, newer options for goal-directed medical therapy, as well as newer devices for percutaneous interventions is important in making an informed decision. It also emphasizes the role of a multidisciplinary team in the management of these patients. Finally, the advent of recent-generation TEER devices has expanded the initial morphologic considerations for successful TEER, but the importance of experienced operators in patients who are not ideal for TEER should be considered.[35]

The most recent transcatheter mitral valve intervention involves transseptal placement of a balloon-expandable TAVR prosthesis in a deteriorating surgical mitral bioprosthesis or surgical mitral ring in patients who are at high risk for repeat surgery. Understanding the nuances of each surgical prosthesis and the infrequent performance of this procedure should limit it to highly experienced structural heart centers that are equipped to provide and interpret advanced imaging assessments preprocedure (CT angiography and transesophageal echocardiography) and capable of dealing with unique complications, including acute left ventricular outflow tract obstruction, valve embolization, paravalvular regurgitation, and hemolysis.

4.2.4.3. Pulmonic Valve Interventions. Dysfunction of the right ventricular outflow tract is almost always related to a congenital etiology. There are rare circumstances where patients without CHD develop pulmonary valve obstruction (eg, due to infective endocarditis) or pulmonary valve regurgitation (eg, due to severe pulmonary hypertension), but most pulmonary valve dysfunction cases are due to native or palliated/repaired CHD. Congenital obstruction of the right