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Research Article

Sign and Treatment an Aortic Stenosis: A Review Article

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Abstract

Introduction: Aortic stenosis is the most common heart valve disease in adults and is the third cardiovascular disease after arterial hypertension and coronary artery disease. Based on the Euro Heart Survey on valvular heart disease, aortic stenosis is the single most common primary valve disease (43.1%), and possibly degenerative aortic stenosis in elderly individuals. Stenosis of the aortic valve generally occurs in older adults, where 3-5% of people over the age of 65 have this disease. Aortic stenosis has greater morbidity and mortality than other heart valve diseases. Currently, aortic stenosis is the most common valvular heart disease in the country and its prevalence increases with age. Therefore, with the increase in life expectancy, the population of patients with aortic valve stenosis will increase in number in the future.

Discussion : The prevalence of stenosis of the aortic valve increases with age. Based on the Euro Heart Survey on valvular heart disease, the degenerative process was the dominant etiology of aortic stenosis (81.9%), followed by rheumatic disease (11.2%). Endocarditis accounts for 0.8% of cases of aortic stenosis, congenital aortic stenosis with aortic bicuspid valve occurs in 5.4% of patients, whereas 0.6% is due to other causes. Rare causes of aortic stenosis include metabolic syndrome (Fabry disease), nonspecific infectious disease, erythematous lupus, Pagani's disease, hyperuresemia, changes due to drugs, and post radiation therapy. The three main causes of aortic stenosis include calcification of the trileaflet valve, abnormal congenital valves with calcification (unicuspid or bicuspid), and rheumatic valve disease. Regardless of the etiology, aortic stenosis will cause obstruction in left ventricular emptying leading to concentric hypertrophy where there is an increase in the mass and thickness of the left ventricular wall. This aims to normalize the pressure on the wall during systolic and to keep the left ventricular ejection fraction normal.

Conclusion: After defining symptoms of aortic stenosis, the prognosis without surgical intervention is very poor. There are studies that project that the mean time from symptom onset to death is 2 years for patients with syncope complaints on activity, 3 years for those with symptoms of heart failure, and 5 years for those with angina. More severe symptoms will lead to a worse outcome.

Keywords: Aortic Stenosis; Degenerative; Calcification; Surgery

Introduction

Aortic stenosis is the most common heart valve disease in adults and is the third cardiovascular disease after arterial hypertension and coronary artery disease. Based on the Euro Heart Survey on valvular heart disease, aortic stenosis is the single most common primary valve disease (43.1%), and possibly degenerative aortic stenosis in elderly individuals. Stenosis of the aortic valve generally occurs in older adults, where 3-5% of people over the age of 65 have this disease. Aortic stenosis has greater morbidity and mortality than other heart valve diseases. Currently, aortic stenosis is the most common valvular heart disease in the country and its prevalence increases with age. Therefore, with the increase in life expectancy, the population of patients with aortic valve stenosis will increase in number in the future [1].

Diagnostics for aortic stenosis are advancing as techniques develop in the use of echocardiography. Likewise, valve replacement guidelines, approaches, and developments have evolved as the science of anesthesia and surgery has evolved. The bicuspid aortic valve is the most common congenital abnormality of aortic valve stenosis. Whereas in older adults, about 2% of people over 65 years of age, 3% of people over 75 years of age, and 4% of people over 85 years of age have this disease [3].

In elderly adult patients, aortic stenosis results from calcification and progressive degeneration of the three aortic cusps. The commissures do not coalesce as in rhemautic aortic stenosis. In the past, aortic stenosis was thought to be a passive degenerative "wear and tear" disease associated with old age. In addition, clinical factors such as coronary heart disease, hypertension, obesity, diabetes mellitus, smoking, dyslipidemia, and chronic kidney disease are thought to be associated with the occurrence of aortic stenosis. However, research from Otto CM., *et al*. supports that from the histopathological aspect of calcified aortic valve disease shows an active process that has some similarities to the process of atherosclerosis, which involves the accumulation of lipids, infiltration of macrophages and T lymphocytes, damage to the basal membrane, and microscopic calcification [4].

Both aortic stenosis and atherosclerosis share many of the same risk factors as Diabetes Mellitus, hypertension, dyslipidemia, chronic kidney disease, and smoking. In addition, Ortholepp JR also found that genetic factors can play an important role in the formation of calcification in the aortic valve. His study showed that patients with aortic stenosis had a significant difference in the genotype of vitamin D receptors compared to people without aortic stenosis [5].

Research from Stewart Bf., *et al*. showed that 26% of the 5201 men and women over the age of 65 had sclerosis of the aortic valve, where there was thickening or accumulation of calcification in the cusp of the aortic valve. In its early stages, aortic sclerosis appears without stenosis, but as the disease progresses, the valve leaves become increasingly immobile and eventually coalesce, causing obstruction to the flow of the left ventricle of the heart. In the study of Cosmi JE., *et al*. In which more than 2000 patients with aortic sclerosis were examined, 16% developed aortic valve stenosis. It was found from this cohort study that the mean time interval between aortic valve sclerosis to aortic stenosis was 8 years [6].

Discussion

Ethiology and pathophysiology

The prevalence of stenosis of the aortic valve increases with age. Based on the Euro Heart Survey on valvular heart disease, the degenerative process was the dominant etiology of aortic stenosis (81.9%), followed by rheumatic disease (11.2%). Endocarditis accounts for 0.8% of cases of aortic stenosis, congenital aortic stenosis with aortic bicuspid valve occurs in 5.4% of patients, whereas 0.6% is due to other causes. Rare causes of aortic stenosis include metabolic syndrome (Fabry disease), nonspecific infectious disease, erythematous lupus, Pagani's disease, hyperuresemia, changes due to drugs, and post radiation therapy. Calcification of aortic stenosis develops in patients with end-stage renal disease [7].

The three main causes of aortic stenosis include calcification of the trileaflet valve, abnormal congenital valves with calcification (unicuspid or bicuspid), and rheumatic valve disease. Regardless of the etiology, aortic stenosis will cause obstruction in left ventricular emptying leading to concentric hypertrophy where there is an increase in the mass and thickness of the left ventricular wall. This aims to normalize the pressure on the wall during systolic and to keep the left ventricular ejection fraction normal. Although hypertrophy helps maintain the ejection fraction, hypertrophy causes abnormal compliance of the left ventricle, left ventricular diastolic dysfunction with decreased left ventricular diastolic filling, increases left ventricular end diastolic pressure, and ultimately is

associated with increased mortality. As left ventricular compliance decreases, systolic pressure in the atria is critical in maintaining cardiac output and the onset of atrial fibrillation will result in clinical deterioration and decompensation of the left ventricle [1,8].

The increase in systolic blood pressure, ventricular mass, and ejection time will cause increased oxygen consumption from the myocardium. This increase in oxygen demand coupled with the abnormal pattern of coronary flow will cause angina pectoris. Increased oxygen consumption coupled with efforts to reduce the number of ischemic heart muscle causes a further deterioration of left ventricular function, whereby stroke volume and cardiac output decrease. In addition, there will be an increase in pressure in the left atrium and pulmonary blood vessels, causing pulmonary hypertension. It is at this stage that usually the onset of symptoms will begin and severe stenosis will occur. Patients with aortic valve stenosis are generally asymptomatic for a long period of time despite obstruction and increased cardiac pressure load. Adult patients with asymptomatic aortic stenosis have good clinical outcomes, indistinguishable from similar-age controls without aortic valve abnormalities. It is estimated that the incidence of sudden cardiac death is only 3-5% of all deaths in asymptomatic aortic stenosis patients [2,9].

The prognosis changes drastically with the onset of symptoms including angina pectoris, syncope, or heart failure after a long latent period. Symptom development is a critical point in the course of aortic stenosis. In elderly adult patients with minimal daily physical activity will experience a delay from the onset of clinical symptoms, or if they appear often associated with conditions coexisting at that time. Ross and Braunwald found that the patient survival rate after the onset of angina pectoris was 3 years, after the onset of syncope was 3 years, and after the onset of heart failure was 1.5 to 2 years. The presence of aortic stenosis in older adults will increase the risk of myocardial infarction and cardiovascular death [10].

Clinical symptoms

The classic symptoms characteristic of aortic stenosis include shortness of activity and other symptoms of heart failure, angina and syncope. These symptoms can appear in both mild, moderate, and severe aortic stenosis. The onset of these symptoms indicates a significant hemodynamic disturbance and is a critical time for making management decisions. These manifestations often do not occur until the condition is advanced. Because of the prolonged and latent asymptomatic period, many patients are unaware of their condition until a systolic murmur is detected on physical examination, new-onset atrial firylation, or during cardiac catheterization in symptomatic coronary artery disease. Descriptions of the most common early symptoms are decreased exercise tolerance, shortness of breath on minimal activity, dizziness during activity, and dizziness from spins. In older adults, the most common symptoms are chest pain, tightness, decreased exercise tolerance, and dizziness, where these symptoms can come from many other causes so often aortic stenosis is missed from the differential diagnosis. Symptoms may not appear in older people who rarely move or are inactive in daily activities. Many patients are not aware of the early manifestations of aortic stenosis because of a gradual change in hemodynamic status [10,11].

Shortness of activity or fatigue indicates a decrease in exercise tolerance related to cardiac ischemia, increased left ventricular pressure at the end diastolic, and decreased cardiac output. Angina can occur in patients with calcified aortic valve disease as a consequence of coronary artery disease. In patients without coronary artery disease, angina may occur due to decreased subendocardial blood flow and increased myocardial oxygen demand due to concentric hypertrophy. Syncope occurs due to decreased perfusion to the brain due to decreased cardiac output, for example when preload decreases and during activity, such as after changing positions from sitting to standing, dehydration, and use of diuretics. Syncope can also be caused by high intraventricular pressure during activity that causes the left ventricular baroreceptors to mismatch leading to vasodilation followed by decreased cardiac output [12].

Some patients may complain of severe gastrointestinal bleeding symptoms secondary to angiodysplasia associated with aortic stenosis. Infective emphocarditis is less common in older patients with aortic stenosis when compared to younger patients. This is because the endocardial surface is more calcified in older adults. Negative endocarditis, atrial fibrillation, and aortic atheroma are the main causes of systemic embolism, including stroke in older patients. Sudden death is rare in asymptomatic patients [13].

Diagnosis

In aortic stenosis, a difference in blood pressure between the left and right arms is more than 10 mmHg. On auscultation exami-

nation may reveal paradoxal/reverse splitting in which there is delayed closure of the aortic valve. It can also be that the intensity of A2, which should be louder than P2, is reduced. Aortic stenosis is often diagnosed by the presence of a mid-diastolic murmur on physical examination or on echocardiographic examination. In aortic stenosis there is a coarse crescendo-decrescendo ejection systolic murmur with the loudest peak audible in the intercostal spaces on either side of the right sternum extending into the neck (carotid artery), which is often accompanied by thrill. However, the murmur may also radiate to the apex rather than to the carotid in an elderly adult patient with aortic stenosis (Gallavardin phenomenon). A clear S4 heart sound followed by systole in the atria in a patient with incomplete sinus and left ventricular rhythm [14].

Obtaining a soft murmur with an early peak, a spike in the carotid pulse with a normal rhythm, and a spill in the S2 heart sound indicate mild to moderate aortic stenosis. In severe aortic stenosis, a carotid pulse is weak in amplitude and takes a long time to reach a pressure peak (pulsus parvus et tardus). The presence of pulsus parvus (reduced amplitude of the carotid pulse), pulsus tardus (delayed peak carotid pulse pressure), reduced A2 intensity, the presence of a midsystolic murmur or a latepeaking systolic murmur can help determine the severity of aortic stenosis. The intensity of the murmur is related to the patient's cardiac output and size, not reflecting the severity of the aortic stenosis. However, distinguishing murmurs due to aortic stenosis that interfere with hemodynamics and mild stenosis is very difficult to do on the basis of physical examination alone. Other diagnostic tools are needed to help determine the severity of aortic stenosis [15,16].

Supporting examination

Electrocardiography (EKG)

Not diagnostic, but left ventricular hypertrophy can usually be found. Left atrial enlargement, left axis deviation, LBBB can also be found. In the late stages of aortic stenosis, atrial fibrillation can be obtained [17].

Chest X-ray

Generally a normal picture is obtained with mild to moderate stenosis. There may be concentric hypretrophy of the left ventricle without cardiomegaly and there may be poststenotic dilatation of the aorta [17].

Echocardiography

Doppler echocardiography can accurately identify the presence of aortic stenosis. This examination is cost effective, noninvasive, and can be done real-time evaluation. This tool can determine left ventricular function, how far hypertrophy has occurred, and the number of valves calcified. Standard evaluations of the degree of severity of aortic stenosis include measurement of aortic velocity, mean transaortic gradient pressure, and continuity of the equation valve area. The speed of blood flow will increase as the valve orificium shrinks. Aortic valve pressure gradient greater than 40 mmHg indicates severe aortic stenosis. The following is the division of the degree of severity of aortic stenosis based on echocardiography measurements [17]:

	Mild	Moderate	Severe
AoV_{max} (m/s)	2.5-3.0	3.0-4.0	>4.0
Peak gradient (mmHg)	<40	40-65	>65
Mean gradient (mmHg)	<20	20-40	>40
EOA (cont eq) (cm^2)	>1.5	1.0-1.5	<1.0
EOAi (cm^2/m^2)	>0.85	0.6-0.85	<0.6
Dimensionless index	>0.50	0.25-0.50	<0.25

Table 1

Exercise testing

Can be useful if done by experienced personnel. In asymptomatic patients it can be used to determine the weight of daily activities. Contraindicated in patients with severe stenosis.

Cardiac catheterization

The main objective is to determine the presence of coronary heart disease by angiography rather than to determine the hemodynamic degree of aortic stenosis.

CT scan of the chest

Can be used to determine calcification and its progress in aortic stenosis.

MRI

Used to determine the volume, function, and mass of the left ventricle.

Treatment

Medication

There is no effective drug for treating aortic stenosis. Medical therapy is not the definitive therapy for aortic stenosis and there are no proven drugs to delay the progression of aortic disease or improve survival. Although not proven to prolong survival rates, medications can help manage symptoms. This can occur by adjusting the preload and afterload of the heart which can have a major impact on hemodynamics. However, this can be dangerous in severe aortic stenosis. As for drugs that play a role [18,19]:

- Statins
- ACE inhibitors
- Beta Blocker
- Diuretic
- Nitrate
- Digoxin

Surgery

Aortic Valve Replacement (AVR) is the only therapeutic modality that can improve symptoms and hemodynamic disturbances due to aortic stenosis, which can be achieved surgically. AVR is a therapeutic option for severe degenative aortic stenosis, which provides relief from symptoms and provides great potential for improving patient survival. Surgery for AVR is intended for both asymptomatic and symptomatic patients with severe aortic stenosis. However, patients with symptoms should be immediately programmed for surgery. The following indications for AVR based on AHA/ACC [18,20,21].

Class I

- AVR is indicated for symptomatic patients with severe AS.* (Level of Evidence: B)
- AVR is indicated for patients with severe AS* undergoing coronary artery bypass graft surgery (CABG). (Level of Evidence: C)
- AVR is indicated for patients with severe AS* undergoing surgery on the aorta or other heart valves. (Level of Evidence: C)
- AVR is recommended for patients with severe AS* and LV systolic dysfunction (ejection fraction less than 0.50). (Level of Evidence: C)

Class IIa

- AVR is reasonable for patients with moderate AS* undergoing CABG or surgery on the aorta or other heart valves (Level of Evidence: B).

Class IIb

- AVR may be considered for asymptomatic patients with severe AS* and abnormal response to exercise (e.g., development of symptoms or asymptomatic hypotension). (Level of Evidence: C)
- AVR may be considered for adults with severe asymptomatic AS* if there is a high likelihood of rapid progression (age, calcification, and CAD) or if surgery might be delayed at the time of symptom onset. (Level of Evidence: C)
- AVR may be considered in patients undergoing CABG who have mild AS* when there is evidence, such as moderate to severe valve calcification, that progression may be rapid. (Level of Evidence: C)
- AVR may be considered for asymptomatic patients with extremely severe AS (aortic valve area less than 0.6 cm2, mean gradient greater than 60 mm Hg, and jet velocity greater than 5.0 m per second) when the patient's expected operative mortality is 1.0% or less. (Level of Evidence: C)

Class III

- AVR is not useful for the prevention of sudden death in asymptomatic patients with AS who have none of the findings listed under the class IIa/IIb recommendations. (Level of Evidence: B)

As for when summarized, the AVR indications for aortic stenosis according to the AHA can be grouped as follows [22]:

- In a patient with symptoms of severe aortic stenosis
- In patients with asymptomatic severe aortic stenosis and left ventricular ejection fraction of less than 50%
- In patients with severe aortic stenosis while undergoing cardiac surgery for other indications.

AVR transcatheter (TAVR)

TAVR is recommended in patients who meet the indications for AVR, have significant resistance to surgery, and are predicted to

have a post-TAVR survival rate of more than 12 months. TAVR is an alternative to AVR surgery that meets the indications for AVR and carries a high surgical risk.

Conclusion

Aortic stenosis is a progressive and chronic disease, has a long latency period where there are no symptoms, the duration of this asymptomatic phase varies greatly between individuals. The incidence of sudden cardiac death is very rare at this stage, even in very severe aortic stenosis. In asymptomatic aortic stenosis, the average survival rate ranges from 20% to 50% at 2 years. After defining symptoms of aortic stenosis, the prognosis without surgical intervention is very poor. There are studies that project that the mean time from symptom onset to death is 2 years for patients with syncope complaints on activity, 3 years for those with symptoms of heart failure, and 5 years for those with angina. More severe symptoms will lead to a worse outcome.

Bibliography

1. Eveborn GW., *et al*. "The evolving epidemiology of valvular aortic stenosis: the Tronso study". *Heart* 99 (2013): 396-400.
2. Otto CM and Prendergast B. "Aortic-valve stenosis - from patients at risk to severe valve obstruction". *The New England Journal of Medicine* 371 (2014): 744-756.
3. Mathieu P and Boulanger MC. "Basic mechanisms of calcific aortic valve disease". *Canadian Journal of Cardiology* 30 (2014): 982-993.
4. Carità P., *et al*. "Aortic stenosis: insights on pathogenesis and clinical implications". *Journal of Geriatric Cardiology: JGC* 13.6 (2016): 489-498.
5. Carabello BA. "Introduction to aortic stenosis". *Circulation Research* 113 (2013): 179-185.
6. Novo G., *et al*. "Atherosclerosis, degenerative aortic stenosis and statins". *Current Cancer Drug Targets* 12 (2011): 115-121.
7. Mathieu P., *et al*. "Molecular biology of calcific aortic valve disease: towards new pharmacological therapies". *Expert Review of Cardiovascular Therapy* 2 12 (2014): 851-862.
8. Bekeredjian R and Grayburn PA. "Valvular Heart Disease: Aortic Regurgitation". *Circulation* 112 (2005): 125-134.
9. Cary T., *et al*. "Aortic Stenosis: Pathophysiology, Diagnosis, and Medical Management of Nonsurgical Patients". *Critical Care Nurse* (2013).
10. Lugiano CA. "Aortic stenosis". *Journal of the American Academy of Pas* 26.1 (2013): 46-47.
11. Chambers J and Bridgewater B. "Epidemiology of Valvular Heart Disease". In: Otto CM, Bonow RO, editors. Valvular Heat Disease a companion to Braunwald's heart Disease. 4th ed. Philadephia: Elsevier Saunder (2014).
12. Douglas L Mann., *et al*. "Braunwald's Heart Disease A Textbook of Cardiovascular Medicine Tenth Edition". Philadeplhia: Elsevier Saunders (2015): 99-169.
13. Nishimura RA., *et al*. "2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines". *Journal of the American College of Cardiology* 63 (2014): e57-e185.
14. Vahanian A., *et al*. "Guidelines on the management of valvular heart disease (version 2012). Joint task force on the management of valvular heart disease of the European Society of Cardiology (ESC) European Association for Cardio-Thoracic Surgery (EACTS)". *European Heart Journal* 33 (2012): 2451-2496.
15. Grimard BH, Larson JM. "Aortic Stenosis: Diagnosis and Treatment". *American Family Physician* (2008).
16. Akahori Hirokuni Tsujino., *et al*. "Mechanisms of aortic stenosis". *Journal of Cardiology* 71.3 (2017): S0914508717303283.
17. Iung B., *et al*. "A Prospective Survey of Patients with Valvular Heart Disease in Europe". *European Heart Journal* (2003).
18. Nishimura RA., *et al*. "AHA/ACC Guideline for The Management of Patients With Valvular Heart Disease A Report of the American College of Cardiology/American Heart association Task Force on Practice Guidelines". *Journal of the American College of Cardiology* 63 (2014): e57-185
19. Noboru Motomura., *et al*. "Aortic Valve Surgery". *Intech* (2011).
20. Olizowska M. "Pathogenesis and Pathophysiology of Aortic Valve Stenosis in Adults". *Polskie Archiwum Medycyny Wewnetrznej* (2011).

21. Petr Santavy., *et al*. "Aortic Valve Stenosis - Current View on Diagnostic and Treatment". *Intech* (2011): 35-51.

22. Sylvia A. Price, Lorraine M. Wilson. Patofisiologi Ed.6. Jakarta : EGC (2003).