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Our outcomes of aortic valve sparing reimplantation (David procedure) in patients with ascending aortic aneurysm and type A aortic dissection

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ABSTRACT

Aim: To present our outcomes with David procedure in patients with ascending aortic aneurysms (AAA) and type A aortic dissection (AD).

Methods: Thirty-six patients, aged between 38-75 years, followed-up in the cardiovascular surgery clinic of our hospital were included in the study. Patients' demographic data such as age and gender, type of dissection, urea and creatinine values, length of stay in the ICU, duration of hospitalization were recorded. Outcomes of postoperative and long-term ecography were analyzed.

Results: Of the 36 patients included in the study, 26 (72.22%) were male and 10 (22.78%) were female. The mean age of all patients was 60 ± 10 years. Ascending aortic aneurysm (AAA) was found in 20 (55.56%) patients and type A aortic dissection (AD) in 16 (44.44%) patients. In the postoperative echocardiography, 7 (23.33%) patients were normal, while 2 (6.67%) had trace aortic insufficiency, 17 (56.67%) patients had mild aortic insufficiency, 3 (10.00%) patients had moderate aortic insufficiency and 1 (3.33%) severe aortic insufficiency. Echocardiography performed one month after the operation revealed normal pathology in 10 (33.33%) trace aortic sufficiency in 2 (6.67%) patients, mild aortic insufficiency in 17 (56.67%) patients, and moderate aortic insufficiency in 1 (3.33%) patient.

Conclusion: The results of this study indicate that aortic valve-sparing reimplantation (David) procedure can be safely and effectively performed in patients with ascending aortic aneurysm and type A aortic dissection. It eliminates the need for a mechanical prosthesis and its complications.

Keywords: Ascending aortic aneurysm, type A aortic dissection, aortic pathology, aortic valve sparing reimplantation, David procedure.

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Introduction

Aortic dissection is the most commonly fatal condition of the aorta with a worldwide prevalence estimated as 0.5-0.9 per 100,000 per year [1]. Fifty percent of patients with type A aortic dissection (AD) die within 48 hours following onset of symptoms without surgery [2]. In cases of AAD accompanied by aortic valve insufficiency, composite graft replacement of the aortic valve and the ascending aorta have been the recommended surgical technique in these patients for many years. Aortic root pathologies including aneurysmal disease or aortic dissection have

been treated with replacement of the aortic valve and aortic root conventionally [3]. Composite replacement of the aortic root and aortic valve with a biological or mechanical valved conduit has been the standard treatment in cases of aortic root pathologies for a long time.

In the case of ascending aortic aneurysms (AAA) accompanied by aortic valve insufficiency, aortic valve replacement was accepted as the only solution until the pre-1990 period [4,5]. This method has provided excellent long-term results, although known complications of prosthetic valve replacement such as the need for life-long anticoagulation have prompted researchers to focus on effective alternative techniques that preserve the native valve [3].

In the early 1990's, David et al. described an aortic valve sparing procedure in which the valve was reimplanted within a prosthetic vascular graft [6]. Dr David introduced his "re-implantation" procedure where an appropriately sized Dacron graft is seated below the annulus of the aortic valve, which results in sparing of both the valve leaflets and the annulus [7]. It has been reported that this technique makes the re-implantation operation more durable through the prevention of aortic insufficiency caused by either primary valve leaflet dysfunction or annular dilatation [8]. The benefits of David procedure over the other methods include potentially more favorable hemodynamics, no need for life-long anticoagulation and thus reducing the risks of thromboembolic events and potentially lower risk of endocarditis [9]. David procedure has been adopted widely and modified continuously, broadening its range of application in order to achieve excellent results [10]. On the other hand, it should be remembered that the operative results heavily depend on the learning curve of the surgeon, which directly influences the perioperative outcome and long-term performance of the aortic valve [11]. For this reason, David procedure is often restricted to surgeons experienced in aortic root surgery and should be performed only in high-volume specialized centers [12]. In this study, we aimed to present our outcomes with David procedure in patients with AAA and type A AD.

Materials and methods

Informed consent was not needed due to the retrospective nature of the study. This study was conducted in accordance with the relevant ethical principles of the Declaration of Helsinki revised in 2013.

Thirty-six patients, aged between 38-75 years, followed-up in the cardiovascular surgery clinic of our hospital with the diagnosis of AAA or type A AD and underwent aortic valve sparing operation with David procedure between March 2021 and February 2023 were included in the study. During the study period, all patients who left the operating room with a successful AV-sparing operation were included in the study. Patients with advanced visceral malperfusion and those with an unknown neurological condition following cerebral malperfusion were excluded from the study.

Patients' demographic data such as age and gender, type of dissection, urea and creatinine values, length of stay in the ICU, duration of hospitalization were recorded. Outcomes of postoperative and long-term ecography were analyzed. Mortality status was also recorded. Patients' data were obtained from the hospital automation system and patient files and were evaluated retrospectively.

Surgical technique: All procedures were performed by the same experienced surgeon. A median sternotomy was used. Before median

sternotomy, the right upper brachial artery was cannulated. A membrane oxygenator and a standard non-pulsatile cardiopulmonary bypass (CPB) were used. CBP was established between the right atrium and the right upper brachial artery. In the case of cardiac arrest determined by cold crystalloid antegrade/retrograde cardioplegia, cold blood cardioplegia was infused. The administration of cardioplegia was repeated at 20 minutes intervals. In all patients, we used moderate hypothermia.

David-V re-implantation procedure was used in aortic root reconstruction. Briefly, the aortic sinuses were exposed except nearly 5 mm of aortic wall left attached to the annulus. The annulus was sized using the Hegar dilator. The graft diameter was determined by adding 5 mm to the annulus. The graft was lowered into its position below the annulus and mattress sutures were tied over the Hegar dilator across the aortic valve. The valve was then attached to the wall of the Dacron graft with running polypropylene sutures. The coronary artery buttons were re-implanted into the graft in an anastomotic fashion. An open distal anastomosis method was preferred for AAAs as described previously [13].

Echocardiography: Postoperative and long-term transthoracic echocardiography (ECHO) was used to evaluate success of the procedure. ECHO was performed using a VIVID 7 (General Electric, USA) with a 2.5 MHz ultrasound transducer. Aortic insufficiency was assessed as described by Perry et al. (14) and classified as normal or trace (grades 0–0.5), trivial (1+), mild (2+), moderate (3+) and severe (4+). Echocardiography procedures were performed immediately following the David procedure and one month after the operation.

Data analysis: Data obtained in this study was analyzed using the Microsoft Excel software. Continuous variables are expressed as mean ± standard deviation, while categorical variables are given as percentages. David procedures that showed normal, trace or minimal aortic insufficiency on echocardiography were considered successful.

Results

A total of 36 patients with aortic valve pathologies (AAA or AAD) who underwent aortic valve sparing (David) procedure were included in the study with 26 (72.22%) being male and 10 (22.78%) being female. The mean age of all patients was 60 ± 10 years. The mean age was found as 58 ± 10 years in the male and 64 ± 10 years in the female patients.

When aortic valve pathologies of the patients included in the study were examined; ascending aortic aneurysm (AAA) was found in 20 (55.56%) patients and type A dissection (AAD) in 16 (44.44%) patients (Figure 1).

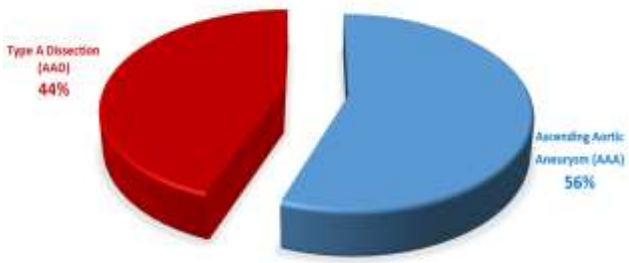

Figure 1. The distribution of aortic pathologies.

The mean urea value of the patients was found as 36.38 ± 13.04 mg/dL and the mean creatinine was found as 0.95 ± 0.19 mg/dL. Mortality occurred in six (16.67%) patients. The mean length of stay in the intensive care unit was found as 5.2 ± 6.54 days and the mean duration of hospitalization as 18.8 ± 12.66 days.

In the postoperative echocardiography, 7 (23.33%) patients were normal, while 2 (6.67%) had trace aortic insufficiency, 17 (56.67%) patients had mild aortic insufficiency, 3 (10.00%) patients had moderate aortic insufficiency and 1 (3.33%) severe aortic insufficiency. Echocardiography performed one month after the operation revealed normal pathology in 10 (33.33%) trace aortic sufficiency in 2 (6.67%) patients, mild aortic insufficiency in 17 (56.67%) patients, and moderate aortic insufficiency in 1 (3.33%) patient. Table 1 shows the grades of aortic insufficiency obtained in postoperative and postop one month echocardiographic examinations.

Table 1. Grades of aortic insufficiency in postoperative ECHO and postoperative one month ECHO.

Parameter		**n (%)**
Postoperative ECHO	**Normal**	7 (23.33)
	Trace (Grades 0-0.5)	2 (6.67)
	Mild (Grade +2)	17 (56.67)
	Moderate (Grade +3)	3 (10)
	Severe (Grade +4)	1 (3.33)
Postoperative one month ECHO	**Normal**	10 (33.33)
	Trace (Grades 0-0.5)	2 (6.67)
	Mild (Grade +2)	17 (56.67)
	Moderate (Grade +3)	1 (3.33)

Discussion

In this study, we performed aortic valve sparing (David) procedure in 36 patients and found that the operation was successful in 30 patients. The success rate of the procedure was found as 83.33%. As in the present study, David procedure has been applied in numerous studies in the literature with successful results. Beckmann et al. performed David procedure on 109 patients with acute aortic dissection type A (AADA). Mean age of the patients was 54 ± 12 years and 72% of the patients were male. In that study, the valve-sparing David procedure had acceptable long term results even in emergent operations for patients with AADA [15]. Similarly, in our study the mean age of the patients was 60 ± 10 years and 72.22% of the patients were male. On the other hand, in another study again by Beckmann et al., aortic valve-sparing David procedure was performed on 29 adolescent patients with a very low perioperative risk [11].

David procedure is an extremely complex method and should only be performed by surgeons who have already gained sufficient experience with this technique. In our study, all procedures were performed by the same experienced surgeon. Tissue valve prostheses have the disadvantage of early deterioration with reported reoperation rates of approximately 10% at 15 years after the operation [16]. In addition, patients with mechanical conduits/valves have a higher risk of thromboembolic and bleeding complications [17]. The David procedure eliminates these risks and complications.

In a study by Gurer et al., aortic re-implantation (David) operation was performed on 13 patients who had AAA with a mean age of 52 years. The authors reported that valve sparing re-implantation and remodelling techniques can be performed with successful early and mid-term results when performed on elective patients and by experienced surgical teams [18]. In another study by Demirdas et al., David procedure was successfully performed on 54 patients and reported excellent early and mid-term results [19].

Most studies have reported in-hospital mortality between 0% and 6%. In the present study mortality rate was 16.67%. Our larger rate compared to the literature could be attributed to the small number of patients in our study. The largest series in the literature was reported by David et al. on 296 patients. In that study, in-hospital mortality occurred in 1.3% in their series [20].

Currently, the main concern related to the performance of aortic valve sparing procedure is long-term durability as measured by aortic insufficiency. In our series, the vast majority of patients (90% one month after the operation) had a normal aortic pathology or mild aortic insufficiency. In the study by Demirdas et al., freedom from moderate to severe aortic insufficiency was found as 96.2% at five years [19].

In a study by Leshnower et al., midterm results of David procedure performed on 350 patients with AAD were evaluated retrospectively. Accordingly, it was concluded that David procedure can be performed with low morbidity and mortality in patients presenting with type A aortic dissection who require aortic root replacement. At mid-term follow-up, valve function was durable, and the incidence of valve-related complications was low [21]. As a limitation, we followed-up our patients only until one month after the operation and our results reflect early outcomes of David procedure in patients undergoing aortic valve sparing surgery. In a systematic review and meta-analysis by Wilson-Smith et al., it was reported that there is a clear transition towards the David procedure from the other methods, with the bulk of contemporary literature publishing on this technique [22]. In a retrospective study by Schamberger et al. comparing aortic valve-sparing reimplantation (David) and biological aortic root replacement (Benthall) procedures in 411 patients, Short-term outcomes were excellent for both procedures in patients with aortic root pathology. The authors concluded that David procedure may be preferable to Benthall procedure in patients with suitable pathoanatomy [23]. de Kerchove et al. stated that David procedure is the most robust form of annuloplasty of the aortic valve and is an indispensable tool which can be applied, even in normal appearing aortic roots, to facilitate preservation and repair of aortic valves [24]. Lehsnower et al. reported that in selected patients possessing appropriate aortic cusp anatomy, David procedure can be safely and effectively performed for the expanded indications of aortic dissection, severe AI, and reoperative cardiac surgery with low operative risk (Lehsnower). Indications for David procedure will be expanded as evidence in the literature related to this method accumulates.

This study has limitations. First, it was designed as a retrospective study and conducted in a single center. Second, follow-up duration is limited to one month of the procedure. Finally, the study lacks a comparison with any other procedure used for repair of aortic root pathologies or between age groups, gender etc. However, we believe that our results will provide a contribution to what is known about David procedure in the literature.

Conclusions

The results of this study indicate that aortic valve-sparing reimplantation (David) procedure can be safely and effectively performed in patients with ascending aortic aneurysm and type A aortic dissection. It eliminates the need for a mechanical prosthesis and its complications. However, further comprehensive multi-center prospective studies with a larger patient population and longer

follow-up duration are needed to draw more definitive conclusions.

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