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Chapter

Introductory Chapter: Aortic Stenosis

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1. Definition and symptoms

Aortic stenosis is the most frequent cause of valvular intervention in the Western world and is increasing with age. Thus, awareness and basic knowledge about the management of aortic stenosis are important for a diverse spectrum of health-care providers. When a diagnosis of aortic stenosis is established, careful attention and management are warranted by several health-care providers including general practitioners, internists, geriatricians, anesthesiologists, thoracic surgeons, and imaging experts, besides cardiologists.

Symptoms of aortic stenosis are unspecific and often vague as the disease progression is typically slow. However, when patients finally present with symptoms related to a severe aortic gradient, it may require prompt action. Typically patients with aortic stenosis are limited by shortness of breath at exertion. Because adaptation of lifestyle is common, it is crucial to recognize dyspnea due to aortic stenosis. Sometimes, a dramatic episode like syncope or cardiac arrhythmia occurs. Cardiac auscultation using a stethoscope is common in everyday practice throughout the health-care system, and the presence of a cardiac murmur may suggest an aortic stenosis. The same holds true for echocardiography (ECG), and signs of left ventricular hypertrophy may lead to further investigations.

2. Diagnostic tools

2.1 Echocardiography

Echocardiography is the cornerstone in identification and follow-up of aortic stenosis. It visualizes the calcification of the aortic valve, and the Doppler technique quantifies the left ventricular outflow gradient [1]. The aortic valve area can be estimated by calculation or planimetry but must be considered in conjunction with the mean gradient, wall thickness, ejection fraction, ventricular dimension, valve calcification, and hemodynamic parameters at the time of exam.

Four classes of aortic stenosis can be described:

- High-gradient aortic stenosis. Here the valve area is <1 cm^2, and the mean gradient is >40 mmHg. This is clearly a severe aortic stenosis regardless of ejection fraction.

- Low-flow, low-gradient aortic stenosis with reduced ejection fraction. Dobutamine echocardiography may be useful in these situations; an aortic valve area above 1 cm^2 with flow normalization is suggestive of pseudosevere state.

- Low-flow, low-gradient aortic stenosis with normal ejection fraction should be further evaluated if the area is <1 cm^2, especially in the elderly with ventricular hypertrophy and diminished left chamber size. Other imaging tools using computerized tomography are beneficial to assess calcification score [2, 3].

- Normal-flow, low-gradient aortic stenosis with normal ejection fraction and mean gradient <40 mmHg even though the valve area is <1 cm^2 is judged to be mild or moderate but not severe.

2.2 Exercise test

Evaluation of symptoms is related to the aortic stenosis that can be refined at an exercise test, typically ergometer bicycle test [4]. Using echocardiography at pharmacologically induced stress may reveal an increase in the pressure gradients [5]. Furthermore the response of ventricular function at exercise may give valuable information.

2.3 Miscellaneous imaging techniques

Multislice computerized tomography is nowadays an established method for quantification of valve calcification which is important in patients with low gradients. Furthermore computerized tomography offers excellent visualization of the aorta beyond the first part, the root. This is crucial in determination of preoperative anatomical assessment.

2.4 Laboratory markers

NT-proBNP is useful in follow-up of patients with aortic stenosis and is a complementary tool between intervals of echocardiography [6, 7].

3. Follow-up

Patients with aortic stenosis who are asymptomatic should undergo reevaluation every 6 months and should be asked to inform their physician the case of onset of symptoms. In mild to moderate aortic stenosis, evaluation every 3 years is reasonable but more often if significant calcification is assessed.

4. Treatment

4.1 Aortic stenosis without symptoms

While symptomatic severe aortic stenosis should be recommended intervention as rule of thumb, patients without symptoms are controversial. Still, the presence of an unequivocal severe aortic stenosis has not been proven to benefit from early intervention [8, 9]. Patients with reduced ejection fraction deemed to be secondary to aortic stenosis should not be refrained from an intervention. It is also reasonable to recommend intervention in cases of exercise-induced symptoms attributed to stenosis [10]. In the careful evaluation of asymptomatic patients, the following factors can be taken into account: massive hypertrophy, abnormal longitudinal left ventricular function, and pulmonary hypertension.

4.2 Pharmacological approach

Pharmacological therapy, including statins, has no impact on the disease progression in aortic stenosis. Nevertheless, concomitant hypertension should be treated. Patients who deteriorate into reduced ejection fraction should be subject to current heart failure optimization including beta-blocker, angiotensin-converting enzyme blocker/angiotensin receptor blocker, aldosterone receptor blocker, and rate/rhythm control if atrial fibrillation occurs.

4.3 Interventional approach

A patient with symptoms due to severe aortic stenosis should be evaluated for an interventional treatment. This is the only approach that will improve survival and relieve symptoms. In patients with an overall life expectancy of <12 months based on irreversible comorbidities, a conservative management is advocated.

The interventional mode is either surgical aortic valve replacement (SAVR) or transcatheter aortic valve implantation (TAVI). Based on the European Society Guidelines, a STS/EuroSCORE ≥4% favors TAVI and patients younger than 75 years based on limited long-term follow-up data of TAVI. In elderly patients, severe comorbidities (pulmonary or renal), considerable frailty, and those with restricted mobility, TAVI is preferred. In patients who previously underwent open-chest heart surgery, TAVI is advantageous due to adherent tissue which may complicate a second sternotomy.

4.4 Anatomical aspects: TAVI vs. SAVR

There are several factors that may be taken into account when choosing between TAVI and SAVR. A possible arterial approach is almost a prerequisite for TAVI, even though alternative routes may be an option. TAVI is the preferred method in patients who have sequele after chest radiation, porcelain aorta, risk of damage to grafting anastomosis following bypass surgery, and chest deformation. On the contrary, aortic root malfunction, thrombi in the aorta, and valve prosthesis mismatch are factors likely to favor TAVI.

SAVR should be performed in the case of concomitant need of other valve surgeries, aneurysm of the aorta, and septal hypertrophy requiring myectomy in hypertrophic cardiomyopathy.

4.5 Cardiac and extra-cardiac aspects: TAVI vs. SAVR

The individual risk should be assessed after careful evaluation and discussed between team members. The local resources and experience are important to be taken into account. In patients with high risk, TAVI is superior [11, 12]. Recently additional evidence points in the direction to favor TAVI in the majority of cases even in patients with low risk [13]. Notably, significant vascular complications, need of pacemaker implantation, and paravalvular regurgitation are more frequent for TAVI [14, 15]. SAVR is associated with more severe bleeding, acute renal failure, and atrial fibrillation. The risk of ischemic stroke seems to be similar [14, 15].

5. Future perspectives

The technical advancement of TAVI is expected to improve, and the increased volume is likely beneficial. However, long-term results over the decades are still

lacking. Complications, including the need of pacemaker implant, require attention and further innovation of techniques besides increased experience. Nevertheless, careful clinical judgment in the individual case is always warranted.

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