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Review article – Special issue: Structural heart disease – Aortic and mitral valves

Aortic valve repair and valve sparing procedures



Jan Vojáček, Pavel Žáček*, Jan Dominik

Department of Cardiac Surgery, Faculty of Medicine in Hradec Králové, Charles University in Prague and University Hospital Hradec Králové, Sokolská 581, 500 05 Hradec Králové, Czech Republic

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ABSTRACT

Aortic valve repair and valve sparing procedures enable restoration of competence in regurgitant aortic valve, and thus to avoid the risks related to valve replacement. Successful aortic valve repair requires deep understanding of the static and dynamic geometry of the aortic valve and aortic root. Aortic regurgitation originates from malapposition of the aortic leaflets and it is also frequently connected to dilation of the aortic root and ascending aorta. Techniques of surgical procedures for aortic regurgitation have been subject of historical development and currently tend to simplification and standardisation. Basic principles stand upon morphological normalisation at the level of the basal ring, sinotubular junction and valve leaflets. Remodelation of the aortic root and reimplantation of the aortic valve keep to be standard procedures in case of a dystrophic dilation of the aortic root.

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* Corresponding author.

E-mail addresses: vojacek.jan@fnhk.cz (J. Vojáček), zacek@fnhk.cz (P. Žáček), dominik@fnhk.cz (J. Dominik).<http://dx.doi.org/10.1016/j.crvasa.2017.01.025>

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Introduction

The concept of sparing procedures, i.e. the valve-sparing aortic root replacement – VSARR, was proposed for the first time by Yacoub in 1983, when he described a so-called remodelling of the aortic root [1,2].

Less than one decade later, David proposed a so-called aortic valve reimplantation [3]. In spite of certain essential differences, principles of both procedures are very similar, consisting of the elimination of the pathologically dilated aortic wall, which is then replaced with a vascular prosthesis. The aortic valve as such is thus spared in such procedures. The restoration of a normal geometry of the aortic root by means of a vascular prosthesis also returns the aortic valve function to normal condition, i.e. it leads towards the elimination of the aortic regurgitation (AR) functional phase. Originally, such procedures were indicated mainly in patients suffering from aortic root dilation to prevent the occurrence of aortic dissection; only rarely such procedures were a choice for the primary treatment of aortic regurgitation. Such procedures were rarely used for interventions in patients with bicuspid aortic valves. The majority of patients suffered from a mild or moderate functional aortic regurgitation. In the course of time, as experience grew, such strategy was applied more frequently as a primary treatment of a severe aortic regurgitation. A gradual development of surgical techniques including interventions in the aortic valve leaflets, enabled to intervene also in patients suffering from aortic regurgitation on the basis of the morphological disease of the aortic valve (most often, the leaflet prolapse), also in cases without a simultaneous dilation of the aortic root. Such procedures, in which the intervention is carried out only in the leaflets of the aortic valve without any replacement of the aortic root, are termed “isolated aortic valve repairs”, and these are alternatives of the isolated aortic valve replacement. In the last decade, aortic valve repairs start to be more often indicated in patients suffering from regurgitation of the bicuspid aortic valve, in which an intervention on the leaflets is always an inseparable part of the procedure.

A deeper understanding of the AR pathophysiology, mechanism of its origin and especially a thorough analysis of the causes of valve sparing procedures failures (recurrence of regurgitation) have lead towards findings which are of a vital importance for long-term correct function of the repaired aortic valve. It has been especially proven that a long-term functional aortic regurgitation due to an aortic dilation causes secondary changes in the aortic valve leaflets (progression of degenerative changes, thinning and stretching of the leaflet tissue up to a formation of prolapses). According to another finding, the procedure as such (remodelling, implantation) is of an equal importance, as it reduces/normalises the diameter of the aorta at a level of the sinotubular junction (STJ), and it may induce a prolapse of a leaflet which was before defectless from the morphological point of view. It means, in practical application, that in majority of patients with AR, who have been indicated for the VSARR, an associated intervention will be necessary on the aortic valve leaflets. Currently, it is recommended to use the term *aortic valve repair* only for interventions on aortic leaflets, while the term *sparing*

Table 1

Type I Normal leaflet motion	IA: dilation of sinotubular junction	
	IB: dilation of the sinuses of Valsalva	
	IC: dilation of ventriculoaortic junction	
	ID: leaflet perforation	
Type II Excessive leaflet motion		
Type III Restrictive leaflet motion		

procedure denominates the remodelling or reimplantation in which the healthy aortic valve is spared.

Indication

Sparing procedures and repairs of aortic valve are indicated in patients with aortic regurgitation and/or an important dilation of the ascending aorta. The aortic stenosis and/or also a combined defect are contraindications of the repair. The existence of degenerative changes of the leaflets and/or the restriction (insufficient leaflet surface) of these is also a contraindication of such a technique. The leaflets should be fine, pliable, only with slight degenerative changes.

When aortic repair is indicated, it is paramount to know the aetiology of the AR, which is done on the basis of a detailed analysis of transoesophageal echocardiographic examination (TEE). For such a purpose, it is recommendable to use an AR functional classification, based on the evaluation of the aortic valve leaflets mobility according to El Khoury [4]. Such a classification is used for classifying the AR into three groups (Table 1), and it is similar to the functional classification of mitral regurgitation. The first two groups with normal (functional AR) and an excess leaflets mobility (AR caused by the prolapse of leaflets) are suitable indications for aortic valve repair. On the contrary, the third group, in which problems are caused by a restriction, is not eligible for repair.

Surgical techniques of the aortic valve repair

There are manifold techniques of the aortic valve repair; it is always paramount to choose such a technique which addresses the root cause of the aortic regurgitation. The *sinotubular junction*, *aortic valve leaflets* and *aortic annulus* are three basic areas for the surgeon's possible intervention. All these three areas influence one another. A diagnosis in the individual areas of the aortic root is specific for a given patient with aortic regurgitation (and aortic dilation). A perfect understanding of the role of these three geometric elements and knowledge of methods of their influencing are necessary

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