How to Cite:
Allam, M. A. M., Mahmoud, M. H., Soliman, S. A., Elnaggar, I. M. E., & Elsharkawy, A. A. (2022). Early outcomes of valve preservation in patients with ascending aortic aneurysm and bicuspid valve disease. *International Journal of Health Sciences*, *6*(S5), 6812–6820.
https://doi.org/10.53730/ijhs.v6nS5.11554

Early outcomes of valve preservation in patients with ascending aortic aneurysm and bicuspid valve disease

Mohamed Ahmed Mohamed Allam
Cardiothoracic Surgery department, Faculty of Medicine- Cairo University, Egypt

Mohamed Hassan Mahmoud
Cardiothoracic Surgery department, Faculty of Medicine- Cairo University, Egypt

Said Abdelaziz Soliman
Cardiothoracic Surgery department, Faculty of Medicine- Cairo University, Egypt

Ismail Maged Elsaid Elnaggar
Cardiothoracic Surgery department, Faculty of Medicine- Cairo University, Egypt
Corresponding author Email: ismailcts2014@gmail.com

Ahmed Abdelaziz Elsharkawy
Cardiothoracic Surgery department, Faculty of Medicine- Cairo University, Egypt

***Abstract*---**Background: Bicuspid aortic valve (BAV) is the most frequent congenital heart disease affecting 1% to 2% of the population, with thoracic aortic aneurysm (TAA) formation being its second most frequent complication after aortic valve dysfunction (stenosis or insufficiency). Aortic valve replacement (AVR) with mechanical or biologic prostheses has long been the procedure of choice. Although prosthetic AVR is effective in correcting the hemodynamic problem, there are important long-term drawbacks. These are particularly present in a younger patient population, such as the majority of individuals with a BAV. Patient and methods: 40 patients underwent aortic valve repair for bicuspid aortic valve disease with ascending aortic aneurysm in the period between June 2020 and February 2022 in Kasr Alainy hospitals. Results: All our patients showed significant improvement regarding left ventricular dimensions and contractility. Two patients had mild to moderate regurge and thirty eight patients had non-significant regurge in the six month follow up echo. One patient complicated by complete heart block required permanent pacemaker implantation, another two patients had postoperative high drainage required revision for bleeding. One patient died from ventilator associated pneumonia after prolonged

Manuscript submitted: 9 April 2022, Manuscript revised: 18 June 2022, Accepted for publication: 27 July 2022

mechanical ventilation due to disturbed conscious level. Conclusion: Techniques for BAV have become standardized and reproducible, thus offering a tailored approach for the majority of patients with regurgitant BAVs. Improved understanding of the mechanisms of BAV regurgitation, predictors of repair durability, and surgical techniques should translate into wider adoption of repair for most BAVs.

***Keywords*---**Bicuspid aortic valve, ascending aortic aneurysm, outcome.

Introduction

BAV is associated with dilatation of the proximal aorta, independent of valvular dysfunction, in approximately 50% of patients. Previously, aortic dilatation in the presence of a BAV was considered to be associated with a disproportional increased risk of acute aortic events in Marfan's syndrome, and guidelines suggested earlier intervention compared to a tricuspid aortic valve [(1)]. Patients with a bicuspid aortic valve (BAV) frequently require surgical intervention for aortic regurgitation (AR) and/or aneurysm. Valve-preserving surgery and repair of regurgitant BAVs have evolved into an increasingly used alternative to replacement. Anatomic predictors of possible repair failures have been identified and solutions developed [(2)].

Patient and Methods

This study is an observational prospective study aimed to determine the early outcomes of valve preservation in patients with ascending aortic aneurysm and bicuspid valve disease in a sample of patients were identified from the database of Kasr Alainy Hospital between June 2020 and February 2022 after 6 months follow up.

Patient population

Data of 40 cases with ascending aortic aneurysm and bicuspid valve, are reviewed and data analyzed regarding measuring bypass time, cross clamp time, technique of repair, intraoperative regurge, significant inotropic support and arrhythmias, extubation time, ICU stay and Echo 6 months postoperatively .

Patients were selected according to the following inclusion and exclusion criteria:

Inclusion criteria: Patients with regurgitant bicuspid aortic valve disease with ascending aortic aneurysm and favorable valve anatomy for repair.
Exclusion criteria: Redo surgery, dissecting aneurysms, impaired contractility with EF less than 35 and patients with concomitant cardiac disease requiring surgery.

Preoperative data:

Patients were subjected on admission to the following

Detailed history taking regarding name, age, sex, smoking, clinical symptoms (dyspnea, PNDs, palpitation, chest pain if found), history of DM, hypertension, previous stroke, previous operations, blood transfusion, drug allergy and hepatic or renal problems, previous MI and cerebrovascular problems. Cardiac examination for any associated other valvular diseases. General examination for any scars of previous operations, lower limb edema, peripheral pulsations and lower limb varicose veins.

Investigations: all patients received

Echocardiography was performed to establish severity of aortic regurge, aortic annulus, aortic dilatation, LV Function (EF), RV Function (TAPSE), to exclude other valvular diseases, regional wall motion abnormalities and any associated lesions. CT chest with contrast (Aortography) to assess the aortic aneurysm measurements (sinus, sinotubular junction, ascending aortia, aortic arch and descending aortic diameters) , exclusion of dissecting flap occurrence and exclusion of coarctation (more common with bicuspid aortic valve) and any other congenital anomalies. Coronary angiography or CT coronary angiography should not exceed 6 months old so as to exclude any recent coronary lesions in patients with history of cardiovascular disease, male patients over 40 years old and postmenopausal females [(3)]. Routine laboratory investigations were done; CBC, urea and creatinine, AST, ALT, albumin, bilirubin; total and direct and bleeding profile. E.C.G. was done to detect rhythm of the patient's heart rate, Q waves or elevated ST segment). Preparation should be done regarding patient consenting, illustration of details of the operation to be done.

Operative data

There are different ways of performing almost every element of aortic repair. Several factors are taken into account when planning an aortic repair to provide minimum morbidity and mortality, and the most durable repair with best symptom free life expectancy. TEE probe is placed after anesthesia to assess the aortic valve morphology of cusps, annular diameter, degree of regurge and ascending aortic diameter before bypass. The surgical approach was done through a median sternotomy. The cardiopulmonary bypass (CPB) was established by an arterial cannula in the ascending aorta/aortic arch. Venous drainage was achieved through a two-stage cannula inserted in the right atrium.

Cardioplegia is administered selectively through coronary ostia (left and right). Custodiol (Bretschneider, HTK, at 2-8°C) patients were given 25-30mL/Kg in a single dose over 12–15min, under an initial hydrostatic pressure of 80-100mmHg. (Maximum pressure 120 mmHg) another half dose was administered after three hours of cross-clamping or in case of any electrical or mechanical activity HTK cardioplegia has been used for all patients to allow sufficient time for assessment and repair techniques to be done. TEE evaluation after the end of CPB to evaluate

the aortic valve competence after repair, leaflet height, coaptation level, coaptation distance and also for optimum de-airing.

Postoperative data

Patients were transferred to ICU on inotropic support whenever needed while being mechanically ventilated with monitoring of the blood pressure, heart rate and oxygen saturation during transfer. Chest tube drainage was monitored hourly, patients were kept in the ICU till hemodynamic stability was secured and there was no need for further stay to be discharged to the ward to be prepared for hospital discharge.

The following data were recorded

Period of mechanical ventilation, type and dose of inotropic support, duration of hospital and ICU stay. Incidence of postoperative complications: postoperative bleeding (defined as a blood loss > 1.5ml/kg/h for 6 consecutive hours within the first 24 hours or in case of reoperation for hemostasis during the first 12 postoperative hours), low cardiac output syndrome, neurologic events, renal and hepatic dysfunction, arrhythmias and death. Operative Mortality, which is defined as (1) all deaths occurring during the hospitalization in which the operation was performed, even if after 30 days. (2) all deaths occurring after discharge from the hospital, but before the end of the thirtieth postoperative day.

Patients were discharged from hospital when: The wound was clean, sternum was stable with stable cardiovascular status, normal laboratory findings, satisfactory echocardiographic results. Each patient upon discharge was given a card contains details of his operation including the surgeon, operation date, operation done, duration of hospital stay and any problems may be encountered during his hospital stay for arrangement of follow up echo after 6 months.

Statistical analysis

The collected data were coded, tabulated, and statistically analyzed using IBM Statistical Package for Social Sciences version 22.0 (IBM Corporation, Chicago, USA, 2013). Independent t test used to assess the statistical significance of the difference between two study group means. Chi-Square test used to examine the relationship between two or more qualitative variables. All tests were two-sided, p was considered significant if < 0.05.

Results

This was a prospective randomized observational study of 40 patients underwent aortic valve repair for bicuspid aortic valve with ascending aortic aneurysm in the period between June 2020 and February 2022 in Kasr Alainy hospitals.
There were 12 females (30 %) and 28 males (70 %). The mean age was 44.73 ± 9.48 years. The mean weight was 69.55 ± 11.09 kg. Table (1)

Table (2): Statistical analysis of the results of age and weight

	Mean	SD	Minimum	Maximum
Age	44.73	9.48	22.00	58.00
Weight	69.55	11.09	52.00	95.00

Preoperative echo revealed that mean ED was 6.1±0.45 cm, ES 4.09±0.39 cm, mean EF 61.68±6.73%. Table (2)

Table (3): Statistical analysis of preoperative echo data

	Preoperative echo	
	Mean	SD
ED	6.10	0.45
ES	4.09	0.39
EF	61.68	6.73

The mean bypass time was 150.28±11.57minutes and mean cross clamp time was 123.02±10.11minutes. Table (3)

Table (4): Statistical analysis of perfusion

	Mean	SD	Minimum	Maximum
Bypass	150.28	11.57	120.00	195.00
Cross Clamp	123.02	10.11	100.00	150.00

Intraoperative echo study revealed data summarized. Table (4)

Table (5): Statistical analysis of intraoperative TEE data

intra operative TEE	Mean	SD	Minimum	Maximum
EF	46.95	5.64	38.00	60.00
mean PG	10.10	1.22	8.00	12.00
peak PG	19.58	1.75	15.00	23.00
leaflet height (cm)	2.22	0.21	1.90	2.60
coaptation distance (cm)	1.16	0.20	0.80	1.60

All patients transferred to ICU on mechanical ventilation with the mean postoperative mechanical ventilation time 8.28±2.31 hours and stayed in ICU with mean 48.55±21.7 hours. Table (5)

Table (6): Statistical analysis of postoperative ventilation and ICU stay

	Mean	SD	Minimum	Maximum
Ventilation (Hrs)	26.28	12.31	5.00	180.00
ICU (Hrs)	48.55	21.70	36.00	180.00

Postoperative echo revealed that mean ED was 5.67±0.44cm, ES 3.74±0.4cm, mean EF 59.47±5.19%. Table (6)

Table (7): Postoperative echo after 6 months data

Follow Up Echo 6th Month	Mean	SD	Minimum	Maximum
ED	5.67	0.44	5.00	6.40
ES	3.74	0.40	3.00	4.50
EF	59.47	5.19	44.00	69.00
mean pg	6.70	0.76	6.00	9.00
peak pg	12.73	1.34	10.00	15.00

Significant decrease in left ventricular dimensions postoperatively. Comparison between pre and post showed significant improvement in contractility. Table (7)

Table (8): Postoperative echo after 6 months data

	Preoperative		Follow Up Echo 6th Month		P value
	Mean	SD	Mean	SD	
ED	6.10	0.45	5.67	0.44	<0.01
ES	4.09	0.39	3.74	0.40	<0.01
EF	59.47	5.19	61.68	6.73	<0.02

Discussion

In patients with suitable morphology of the diseased valve (typically only patients with aortic regurgitation), repair of the aortic valve is a desirable option. The development of aortic valve repair as an alternative to replacement has been driven by potential benefits of preserving the native valve, which include lower risk of infective endocarditis and avoiding anticoagulation medications and fewer complications of the operated valve. In our study after reviewing of 40 patients who underwent aortic valve repair for bicuspid aortic valve with ascending aortic aneurysm in Al Kasr AlAiny we found that predominance of male gender 28 males (70%) 12 females (30%) and the mean age of the patients in the study was 44.73 ± 9.48 years old.

In a study by Aicher and colleagues, [4] was to evaluate the Effect of valve configuration on outcomes of BAV repair they revealed higher incidence of bicuspid aortic valve in males as his study included 316 patients with 84.8% male and 15.2% female patients as bicuspid aortic valve is characterized by an uneven distribution between sexes. BAV is more frequent in males than in females. Also Jasinki and collegues, [5] conducted a study to evaluate a 17 year outcome after bicuspid aortic valve repair showed 73% males and mean age 42 years. In another study by Alsoufi and colleagues, [6] was to evaluate the results of valve preservation and repair for bicuspid aortic valve insufficiency they revealed that the mean age of 71 patients is 41.5±13.2 years. Preoperative co morbidities in our institute showed 14 (35%) patients were hypertensive, 6 (15%) patients were diabetic, 5 (12.5) patients were smokers, 2 (5%) patients had HCV, one (2.5%) patient with renal impairment and one patient had previous stroke.

Marek and colleagues, [7] in a study was to evaluate outcomes after 17 years of experience in repair of bicuspid aortic valve reported that 3% of patients were

diabetic, 30% of patients were hypertensive, 5 % patients were smokers which confors with our preoperative parameters. The preoperative echo parameters (EF, ES and ED) were recorded for all our patients and revealed that mean EF 61.68±6.73%, ES 4.09±0.39cm and mean ED was 6.1±0.45cm. Similarly Jasinki and collegues, [5] in their study which was to evaluate a 17 year outcome after bicuspid aortic valve repair they revealed that preoperative mean EF 58.0±7.83%, ES 4.0±1.4cm and mean ED was 6.0±1.5cm. The cross clamp was also measured for all patients, the mean cross clamp time was 123.02±10.11minutes and bypass time was measured for all patients, the mean bypass time was 150.28±11.57minutes.

Our results were better than Safari and colleagues, [8] in their study to evaluate longer term outcomes in bicuspid valve repair as they observed that the mean cross clamp time was 131 min, while the mean bypass time was 181min. However, Elkhoury and colleagues, [9] in their study to evaluate repair of bicuspid aortic valves in patients with aortic regurgitation found that the mean cross clamp time was 92 ± 36 min, while the mean bypass time was 108 ± 46min which is shorter than our time. All patients in our study were observed regarding mean ICU stay were 48.55±21.7 hours while Safari and colleagues, [8] reported ICU stay of range (1-13 days).

The six-month postoperative echo parameters (EF, ES and ED) were recorded for all our patients and revealed that mean EF 59.47±5.19%, ES 3.74±0.4cm and mean ED was 5.67±0.44cm. Jasinki and collegues, [5] in their study they revealed that postoperative mean values for EF was 60.0±9.3%, ES was 4.0±1.4cm and ED was 5.4±1.1cm. Also Elkhoury and colleagues, [9] they revealed that the postoperative mean EF 58.0±7.83%, ES 4.2±1.1cm and ED was 6.0±1.5cm. The six-month postoperative echo was recorded regarding aortic valve regurge for all our patients and revealed that 2 (5%) patients had mild to moderate regurge (grade 2) and 38 (95%) patients had non-significant regurge (less than grade 1).

In a study by Safari and colleagues, [8] was to evaluate longer-term outcomes after bicuspid aortic valve repair they revealed that (8%) of patients had mild to moderate regurge and (92%) of patients had non-significant regurge. Similarly Elkhoury and colleagues, [9] found that 4 out of 68 patient (6.25%) had moderate regurge and 64 out of 68 (93.75%) had non-significant regurge. On the other hand Ashikhmina and colleagues, [10] in a study was to evaluate repair of the bicuspid aortic valve as a viable alternative to replacement with a bioprosthesis on 105 patients showed astonishing results that all patients had non-significant regurge.

Regarding ES of all patients compared preoperatively and six-month postoperatively were 4.09±0.39 and 3.74±0.4 respectively. This showed improvement with significant difference (p-value 0.01). We agreed with Ashikhmina and colleagues, [10] in their study they revealed that there was also improvement in ES with significant difference between preoperative and postoperative follow up were 4.1±0.6 and 3.6±0.7 respectively (p-value <0.001).
Jasinki and collegues, [5] also they observed significant statistical difference in ES between preoperative (4.0±1.4) and postoperative follow up (3.7±1.2) (p-value <0.001). Regarding ED of all patients compared preoperatively and six-month

postoperatively were 6.1±0.45 and 5.67±0.44 respectively. This showed improvement with significant statistical difference between preoperative and postoperative follow up (p-value 0.02).

Similarly, Safari and colleagues, [8] in a study they revealed that there was also improvement in ED with significant statistical difference between preoperative and postoperative follow up (p value <0.01). One (2.5%) of our patients required permanent pacemaker and two (5%) of patients required revision for bleeding also Jasinki and collegues, [5] and his colleagues reported (3%) of patients required pacemaker implantation and (3%) of patients required revision for bleeding. Mortality reported from the study group was 1 (2.5%) patient due to disturbed conscious level and prolonged intubation also Jasinki and collegues, [5] and his colleagues reported mortality of (3%) of patients while Schneider et al., [11] and his colleagues in 2017 reported mortality (0.6%) patients for study group.

Conclusion

Emerging evidence suggests that the heterogeneous presentation of bicuspid aortic valve phenotypes may be a more complex matter related to congenital, genetic, and/or connective tissue abnormalities. Optimal management of patients with BAV disease and associated ascending aortic aneurysms often requires a thoughtful approach, carefully assessing various risk factors of the aortic valve and the aorta and discerning individual indications for ongoing surveillance, medical management, and operative intervention.

Conflict of interest

Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

References

1. Judge DP, Dietz HC. Marfan's syndrome. Lancet. 2005; 366(9501): 1965. doi:10.1016/S0140-6736 (05) 67789-6
2. Ehrlich T, de Kerchove L, Vojacek J. State-of-the art bicuspid aortic valve repair in 2020. Prog Cardiovasc Dis. 2020; 63(4):457-464. doi: 10.1016/J.Pcad. 2020.04.010
3. Baumgartner H, Falk V, Bax JJ. 2017 ESC/EACTS Guidelines for the management of valvular heart disease. Eur Heart J. 2017; 38(36): 2739-2791. doi:10.1093/Eurheartj/Ehx391
4. Aicher D, Kunihara T, Abou Issa O, Brittner B, Gräber S, Schäfers HJ. Valve configuration determines long-term results after repair of the bicuspid aortic valve. Circulation. 2011; 123(2):178-185. doi:10.1161 /Circulationaha.109.934679
5. Jasinski MJ, Kosiorowska K, Gocol R. Bicuspid aortic valve repair: outcomes after 17 years of experience. Eur J Cardio-Thoracic Surg. 2021; 60(5):1053-1061. doi:10.1093/Ejcts/Ezab176
6. Alsoufi B, Borger MA, Armstrong S, Maganti M, David TE. Results of valve preservation and repair for bicuspid aortic valve insufficiency. J Heart Valve

Dis. 2005; 14(6):752-758. Accessed January 23, 2022. https:// pubmed. ncbi.nlm.nih.gov/16359055/
7. Jasinski MJ, Kosiorowska K, Gocol R. Bicuspid aortic valve repair: outcomes after 17 years of experience. Eur J Cardio-Thoracic Surg. 2021; 60(5):1053-1061. doi:10.1093/Ejcts/Ezab176
8. Safari M, Monsefi N, Karimian-Tabrizi A. Longer-term outcomes after bicuspid aortic valve repair in 142 patients. J Card Surg. 2021; 36(12): 4645-4651. doi: 10.1111/JOCS.16006
9. El Khoury G, Vanoverschelde JL, Glineur D. Repair of Bicuspid Aortic Valves in Patients with Aortic Regurgitation. Circulation. 2006; 114 (SUPPL. 1). doi:10.1161/ Circulationaha. 105. 001594
10. Djuraev, A. M., Alpisbaev, K. S., & Tapilov, E. A. (2021). The choice of surgical tactics for the treatment of children with destructive pathological dislocation of the hip after hematogenous osteomyelitis. International Journal of Health & Medical Sciences, 5(1), 15-20. https://doi.org/10.21744/ijhms.v5n1.1813
11. Ashikhmina E, Sundt TM, Dearani JA, Connolly HM, Li Z, Schaff HV. Repair of the bicuspid aortic valve: A viable alternative to replacement with a bioprosthesis. J Thorac Cardiovasc Surg. 2010; 139(6):1395-1401. doi:10.1016/J.Jtcvs.2010.02.035
12. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. International Journal of Health Sciences, 6(1), i-v. https://doi.org/10.53730/ijhs.v6n1.5949
13. Schneider U, Feldner SK, Hofmann C. Two decades of experience with root remodeling and valve repair for bicuspid aortic valves. J Thorac Cardiovasc Surg. 2017; 153(4):S65-S71. doi:10. 1016/j .jtcvs. 2016.12.030