A RETROSPECTIVE ANALYSIS OF OUTCOMES OF AORTOPLASTY IN PATIENTS WITH BICUSPID AORTIC VALVE

DR. PRITHVIRAJ VIVEK PATIL

MCH CARDIOTHORACIC AND VASCULAR SURGERY THESISYEAR: 2020-2023

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY, TRIVANDRUM

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A RETROSPECTIVE ANALYSIS OF OUTCOMES OF AORTOPLASTY IN PATIENTS WITH BICUSPID AORTIC VALVE

A THESIS SUBMITTED BY

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No Part of the thesis has been submitted for the award or any other degree or diploma to this date.

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The thesis entitled, ' A retrospective analysis of outcomes of aortoplasty in patients with bicuspid aortic valve', was carried out under my direct supervision. No part of the thesis submitted for the award of any degree or diploma prior to this date.

*Clearance was obtained from Institutional Ethics Committee/ Institutional Animal Ethics/ Institutional Committee for stem cell research/ other appropriate committees (if any, specify), for carrying out of study.

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LIST OF ABBREVIATIONS

ABBREVIATION	FULL FORM
AA	Ascending Aorta
AAD	Acute Aortic Dissection
AR	Aortic Regurgitation
AS	Aortic Stenosis
AV	Auriculoventricular
AI	Aortic Insufficiency
AVR	Aortic Valve Replacement
BAV	Bicuspid Aortic Valve
CT	Computer Tomography
CTA	Computed Tomographic Angiogram
ECG	Electro Cardio Gram
L	Left
mm	Millimeter
NYHA	New YorkHeart Association
R	Right
RAA	Reduction Ascending Aortoplasty
S	Stenosis
STJ	Sino tubular Junction
TAV	Tricuspid Aortic Valve

INTRODUCTION

In adults, a bicuspid aortic valve (BAV) is one of the most frequent cardiac defects. Ascending aortic dilation is commonly seen in patients with BAV, however the reason for this relationship is unclear. Two possible explanations exist for this strong correlation. Aortic dilation is one consequence of BAV-related aortic stenosis (AS) or aortic regurgitation (AR), both of which place additional demands on the heart's hemodynamics.[1] The aorta can be dilated by either the increased stroke volume caused by AR or the forceful ejection jet caused by AS (post stenotic dilatation). Another is a weak aorta present at birth. ***McKusick***[2] noted the presence of BAV and Erdheim's cystic medial necrosis in the same patient in 1972. The doctor hypothesised that the link wasn't coincidental, and instead represented an arterial tree abnormality at birth. Patients with BAV show a substantial connection, which has been supported by other writers, and the hypothesis of an underlying congenital abnormality has been presented.

Most recently conducted studies have linked BAV to hastened deterioration of the aortic media. This theory might be supported by the observation that BAV is often accompanied by other aortic anomalies such aortic coarctation, Marfan's syndrome, and aortic dissection. Aortic surgery, such as aortic replacement or wrapping in conjunction with aortic valve replacement, may be necessary for patients with BAV who have experienced aortic dilation (AVR).[3] It is unknown if aortic dilatation persists following AVR, and there is ongoing debate over when and how to treat aortic dilation using balloon valvuloplasty (BAV). If the aortic dilatation is caused by hemodynamic loads,

AVR may stop the aorta from expanding any further. Congenital aortic fragility may cause dilatation to persist despite AVR. We compared patients with BAV who had tricuspid AO and the same risk factors before and after AVR using echocardiography, however the extent of the aortic resection is still up for discussion.[1]

Primacy of competency and long-term repair stability in aortic valve reconstruction cannot be attained with a monolithic approach. Alternatively, doctors may use a cocktail of strategies to overcome the unique obstacles presented by the dysfunctional aortic root. Pathologies of the aortic annulus and root, the ascending aorta, and the aortic leaflets and commissures are commonly seen in patients with bicuspid aortic valves. It may therefore come as no surprise that aortic valve reconstruction results are less gratifying than those attained by mitral repair.[4] It wasn't until 1991 that the procedure for fixing bicuspid aortic valves was detailed in detail by ***Cosgrove et al*** [5] The procedure included a triangle excision of the prolapsing aortic leaflets and a commissural plication. This method was linked to an unsatisfactory rate of re-operations and residual aortic regurgitation at midterm follow-up. A strip of autologous glutaraldehyde-fixed pericardium was employed to augment the free edge of the fused leaflet and increase the region of leaflet co-aptation.[6]

A reduction aortoplasty was performed to treat the dilatation of the ascending aorta that was occurring at the same time. The topic of whether or whether this sort of repair is long-lasting, despite descriptions in the literature of re-operations due to redilatation of the aortic root, remains unsolved. Progressive enlargement of the ascending aorta or acute aortic dissection (AAD) following aortic valve replacement have been linked to the presence of dilatation of the ascending aorta in patients with aortic valve disease

(AVR).[7] Prosthetic graft replacement is recommended if the ascending aorta is visibly aneurysmal. Therefore, whether or not the ascending aorta should be treated in patients with a moderately dilated aorta (40-55 mm in diameter) remains disputed. Patients like this.[8]

There are just a small number of studies reporting on the long-term results of Aortoplasty in BAV patients. This calls for research. The purpose of the current study is to evaluate the results of Aortoplasty in BAV patients over the long term. Patients who underwent aortoplasty more than 10 years ago were the focus of our proposal.

AIM & OBJECTIVES

AIM AND OBJECTIVES

AIM:

- To evaluate the long term (10 years) outcome of aortoplasty patients undergoing Aortoplastic surgery in bicuspid aortic valve.

OBJECTIVES:

- **Primary Objective-**

  To assess ten year outcomes in terms of need of reintervention for aortic events in patients undergoing Aortoplasty in bicuspid aortic valve.

- **Secondary Objective-**

  To assess ten year outcomes in terms of cardiac death and aortic events in patients undergoing Aortoplasty in bicuspid aortic valve.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The bicuspid aortic valve (BAV) is the most common congenital cardiac anomaly in developed nations. It has been presumed that the bicuspid morphology of BAV disease is largely responsible for valvular dysfunction and subsequent hemodynamic derangements.[9] However, the clinical presentation of BAV disease remains quite heterogeneous with patients presenting from infancy to late adulthood with predominantly aortic stenosis, aortic insufficiency, or mixed lesions and variable associated abnormalities including hypo plastic left heart structures, aortic coarctation, and ascending aortic aneurysms. Emerging evidence suggests that the heterogeneous presentation of BAV phenotypes may be a more complex matter related to congenital, genetic, and/or connective tissue abnormalities.[10] Currently, the aetiology of aortic dilatation in patients with BAV disease remains unclear and as a result, management of these aortic aneurysms remains controversial. 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. Current guidelines recommend prophylactic replacement of the ascending aorta in patients with specific risk factors; however, the extent of the aortic resection remains debated.[11] We review current concepts of anatomic classification, pathophysiology, natural history, and clinical management of BAV disease.

Prevalence

It is commonly accepted that bicuspid aortic valve disease has a prevalence of 1 to 2% in the general population with between a 2 : 1 and 4 : 1 predilection for males : females.[12] In the largest necropsy study to date, 21 000 individuals were examined and bicuspid aortic valves were present in 569 (1.4%).[13] However, necropsy studies may underestimate the true prevalence due to selection and misclassification bias. More recently, in a screening transthoracic echocardiography study of 1075 newborns, the incidence of BAV was determined to be 4.6 in every 1000 live births, with a 4 : 1 male : female ratio.[14]

Anatomy of the Bicuspid Aortic Valve:

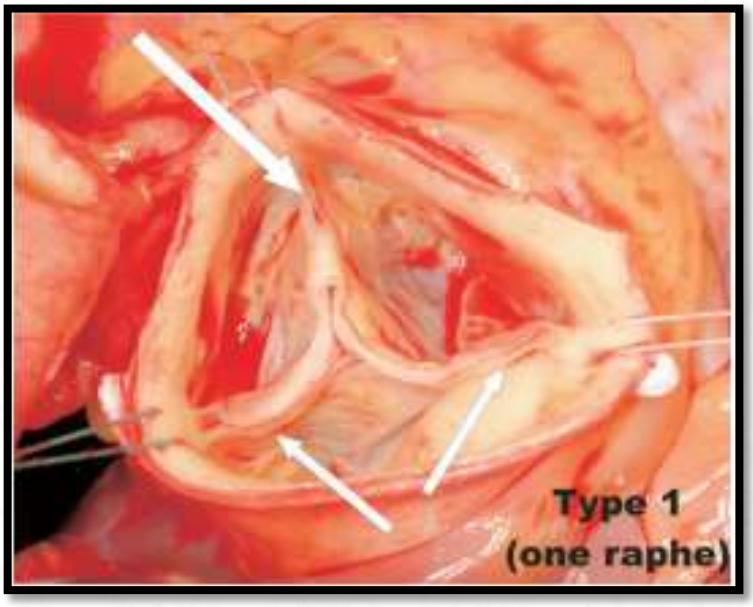
Embryology: The exact cause and mechanism responsible for the development of the BAV is uncertain. The hemodynamic moulding theory suggests that decreased blood flow through the valve during development resulted in a failure of the leaflets to separate; however, there is limited evidence to support this theory.[11] Another popular explanation has been a genetic abnormality, though current studies have been unable to consistently determine specific genetic defects associated with BAV disease. Fernandez and associates.[15] studied aortic valve development in inbred Syrian hamsters and endothelium nitric oxide synthase (eNOS−/−) knockout mice, both of which have a high prevalence of BAV. Using histological sections, this group was able to show that the most common BAV morphologies were a result of two separate developmental defects. Fusion of the left and right-coronary cusps in the Syrian hamsters was a result of extra fusion of the septal and parietal ridges and subsequent

defective outflow tract septation. The posterior cushion developed normally and became the posterior cusp, as in the normal AV. Formation of a BAV in the eNOS−/− mice was a result of fusion of the posterior intercalated cushion with the septal ridge followed by normal outflow tract septation, leading to fusion of the right and noncoronary cusps. These novel findings demonstrated that, at least in animal models, different BAV morphologies are the result of different developmental processes.[15] If this process is similar in humans, it may help to explain the heterogeneous nature of BAV disease. More recently, Sans-Coma and colleagues16 were able to demonstrate that a continuum of aortic valve morphologies, ranging from normal tricuspid valves to pure bicuspid valves, could develop in genetically alike Syrian hamsters. This finding suggests that factors other than genetics may play a role in the development of the BAV. [11,16]

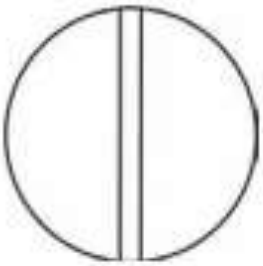
Classification of BAV: The bicuspid aortic valve is often identified by an abnormally large aortic valve cusp with a prominent raphe in an area of cuspal fusion. Fusion of the left-coronary and right-coronary cusps is the most common morphology reported in over 60% of BAV cases (Photograph 1).[17] Fusion of the right-coronary and noncoronary cusps occurs in 15–25% of cases, while fusion of the left-coronary and noncoronary cusps is quite rare, occurring in less than 5%.of individuals with BAV.[18] The interleaflet triangle between the two fused cusps is usually much smaller than normal and can lead to decreased mobility of the cusp.[19] Abnormal creasing of the anomalous cusp during the cardiac cycle is also common. Three major classification schemes of BAV disease have been described to create a common language for diagnosis, prognosis, and surgical planning. Sievers and Schmidtke20 described a

detailed anatomic classification in 2007 based on pathologic examination. According to this nosology, BAV has two functional cusps forming the valve mechanism with less than three zones of parallel apposition between cusps. The valves are categorised according to the number of raphes present (e.g., 0, 1, or 2) and by the spatial orientation of the cusps and location of the raphe(s).[20] The valves are further subcategorized by function-normal, insufficient, stenotic, or "balanced" (both moderate stenosis and insufficiency) (both moderate stenosis and insufficiency). The most common type of BAV by the Sievers' classification is type 1, L-R, S, indicating one raphe between the leftand right-coronary cusps with a hemodynamically predominance of stenosis (Photograph 2).[17] Recognizing associated aortic dilatation in BAV disease, Schaefer and colleagues proposed an integrated classification system based on both cusp fusion and root shape. The cusp fusion classification system is similar to other groups; however, they also described three distinct aortic root shapes termed type N, type A, and type E. In type N "normal" roots, the sinus diameters is greater than that of the sinotubular junction diameter and greater than or equal to the ascending aortic diameter.[21] In Type A "ascending dilatation" roots, the sinus diameter is greater than that of the STJ diameter and less than the diameter of the ascending aorta. Finally in Type E "effaced" roots, the diameter at the level of the aortic sinuses is equal to or less than the diameter of the STJ. In this series, patients with fusion of the L-R coronary cusps, most commonly presented with Type N root anatomy while those with fusion of the right-coronary and noncoronary cusps were more likely to have a Type A root anatomy. The Type E root anatomy was found in 5% of patients with L-R cusp fusion and 14% of patients with R-N cusp fusion. Fazel

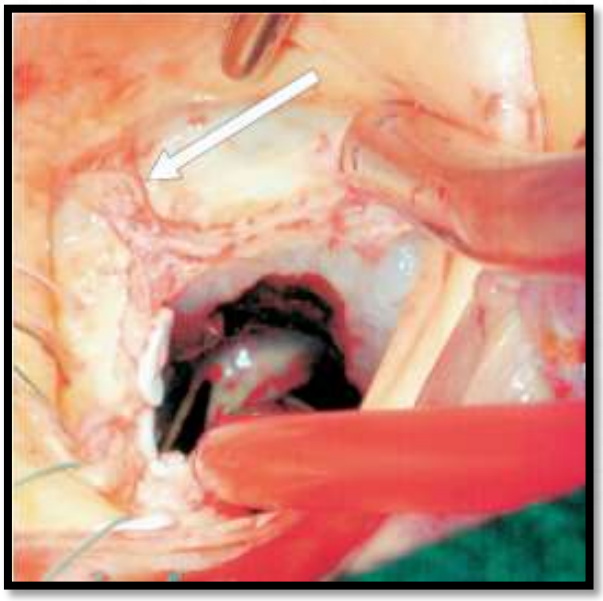
and coworkers from Stanford, CA, USA analysed 64 BAV patients and described four distinct patterns of aneurysmal aortic involvement.[21] Cluster I involved aortic root dilatation alone, cluster II involved dilatation of the tubular ascending aorta alone, cluster III involved dilatation of the tubular ascending aorta and aortic arch, and cluster IV involved dilatation of the aortic root, tubular ascending aorta with tapering across the transverse arch. Seventy-three percent of the patients had involvement of the aortic arch (clusters III and IV) (Photograph 3). Recently, two new clusters Ia (STJ-preserved) and Ib (STJ-dilated) have been reported. These distinct patterns of aortic involvement reinforce the need for an individualised, custom-tailored degree of ascending aortic and arch replacement in patients with bicuspid aortopathy.[11,17,21,22]



Photograph 1. Intraoperative picture of a bicuspid aortic valve type 1, L/R, I (see text and Table 1 for explanation) with one completely developed noncoronary cusp, two completely developed commissures (small arrows), and one raphe between the underdeveloped left and right coronary cusps extending to the corresponding malformed commissure (large arrow) with hemodynamic signs of insufficiency due to prolapse of the conjoint cusps.

main category: number of raphes	0 raphe - Type 0  21 (7)		1 raphe - Type 1  269 (88)			2 raphes - Type 2  14 (5)
1. subcategory: spatial position of cusps in Type 0 and raphes in Types 1 and 2	lat 13 (4) 	ap 7 (2) 	L – R 216 (71) 	R – N 45 (15) 	N – L 8 (3) 	L – R / R – N 14 (5) 
2. subcategory: VALVULAR FUNCTION I	6 (2)	1 (0.3)	79 (26)	22 (7)	3 (1)	6 (2)
S	7 (2)	5 (2)	119 (39)	15 (5)	3 (1)	6 (2)
B (I + S)		1 (0.3)	15 (5)	7 (2)	2 (1)	2 (1)
No			3 (1)	1 (0.3)		

Photograph 2 Schematic presentation of the developmental phenotypes of the aortic valve and typical characteristics. Prominent line in schematic drawings represents a raphe, which is the nonseparated or conjoint segment of two underdeveloped cusps extending into the commissural area. *Angelini and associates.



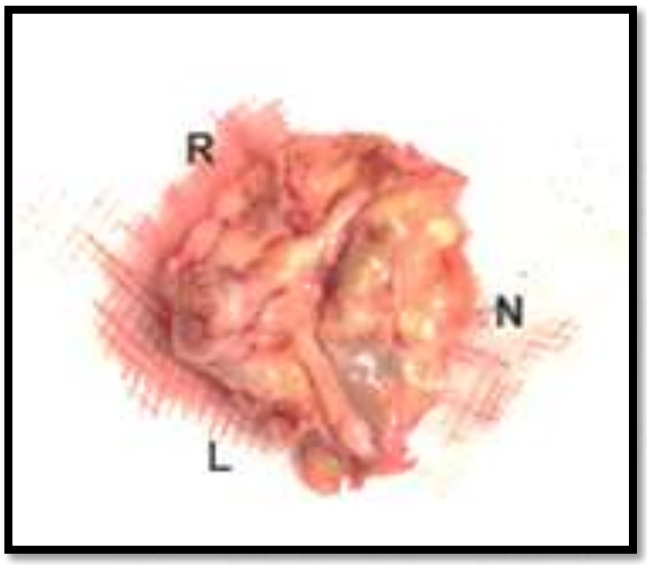
Photograph 3. Situs after excision of a bicuspid aortic valve type 1, L/R, I showing the underdeveloped and obliterated commissure (arrow) between the left and right coronary cusps.

Pathophysiology: BAV disease can present with various hemodynamic derangements including stenosis, insufficiency, and mixed presentations. The predominant hemodynamic lesion in BAV disease may be related to the age of presentation, cuspal fusion patterns, and flow dynamics.[23] In the elderly population, aortic stenosis is the most common presentation affecting 75% patients undergoing surgery for BAV disease, while insufficiency is the reason for intervention in only 13–16% of BAV patients. In infancy, aortic stenosis is much more common than insufficiency in BAV disease where approximately 80–95% of cases of aortic stenosis detected in early life can be attributed to a bicuspid or unicuspid valve.[24] There has been some suggestion that certain BAV morphologies are more highly correlated to the presence of either a stenotic or regurgitant lesion. In a study of 569 paediatric patients with isolated BAV, significant aortic stenosis was more than twice as likely in patients with fusion of the right-coronary and noncoronary cusps, whereas fusion of the left-coronary and noncoronary cusps had no association with aortic stenosis. Fusion of the right-coronary and noncoronary cusps also had a twofold higher odds of having at least moderate aortic regurgitation. This may suggest that right-coronary and noncoronary cusp fusion may have worse long-term prognosis because of more hemodynamically significant lesions.[25]

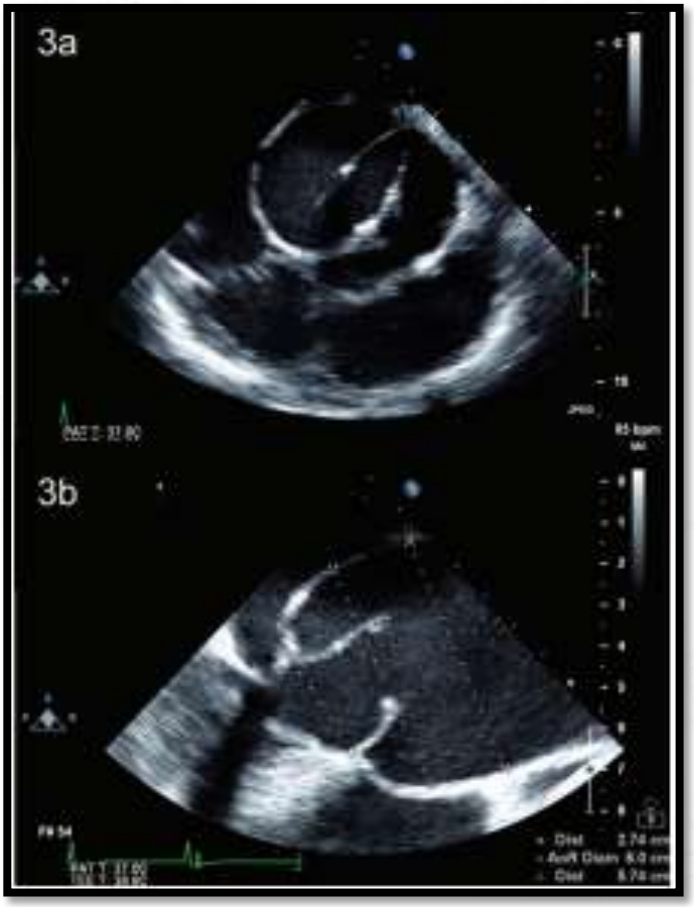
Interestingly, these morphological correlations to specific lesions seem to disappear in the adult population perhaps because of their earlier age of presentation. In adults with BAV, progression of AS appears to progress more rapidly in patients with cusps in the anteroposterior position or left- and right-coronary cusp fusion.[26] In the normally functioning tricuspid aortic valve, the aortic cusps are relatively similar in size, opening into their respected sinuses during systole, and coapting equally during diastole to equalise pressure dynamics across the aortic root. In the BAV, aortic cusps often do not fully open and coaptation is often eccentric. Together, these

abnormalities can produce an elliptical orifice area and flow turbulence, perhaps predisposing to early valve degeneration and calcification leading to clinically significant AS (Figure 1)[27], up to a decade earlier than individuals with tricuspid aortic valves. Echocardiographic studies have shown that in BAV patients, cuspal sclerosis typically begins in the second decade of life while calcification is prominent in most middle-aged patients.[28]

This early degeneration may be related to more aggressive inflammatory changes of the aortic valve, characterised by increased macrophage infiltration and neovascularization. Aortic insufficiency in BAV disease is often mild to moderate in severity and concurrent with aortic stenosis, although predominant insufficiency can occur.[29] Development of AI can be attributed to several different characteristics of the BAV. Firstly, as a result of differences in leaflet dimensions, 15–20% of all BAVs have incomplete closure. Redundancy in the fused leaflet also predisposes the BAV to cuspal prolapse leading to the onset of AI (Photograph 5a). Furthermore, dilatation of the aortic root and sinotubular junction are common traits of BAV disease (Figure (Photograph 5b). 30 This dilatation is often progressive and can lead to deterioration of valvular function. Studies have shown a 36% decrease in coaptation height and a 41% decrease in contact pressure between leaflets in BAV, both of which are likely to be further exacerbated by dilatation of the aortic root and sinotubular junction. Isolated severe insufficiency is relatively uncommon in the setting of BAV and when present, is often related to infective endocarditis.[13,11]



Photograph 4. Photograph of surgically excised bicuspid aortic valve,demonstrating severe calcific stenosis. The left (L) and right (R)cusps are fused with a prominent calcified raphe, opposed to acalcified noncoronary cusp (N)



Photograph 5a) Transesophageal echocardiogram demonstrating a bicuspid aortic valve in short-axis view, with left-right coronary cuspal fusion (Sievers' classification type 1, L-R, insufficient), and moderate-severe aortic insufficiency on colour flow Doppler (not shown). (5b)Transesophageal echocardiogram demonstrating a dilated aortic root and ascending aorta in long-axis view along with a bicuspid aortic alveoli.

Associated Abnormalities Bicuspid aortic valves do not always present in isolation and are commonly associated with other congenital cardiovascular defects. The most robust association occurs with coarctation of the aorta, where up to 3/4 of individuals with aortic coarctation also have coexistent BAV.[32] In this specific BAV population, there appears to be a preponderance of morphological fusion of the left-coronary and right-coronary cusps. Bicuspid aortic valves are also more commonly linked to other left-sided obstructive lesions including interrupted aortic arch , Shone's complex, and hypoplastic left heart syndrome.[33] Other congenital lesions associated with BAV include patent ductus arteriosus, ventricular septal defect, and atrial septal defects. Several studies have also, noted variations in the coronary anatomy in patients with BAV with an increased prevalence of left dominant coronary circulation and shorter left main coronary arteries. [34]

William C Robert (1970)[35] Conducted Clinical and necropsy observations are described in 85 autopsy cases in which the subjects had congenitally bicuspid aortic valves. Sixty-nine of the 72 patients with functionally abnormal valves were observed in a study of 400 autopsy cases; all subjects were over age 14 years, with severe valvular cardiac disease. The 13 functionally normal valves were found during study of 1,440 necropsy cases in which the subjects were free of other valvular or septal defects. The bicuspid aortic valve is the most frequent congenital malformation of the heart or great vessels. It occurs in over 50 percent of patients with anatomically isolated aortic stenosis and in about 25 percent of patients with clinically pure aortic regurgitation . It is not certain why I congenitally bicuspid valve becomes severely

scarred, calcified and stenotic, another only mildly scarred and incompetent, another the site of infection, and why another remains free of these complications during life.

Coma V S etal[15] studied the morphology of the aortic valves of 1,036 Syrian hamsters belonging to two families subjected to high endogamous pressure. Most (n=955) specimens were examined using a corrosion-cast technique. In the remaining 81 specimens, valvar morphology was assessed by means of a stereomicroscope, and in 18 of these cases a histologic study was also performed. In one of the families, a high proportion (30.5%) of hamsters had aortic valves with two leaflets, the aortic sinuses being oriented ventrodorsally. The percentage of such anomalous valves was found to be positively correlated with the inbreeding coefficient of specimens. In the other family, the occurrence of an aortic valve with two leaflets was a sporadic event. Stereoscopic and histologic observations demonstrated that, in 52 of 63 aortic valves with three leaflets, the ventral commissure between the right and left leaflets was partially fused, while in 10 other cases this commissure was completely fused. In addition, in nine of 18 aortic valves with two leaflets, there was a more or less well-developed raphe located in the ventral aortic sinus, approximately where the true ventral commissure would have been. Indicating the existence of a continuous spectrum of aortic valvar morphology, ranging from a valve with three leaflets and no fusion of the ventral commissure to an aortic valve with two leaflets devoid of any raphe. Results of crosses between both related and unrelated hamsters suggest that the observed morphology in individuals is the result of quantitative inheritance.

France A A Peter etal (1993)[36] conducted a meta-analysis of the literature for a patient population to study retrospectively. Data from published studies showed that

87% of 31 patients were men (mean age 60 years), and 66% were known to have systemic hypertension. A dilated ascending aorta was observed at the time of AVR in 66% of patients. AVR was pelt formed because of pure aortic regurgitation in 55% of patients, and combined aortic stenosis and regurgitation in 23%. More than 50% of patients did not survive dissection. Characteristics including sex, age, severity of dilatation, presence of progression in diameter, left ventricular function and time interval after AVR were not helpful in determining a cumulative risk for developing dissection. Because dimion occurred in 4 of 18 patients (22%) with an ascending aorta diameter ~50 mm, it is suggested to consider replacement of the ascending aorta during AVR when a value of 50 mm is exceeded.

Hayden Y Sabet etal (1999)[37] conducted a study Objective: To describe a clinicopathologic study of large group of congenitally bicuspid aortic valves surgically excised at a single institution. retrospectively reviewed. Results were obtained are The age of the 542 patients ranged from 1 to 86 years (mean, 61), and 372 (69%) were men. Among these, 409 (75%) had pure aortic stenosis (AS), 73 (13%) had pure aortic insufficiency (regurgitation) (AI), 53 (10%) had combined AS and AI, and 7 (1%) had normal function. Raphal position was described in 315 and was between the right and left cusps in 270 (86%). Raphal absence occurred more often in valves with equal-sized cusps than unequal (33% versus 14%; P = 0.005). Moderate to severe calcification affected valves with AS more frequently than AI (99% versus 41%; P<O.OOI). In contrast, annular dilatation was associated with AI more than AS (48% versus 11%; P<O.OOI). Acquired commissural fusion involved valves with combined AS and AI. Conclusion of study was functionally, the most

common fate of congenitally bicuspid aortic valves was calcific stenosis with or without regurgitation (85%). Because approximately 4 million US citizens have bicuspid valves and because valve replacement is currently the only treatment of symptomatic AS, this disorder will continue to affect health-care costs.

Baur Matthias etal (2002)[38] conducted a study with the aim to analyse the results of reduction aortoplasty with and without external prosthetic support Results were obtained that, The reduction aortoplasty decreased the internal diameter of the aorta. During follow-up, there was no increase of the aortic diameter either in patients with external prosthetic support. The Conclusion of the study is Reduction aortoplasty showed good longterm results in patients with bicuspid aortic valve and dilatation of the ascending aorta. Redilation of the aorta occurred only in patients with a suboptimal diameter reduction.

Hisayu Yasuda etal (2003)[1] Condued a study, To clarify if the aortic dilation could be prevented by aortic valve replacement (AVR) in BAV patients. Diameters of the sinuses of Valsalva, sinotubular junction and the proximal aorta were measured. The annual dilation rate was calculated by dividing changes of diameters during the follow-up period by the body surface area and the observation interval. We found that aortic dilation in BAV patients tended to be faster than that in TAV patients, although a significant difference was found only at the proximal aorta. They concluded that, AVR could not prevent progressive aortic dilation in BAV. Since the aorta did not dilate in TAV, progressive aortic dilation in BAV seems mainly due to the fragility of the aortic wall rather than hemodynamic factors.

Roos-Hesselink J W et al (2003)[39] conducted a research with aim, To investigate the incidence of clinical problems related to a bicuspid valve (aortic stenosis and regurgitation) and the incidence of ascending aorta and aortic arch pathology in combination with coarctation repair. They observed that, Aortic valve disease was found in 63% of the patients, requiring an intervention in 22%, at a median of 13 years after coarctation repair. Ascending aorta dilatation was observed in 28% and aortic arch abnormalities in 23%, among whom kinking of the aortic arch was found in 12%. Antihypertensive medication was used in 24%. In the patients with hypertension the age at operation and age at follow up were significantly higher. They concluded that, In addition to the well known problems of hypertension and recoarctation, aortic valve and aortic arch pathology are commonly encountered in patients with previous coarctation repair. Aortic abnormalities may predispose to dilatation and dissection, thus necessitating careful lifelongattention in all patients with coarctation.

Takeshi Kamada etal (2003)[8] narrated that, Dilatation of the ascending aorta concomitant with aortic valve disease is occasionally associated with progressive enlargement of the ascending aorta or acute aortic dissection (AAD) (AAD). However, surgical procedure of choice for the aorta and its indication are controversial. Results were obtained that, Operation time and most of other perioperative variables were comparable to those of patients who underwent isolated AVR. The aortic diameter was reduced to 36.1±4.1 mm. Nine patients survived to hospital discharge uneventfully, but one patient developed disruption of the suture line in the aorta and died. During follow-up, no patient suffered AAD but redilatation

was observed in one patient. In the two problematic patients, the ascending aorta was larger than 55 mm, and its media was histologically abnormal. Conclusion: In patients with dilated ascending aorta less than 55 mm in diameter, aortoplasty can be a procedure of choice. However, a prosthetic graft replacement is recommended when the diameter of the ascending aorta is larger than 55 mm.

Sievere Hans et al (2007)[20] conducted a study with aim to establish a classification system based on a 5-year data collection of surgical specimens. Three characteristics for a systematic classification were found appropriate: (1) number of raphes, (2) spatial position of cusps or raphes, and (3) functional status of the valve. The first characteristic was found to be the most significant and therefore termed "type." Three major types were identified: type 0 (no raphe), type 1 (one raphe), and type 2 (two raphes), followed by two supplementary characteristics, spatial position and function. These characteristics served to classify and codify the bicuspid aortic valves into three categories.

Fernandez B et al (2009)[40] conducted a study with the aim, s to decide whether bicuspid aortic valves (BAVs) with fused right and non coronary leaflets (R-N) and BAVs with fused right and left leaflets (R-L) have different aetiologies or are the product of a single diathesis. Results were obtained that, The R-N BAVs result from a defective development of the cardiac outflow tract (OT) endocardial cushions that generates a morphologically anomalous right leaflet. The left leaflet develops normally. The R-L BAVs are the outcome of an extra fusion of the septal and parietal OT ridges that thereby engenders a sole anterior leaflet. The noncoronary leaflet forms normally. They concluded that, Care should be taken in further work on BAV

genetics because R-N and R-L BAVs might rely on different genotypes. Detailed screening for R-N and R-L BAVs should be performed for a better understanding of the relationships between these BAV morphologic phenotypes and other heart disease.

Haddad Rafel etal (2009)[41] conducted a study, To assess the midterm follow-up of reduction aortoplasty with external wrapping associated with aortic valve replacement in high risk patients. Results were showed that, All patients underwent reduction aortoplasty with external wrapping associated with aortic valve replacement. The postoperative hospital mortality and morbidity was 0% and 16.7% (atrial fibrillation), respectively. The mean ascending aortic diameter was 37.0 + 4.5mm after 6 months of follow-up ($P < 0.0001$, compared with the preoperative period). The actuarial survival curve after 28 months of follow-up was 100%. Conclusion of thestudy is Reduction ascending aortoplasty with external wrapping associated with aortic valve replacement is a safe procedure with excellent midterm results in high risk patients with ascending aortic aneurysm and aortic valve disease.

Doss Mirlo etal (2010)[6] conducted a study with the aim s to determine whether reduction aortoplasty can reliably prevent aortic root dilatation after aortic valve repair in bicuspid disease. They observed, At midterm (mean follow-up was 5.1 2.1 years), only one patient in the reduction aortoplasty group showed aortic root dilatation, leading to significant aortic valve regurgitation. Other than that, there was no progression of regurgitation in the whole group of patients. In the David type repair group, no re-operations, progression of aortic root dilatation or recurrent regurgitation occurred. In general, there was only one death in the reduction

aortoplasty group. This patient developed endocarditis after 1 year and died of acute heart failure prior to readmission to our hospital. They concluded, Both reduction aortoplasty and modified David type repair, paired with patch augmentation of the incompetent bicuspid valve, provide excellent midterm results. The reduction of the diameter of the ascending aorta by reduction aortoplasty seems to provide reliable stability that is comparable to the David type repair.

Katie L. Losenno etal (2012)[11] stated in their narrated literature, The bicuspid aortic valve is the most common congenital cardiac anomaly in developed nations. The abnormal bicuspid morphology of the aortic valve results in valvular dysfunction and subsequent hemodynamic derangements. However, the clinical presentation of bicuspid aortic valve disease remains quite heterogeneous with patients presenting from infancy to late adulthood with variable degrees of valvular stenosis and insufficiency and associated abnormalities including aortic coarctation, hypoplastic left heart structures, and ascending aortic dilatation. 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. We review current concepts of anatomic classification, pathophysiology, natural history, and clinical management of bicuspid aortic valve disease with associated ascending aortic aneurysms.

Alealdeen Karlo (2015)[42] conducted a study with the aim, to analyse the short and long term post-operative outcomes in this group of patients. They found that, d 26 patients who underwent aortoplasty during aortic valve replacement. Age (66 ± 13 years), sex (male: female, 15:11), euroscore (5 ± 3), bypass time (95 ± 18 min), x clamp time (68 ± 13 min). Native valve pathology (stenosis: regurgitation: mixed, 13:4:9). (stenosis: regurgitation: mixed, 13:4:9). Type of implant (mechanical: biological, 13:13). (mechanical: biological, 13:13). Median prosthetic valve size was 25 mm in all patients. Post-operatively there was no incidence of stroke. Two patients required hemofiltration but recovered on discharge. Early mortality was (n = 1, 4%) and 10 year mortality was (n = 6,23%). There was no incidence of aortic dissection. The conclusion of the study is, aortoplasty to counter aortic dilatation was successfully performed with acceptable levels of morbidity and mortality. Reduction of the aortic root during the procedure did not give rise to post-operative aortic dissection.

Liu Shen etal (2017)[43] conducted a study, e to ascending aortic replacement to identify the early prognosis of RAA for patients with aortic valve disease and dilatation of the ascending aorta. Results were obtained, The mean follow-up time was 38.8 ± 13.0 months. More patients with mitral valve disease and tricuspid insufficiency were present in the non-BAV group. More patients with ascending aorta larger than 45 mm were present in the BAV group. Two patients died, and 1 patient experienced a stroke. There were no reoperations or aorta-related adverse events. The mean expansion degree and rate of ascending aorta were 0.39 ± 0.26 cm and 1.3 ± 0.8 mm/year, respectively, in patients with aortic redilatation. Redilatation was observed

in the BAV group (37.0 ± 5.0 mm vs 35.5 ± 4.6 mm; p [0.009), whereas the non-BAV group had no significant change. Conclusion of the study is Reduction ascending aortoplasty shows good early results in patients with aortic valve disease and dilatation of the ascending aorta. Redilatation tends to happen in patients with BAV, and long-term follow-up is necessary.

Arnaoutakis George J (2019)[44] conducted a study to summarise the long term (1Year) outcome of BAV repair. They found that, Initial search produced 770 abstracts, reduced to 92 full papers for review after excluding duplications and abstract review for relevance. Twenty-six studies met full inclusion criteria. BAV repair revealed low operative mortality, with excellent 5-year survival, and low freedom from reoperation. Differences in surgical technique between reimplantation and remodeling do not appear to confer protection against reintervention. Systematic assessment of cusp height and annular stabilisation in some form do appear to favour improved long term durability. Leaflet calcification is associated with higher rates of reintervention. They concluded that, : BAV repair is associated with acceptable long term survival. Ongoing standardized outcome assessments will further refine surgical techniques associated with excellent repair durability.

Mojyan Safari et al (2021)[45] aim of their study was to evaluate the longer-term results of bicuspid aortic valve (BAV) repair with or without aortic root replacement. They observed, In-hospital mortality was 1% in Group 1, and 2% in Group 2 (p = .6). The 5- and 10-year survival was 93 ± 2.9% and 81 ± 5.8% in Group 1 and 96 ± 3.1% and 96 ± 3.1% in Group 2, respectively (p = .31). Eleven patients of Group 1 (1.7%/ patient-year) and five patients of Group 2 (2.2%/patient-year) underwent reoperation

of the aortic valve (p = .5). The 5- and 10-year freedom from reoperation were 93.0 ± 2.1% and 77.1 ± 7.1% in Group 1 and 93.0 ± T5.0% and 76.7 ± 9.6% in Group 2 (p = .83), respectively. At the latest follow-up, only two patients of Group 1 and 1 patient of Group 2 had AV regurgitation = 2° (p = .7). The cumulative linearized incidence of all valve-related complications (bleeding, stroke, endocarditis, and reoperation) was 2.9%/patient-year in Group 1% and 4%/patient-year in Group 2, respectively (p = .6). Conclusions of the study is Isolated BAV repair and combined aortic valve reimplantation plus BAV repair provide good clinical longer-term outcomes with relatively low reoperation rate and durable valve function.

Trumello Cinzia et al (2022)[46] conducted a retrospective study with the aim of this is to show medium-long-term results in terms of cardiac death and aortic events in patients undergoing reduction ascending aortoplasty between 1997 and 2009 in our hospital. The Fine and Grey model for competing risk analysis was performed for time to cardiac death, with non-cardiac death as the competing risk, and time to recurrence of both re-dilation (aortic diameter > 45 mm) and re-operation with overall death as the competing risk. Paired t-test was used to evaluate the change in aortic diameter from the post-operative values to follow-up. The population included 142 patients. The mean pre-operative aortic diameter and the diameter at follow-up were respectively 46.5 ± 5.11 mm vs. 41.4 ± 5.55 mm (p-value < 0.001). At a mean follow-up of 11.6 ± 4.15 years, 11 patients (7.7%) required re-operation on the ascending aorta. At 16 years, the CIF of aortic-related events was 29.4 ± 7.2%; the freedom from cardiac death was 89.2 ± 3.7%. Ten patients (7%) died from cardiac causes but no one was aortic-related. The Fine and Grey analysis did not identify any significant

predictors. This procedure is safe but might be justified only in high-risk patients or in those with advanced age/short life expectancy.

Szalkiewicz Phillip petal (2022)[47] analysed the outcomes after nonreinforced RAA in two Austrian centres. Overall, 253 patients underwent RAA [women: 30.8%; median age 74 (63–79) years] with a mean preoperative ascending diameter of 44.7 (±3.5) mm. RAA-related postoperative adverse events occurred in 1.2% (n = 3) over a follow-up of a median of 3.8 (2.4–5.5) years: One type A aortic dissection, one lethal aortic rupture at the suture line, and one suture line bleeding with cardiac tamponed and need of surgical revision. The overall survival rate was 89.7%. Aortic valve morphology itself was no risk factor for mortality (Log-Rank: 0.942). (Log-Rank: 0.942). One hundred and forty patients had a tricuspid [TAV: (55.3%)] aortic valve and 113 patients had a bicuspid aortic valve [BAV: (44.7%)]. Redilatation to a diameter >50 mm according to CT follow-up occurred in 5.7% (n = 5 of 87). One patient needed reoperation with RAA and aortic valve replacement due to a prosthesis-patient mismatch after aortic valve replacement and aortic redilatation. Conclusion was made, Non-reinforced RAA is a safe, feasible, and reproducible procedure with low rates of perioperative complications in selected patients primarily undergoing aortic valve repair with a dilated ascending aorta. Aortic valve morphology has no impact on mortality after RAA.

MATERIALS AND METHODS

MATERIAL AND METHODOLOGY

- **STUDY DESIGN:** A retrospective study was conducted to evaluate the long term (10 years) outcome of aortoplasty patients undergoing Aortoplastic surgery in bicuspid aortic valve.

STUDY AREA: Study was conducted in Department of Cardiovascular and Thoracic Surgery.

ORGANISING THE STUDY:

i. Ethical consideration:

Relevant permission was taken from the Institute of Ethical Committee (IEC) of a medical college and hospital prior to the study conduction.

ii. Approval from authorities:

Permission was obtained for the conduction of a study in cardiovascular and thoracic surgery department and from the principal of that particular medical college and the same were informed to the authority of cardiovascular and thoracic surgery department in respected medical college and hospital.

iii. Designing of Patient, consent form and data collection sheet:

The following four forms were designed for the purpose of study:

1) Consent form- Consent form to be signed by participants was prepared. The patients were explained the purpose of the study, the advantages and the disadvantages associated with the study in Malayalam (local language) **(Annexure I)**.

2) Data collection sheet- Secondary data were obtained from the department of cardiovascular and thoracic from the medical college. And from those we had collected a cases of aortoplasty done in the year of 2001-2010. Information such as Age, Gender, Preoperative parameters, Co-morbidities, Intra-operative parameters and postoperative parameters along with follow up was compiled. **(Annexure II)**

SAMPLE SIZE DETERMINATION:

Present study is retrospective study hence no need to determination of sample size. We got total 1420 number of cases those underwent aortoplasty surgeries with having BAV congenital anomaly. From those 30 numbers of cases only participated in our study hence data were analyzed with those numbers.

SAMPLE SIZE: 30 patients.

SAMPLING TECHNIQUE: Convenience sampling.

ELIGIBILITY CRITERIA:

- **Inclusion criteria:**
- Patients who give written informed consent for being part of the study.
- All patients of age ranging between 18-60 years.
- Patients who underwent Aortoplasty for bicuspid Aortic valve from 2001 to 2011.
- **Exclusion criteria:**
- Patient who refuse to give written informed consent.
- Patients who underwent Redo-surgeries, Valve repair and replacement surgery combined with Coronary Artery Bypass Graft (CABG)

SOURCE OF DATA: 30 Patient who reported to the department of cardiovascular and thoracic surgery and underwent to aortoplastic surgery with BAV congenital anomaly between 2010-2011 years. were included in present study.

STUDY POPULATION: The patients underwent to aortoplastic surgery with BAV congenital anomaly between 2001-2011 years.

SUBJECT WITHDRAWAL CRITERIA:

- Patient who wants to withdraw from the research.
- Patients who cannot follow up for the given period of time.

1. Ethical consideration:

An ethical clearance was obtained from the Institute of Ethical Committee (IEC) of a medical college and hospital prior to conduction of study.

ARMAMENTARIUM USED FOR DATA COLLECTION:

Secondary Data from the computer records were obtained and compiled on data collection form. Patiets were appointed on call for further examination.

CLINICAL PROCEDURE AND EXAMINATION:

After obtaining permission from IEC, Data will be collected with a semi structured questionnaire from hospital records and analyzed, Details of patients who are lost to follow up was only collected over phone .Permission of the patient was taken before asking questions. Preoperative, intra-operative and post-operative data was collected;

retro-prospective analysis of data was performed by principal investigator and co investigators after the procedure. All the patients was followed up for 10 year after the procedure and assessed clinically as well as ECHO and ECG as per departmental protocol. These data was collected through electronic medical records (EMR). The data was kept by the principle investigator. Patient details was kept confidential.

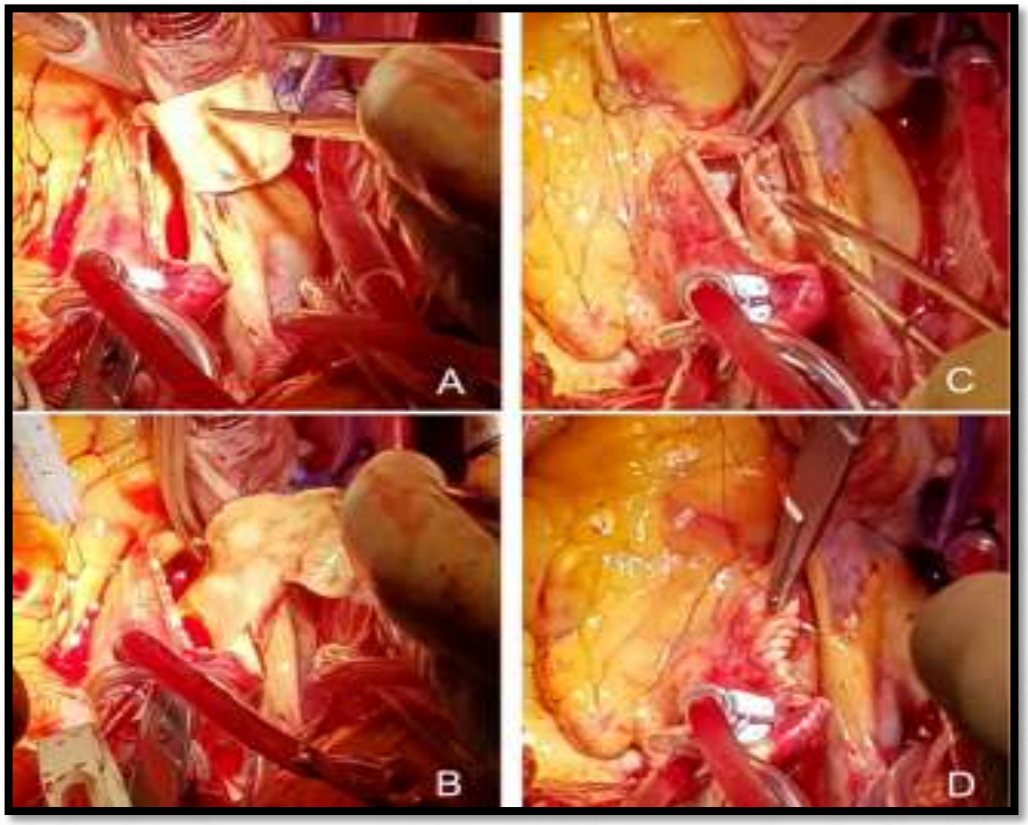
Reduction Aortic Aortoplasty:

Reduction Especially in patients with just a moderately dilated aorta without aortic root involvement and where a shorter aortic cross-clamp duration is desired, aortic repair with ascending aortoplasty (RAA) is an option to ascending aortic replacement using synthetic grafts. Compared to Dacron graft replacement, RAA is advantageous because it requires less skill from the surgeon, requires less time under cross-clamp, results in less blood loss, and has a reduced risk of mortality and morbidity. As RAA may leave fundamentally damaged native aortic wall tissue in situ, it presents significant risk of redilatation, rupture, or dissection to the patient. Ascending aorta reduction aortoplasty may be done in a few different ways, including with and without a sleeve. The many technical variations of this process are too involved to be covered in depth in this chapter. All of these modifications decrease the aortic diameter, which, according to Laplace's rule, should return wall tension to normal.

An elliptical section of the enlarged aortic wall is resected along the length of an aortotomy in an aortoplasty. Thereafter, the aortotomy is reopened using double layers of sutures, often strengthened with Teflon strips, to restore the aorta to its natural form and

size. When the suture line is completed, some writers recommend wrapping this section to strengthen the vessel wall and avoid additional dilatation.

By means of a longitudinal aortotomy beginning next to the aortic clamp at the larger curvature and proceeding all the way down to the non-coronary sinus, a wedge-shaped section of the ascending aorta was removed (Photograph 6). A double layer of 4-0/5-0 prolene suture was used to seal the aortotomy. If further stability of the suture line was deemed essential, a pericardial strip would be added to the line.



Photograph 6: Reduction Ascending Aortoplasty by tissue resection in a wedge-shaped fashion (A,B) and suture line completion in a double-layered fashion (C,D).

STATISTICAL PROCEDURE:

The statistical procedures were carried out in two steps:

1. Compilation and presentation of data

Compilation of data was done in systematic manner. Using Microsoft excel worksheet (Microsoft, USA, version 8.1) A master table was made, accordingly the data was subdivided and distributed which was presented in the form of individual tables and the graphs.

2. Statistical Analysis

Statistical analysis using IBM Statistical Package for Social Science (Statistics for windows, version 21.0, Armonk, NY:IBM corp.) was done and the comparison of data was carried out by applying statistical tests in order to find statistical significance of the results.

- **Statistical tests employed for the obtained data:**

Qualitative data will be expressed in terms of percentages and proportions.

- Quantitative data was expressed in terms of mean and standard deviation.
- Descriptive statistics of each variable was presented in terms of Mean, standard deviation, standard error of mean.
- Chi square test was applied to analyze the statistical significance of the data.
- P value of <0.05 was considered as statistically significant whereas a p value of <0.001 was considered as highly significant.

RESULTS

RESULTS

A retrospective study was conducted with the aim to The study participants included between the ages of 18-60 years. Total 30 participants male and female was enrolled in the study.

Distribution of study participants according to the age group:

The age of study participants were between 18-79 years old. And the mean age was 57.80 years with the standard deviation ±11.04. The maximum 43% (n=13) participants were from age between the group of 50-59years. Followed to this 20% (n=6), 16.6% (n=5), and 3.3% (n=1) of study participants were from the age group 70-79, 40-49, and 60-69 years respectively. only one that is 3.3% (n=3) study participant was the age group between 30-39 years. These distribution is normally distributed and statistically significant with Kolmogrov smirnov test p value is equal to 0.014 which is less than 0.05. **(Table 1) (Graph 1)**

Distribution of study participants according to their sex:

Amongst all 100% (n=30) the study participants 76.6% (n=23) were male and the rest 23.3% (n=7) were accounts female. Nearly males were tripled than the females. Distribution of the study participants is bimomial and statistically significant with one sample binomial test. P value is equal to 0.006 which is less than 0.05.

(**Table 2) (Graph 2)**

Distribution of study participants according to their NYHA Classification:

Amongst all 100% (n=50) the study participants most 66.7% (n=20) of the participants were had Class II NYHA Functional classification than rest 33.3% (n=10) were had NYHA Class III functional classification. Class II classification were found nearly doubled participants that class III. Distribution of the study participants is bimomial and statistically significant with one sample binomial test. P value is equal to 0.018 which is less than 0.05. (**Table 3) (Graph 3)**

Distribution of study participants according to their developed co-morbidity after performing aortoplastic surgery:

Amongst all 100% (n=30) the study participants highest 80.2% (n=24) number of participants had hypertension. 3.3% that is only one participants had Diabetes. And 5 participants doesn't had any comorbidity associated with their surgery. Among these 9 participants had comorbidity with hypertension and diabetes while only one participant had developed periatrial disease along with hypertension and diabetes. Distribution of the study participants is standard and statistically significant with chi square test. P value is less than 0.05 for the normal, Diabetic, Hypertensive with diabetic and Hypertensive associates with diabetes along with Periatrial disease. Only the hypertension has non significant value. (**Table 4) (Graph 4)**

Distribution of study participants according to their past dental history:

Pre-operative mean value of annular size is 25.80 mm with the standard deviation 2.76 mm. which is quite similar after the follow up period and was observed that 25.07 mm with the standard deviation 2.51mm. (**Table 5) (Graph 5)**

Preoperative mean value of STJ were observed that 38.03 mm with the standard deviation 1.52 mm. which is gradually decreasing up to 19.06 mm post-operative follow up with the standard deviation 16.97 mm. (**Table 5) (Graph 5)**

Pre operative mean value was observed 49.20 mm with the standard deviation 2.12 mm for the ascending aorta which gradually decreasing up to mean 28.55 mm with 6.31 mm of standard deviation for the size of ascending aorta. (**Table 5) (Graph 5)**

Pre-operative mean percentage of LVEF was observed nearly 60% with the standard deviation 7. Which is slightly decreasing in to 55% mean value for the post operative LVEF after follow up with thw standard deviation 6.31. (**Table 5) (Graph 5)**

Ascending aortic dilation mean value was observed 38.43 mm with standard deviation 1.47 at the time of per-operation. While this looks same that is 37.53 mm mean value of ascending aortic dilation with the standard deviation in post-operative foow up. (**Table 5) (Graph 5)**

Comparing pre-operative and postoperative follow up parameters of the study participants.

Comparison done between the pre-operative parameters and post-operative follow up parameters with the using paired t test. Showed that, there is statistically highly significant changes between STJ, Ascending Aorta size and Ascending Aorta Dilatation.

p value is equal to 0.000 which is less than the 0.001. There is significant decrease in Annular size dimension after the Surgery and the p value is equal to 0.025 which is less than 0.05. There is no statistical significance for LVEF percentage. P value is equal to 0.100a= which is higher than the 0.05. (**Table 6) (Graph 6)**

Correlation between pre-operative and postoperative follow up parameters of the study participants.

Correlation was done between the pre-operative parameters and post-operative follow up parameters with the using paired t test. Showed that, there is positive correlation in the parameters of Annular size, Ascending Aortic size, LVEF and Ascending Aortic Dilatation. and there values are statistically highly significant because p= 0.000 and this value is less than 0.001. Except only one parameter and that is Ascending Aortic size which is not Statistically significant where p is equal to 0.488 and this value is hugher than 0.05.

Only the STJ parameter had negative correlation which is -0.246 and these are statistically non significant as p is equal to 0.019 which is less than 0.05. (**Table 7) (Graph 7)**

DISCUSSION

DISCUSSION

Present study design was retrospective which was conducted to assess the long term that is more than 10 years outcome following aortoplastic surgery with Bicuspid aortic valve developed patients . 30 participants were included in this study that fulfilled our eligibility criteria. All the study participants were taken from the same institute. Ethical clearance was obtained from the respective authority of the same institute. Results were obtained and presented in tabular and graphical form.

In this study participants were included from the age of 30 to 79 years old. The mean age of the participants were observed is 57.80 with the standard deviation 11.04. Most of the participants that is 42.29% (n=12) participants were within the range of 50-59 years old. Only one participant was found in the range of 30.39 years old. Hence the need of aortoplasty occurs with increasing age. The similar results were obtained in the study of ***Matthias Bauer etal*** **(2002)**[38] in their study mean age of the participants were 56 ± 13 years old. In the study of ***Takeshi Kamdaetal*** **(2003)**[8] found 58±12 years age. In the study of ***Liu Shen etal*** **(2017)**[43] quite similar to our results mean age group were observed and it was 52.7±12.9 years. Slightly more mean age that is 64.4 ± 10.46 was observed in the study of ***Cinzia Trumello etal*****(2017)**[46] **.**

The male were observed tripled than the female who had underwent surgry. And they were 23 in number that is 76.7%. in the study of ***Liu Shen*** **etal (2017)**[43] results were cocncurrent to our result because 71.6% males were included in their study. ***Matias Baur*** **etal (2002)**[38] study showed slight lower male participation than our results and the male contribution of their study was 68% with 79 number of male participants. This

may be due to the prevalence of congenital BAV manifestation is more in males than females.

Most of the that 20 participants 66.7% ware developed Class II NYHA functional classification than very few that is 10 number of participants 33.3% with the class III NYHA Functional Classification . hence the outcome of the patient is optimum after the 10 year plus period of follow up. None study we had found with such parameters to compare the results of our study.

Most number of participants that is 24 (80.2%) were comorbidity of hypertension among those 9 participants had comorbidity with diabetes also. Only on diabetic along with hypertensive patient had co-morbid with periaortic disease. And a single person only with diabetic that is without ant other associates comorbidity were found. A minimum number that is only 5 (16.5%) participants are free from comorbidity were observed in the present study. The results are concurrent with the study of ***Cinzia Trumello etal*** **(2017)**[46] showing 93 number that is 63% participants were hypertensive and 12 (8.5%) participants were diabetics in their study.

In the present study there is no need for the resurvey or other elective surgery for all the participants. Not a single person developed any post operative complications such as Renal failure, Congestive obstructive pulmonary disease, Arrhythmia, Respiratory failure. In the obtained data as well as participants verbal response at the time of interview. While in the study ***Cinzia Trumello etal*** **(2017)**[46] found post-operative complications said above with minimal limit.

The preoperative parameters of the mean value for annular size are 25.80 mm with standard seviation 2.76. which is been 25.07±2.51 post-operatively after the follow up. Similar results were also found in the study of ***Mirco Doss etal*** **(2010)**[6]

The mean value of STJ pre operatively was 38.03±1.52 which gradually decresing up to 19.06±16.97 after the surgery during follow up. Which is higher than the study of ***Mirco Doss etal*** **(2010)**[6]**.**

Pre-operative mean value for ascending aorta was 49.20 with standard deviation 2.12 gradually decreasing up to mean value 28.55 with standard deviation 11.19 mm. after the follow up of post surgery.

The percentage of LVEF was 55.90 ±6.82 at per operative measurments and they are slightly vary after the follow up of post surgery and their value is 55.10±6.31.

Ascending aortic dilatation was observed 38.43±1.47 mm pre-operative parameters while it is slightly decreasing up to 37.53±1.57 mm after the follow up of post-operative. Which is slightly higher than the study of ***Cinzia Trumello etal*** **(2017)**[46]

All the cases were with BAV and none of the case showing RWMA.

CONCLUSION

CONCLUSION

Present study concluded that, A Reduction ascending aortoplasty surgery in patients afflicted with BAV is effective and durable in the long term.

The aortopathy associated with BAV disease certainly predisposes individuals to aortic dilatation, aneurysm formation, and aortic dissection; however, it appears that not all BAV aortas behave similarly. Surgical planning should carefully account for negative prognostic risk factors when addressing the bicuspid aortic valve and ascending aorta and tailor operative strategies to maximize long-term results with minimal perioperative morbidity. In the future, specific genetic and molecular markers may help to identify patients at highest risk for aortic complications.

Aortic dilation in patients with bicuspid aortic valve seems mainly due to the fragility of the aortic wall rather than hemodynamic factors caused by aortic stenosis or aortic regurgitation.

Additional prospective observational studies, and ideally randomized trials, will be necessary to continue advancement of BAV repair procedures.

Limitations:

-Low sample size.

-Study was done only at the local institute hence results cant extrapolate to generalize.

-Respondant Bias because follow up was more than 10 years hence may be subjects have -loss the memorable information.

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REFERENCES

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TABLES

TABLES

Table 1: Distribution of study participants according to their age.

Sr. No.	Age Group (Years)	No. of participants n (%)	Mean Age	Standard Deviation	Kolmogrove smirnaov test (p value)
1.	30-39	1(3.3)	**57.80**	**±11.04**	**0.014***
2.	40-49	5(16.6)			
3.	50-59	13(42.9)			
4.	60-69	5(16.6)			
5.	70-79	6(19.9)			
Total		**30(100)**			

*** p value is significant as p=0.014 which is < 0.05.**

Table 2: Distribution of study participants according to their sex.

Sr. No.	Sex	No. of Participants n(%)	One-sample binomial test (p value)
1	Male	23(76.7)	0.006*
2	Female	7(23.3)	
Total		**60(100)**	

*** p value is significant as p= 0.006 which is < 0.05.**

Table 3: Distribution of study participants according to NYHA Classification .

Sr. No.	Address	No. of Participants n(%)	One-sample binomial test (p value)
1	Class II	20(66.7)	0.018*
2	Class III	10(33.3)	
Total		**50(100)**	

*** p value is significant as p- 0.018 and p < 0.05.**

Table 4: Distribution of study participants according to their developed comorbidity after Aorplastic surgery .

Sr. No.	Co-morbidity	No. of Participants n(%)	Chi Square test (p value)
1	No	5(16.5)	0.002*
2	Hypertension	24 (80.2)	0.100
3	Diabetes Only	1(3.3)	0.00**
Total		**50(100)**	
4	Hypertension+ Diabetes	9	0.003*
5	Hypertension+ Diabetes + Periatrial Disease	1	0.000**

**** p value is highly significant as p=0.0 where p <<0.001**

***p value is significant as p < 0.05.**

Table 5: Distribution of study participants according to their Pre-operative Parameters and Postoperative parameters mean value.

Sr. No.	Pre-operative Parameters	Mean Value ±Standard Deviation	Post-operative Parameters	Mean Value ±Standard Deviation
1	Annular Size (mm)	25.8±2.76	Annular Size (mm)	25.07±2.51
2	STJ (mm)	38.03±1.52	STJ (mm)	19.06±16.97
3	Ascending Aorta	49.20±2.12	Ascending Aorta	28.55±11.19
4	LVEF (%)	55.90±6.82	LVEF (%)	55.10±6.31
5	AA Dilatation	38.43±1.47	AA Dilatation	37.53±1.57

Table 6: Comparing pre-operative and postoperative follow up parameters of the study participants.

Sr. No.	Comparison of Pre-and post operative Parameters	t value	Test of significant (paired t test)
1	Annular Size (mm)	2.368	0.025*
2	STJ (mm)	5.968	0.000**
3	Ascending Aorta	10.175	0.000**
4	LVEF (%)	1.699	0.100
5	AA Dilatation	5.137	0.000**

**** p value is highly significant as p=0.0 where p <<0.001**

***p value is significant as p < 0.05.**

Table 7: Correlation between pre-operative and postoperative follow up parameters of the study participants.

Sr. No.	Correlating of Pre-and post operative Parameters	Correlation value	Test of significant (paired t test)
1	Annular Size (mm)	0.796	0.000**
2	STJ (mm)	-0.246	0.190
3	Ascending Aorta	0.132	0.488
4	LVEF (%)	0.926	0.000**
5	AA Dilatation	0.803	0.000**

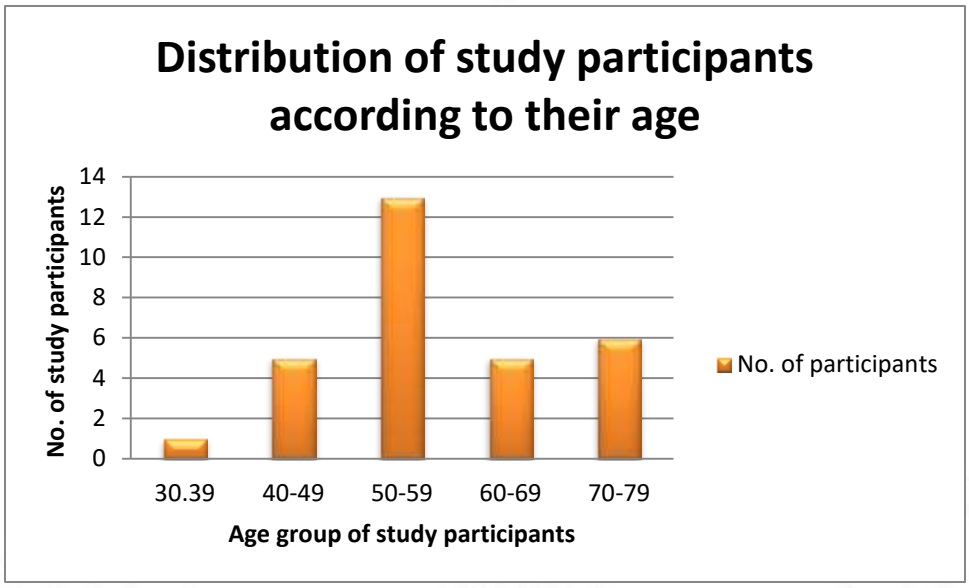
**** p value is highly significant as p=0.0 where p <<0.001**

***p value is significant as p < 0.05.**

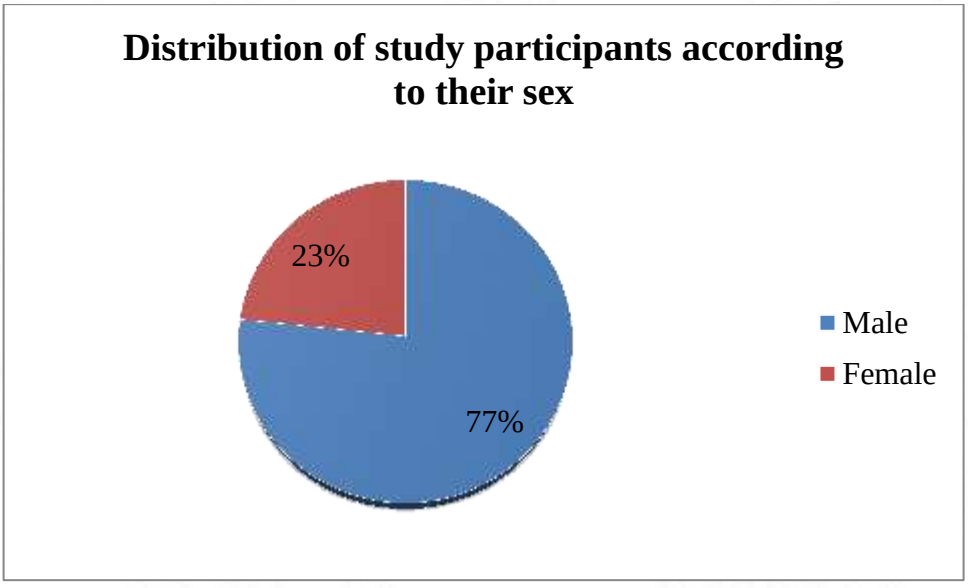
GRAPHS

GRAPHS

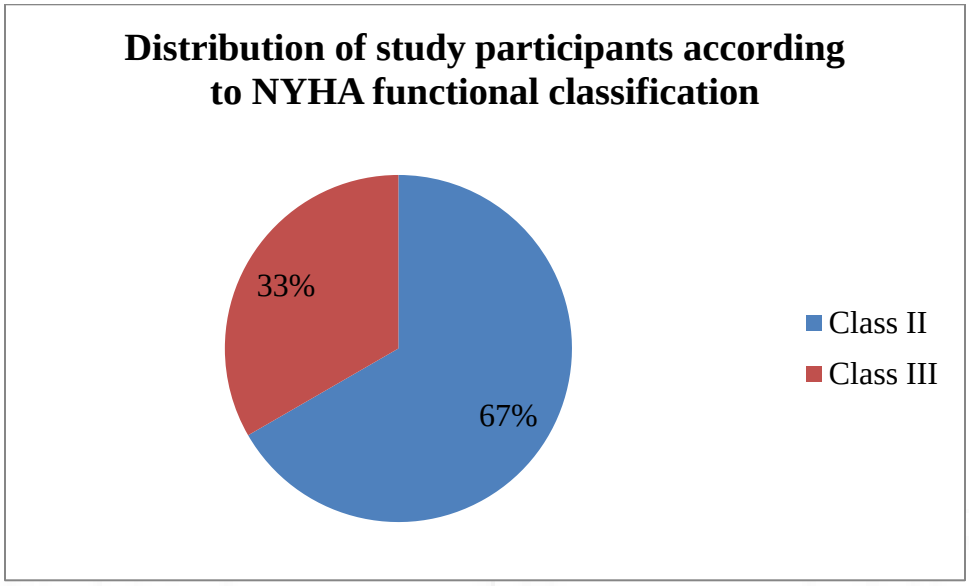
Graph 1: Distribution of study participants according to their age.



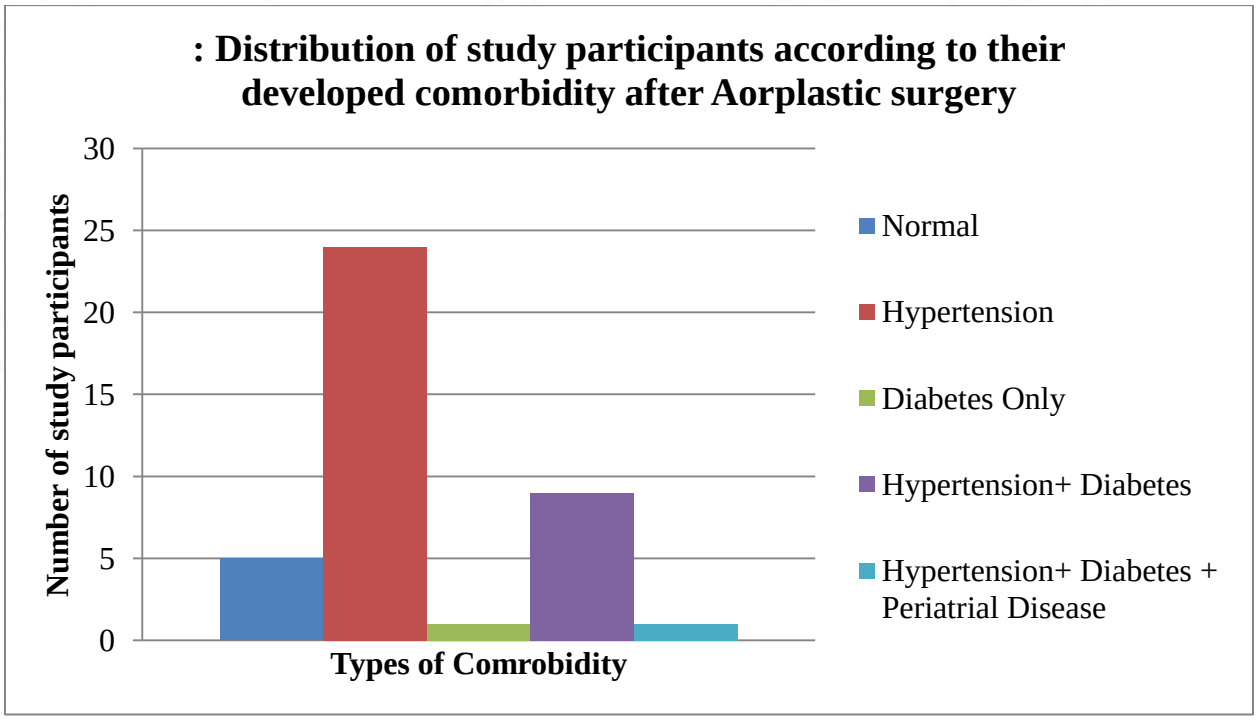
Graph 2: Distribution of study participants according to their sex.



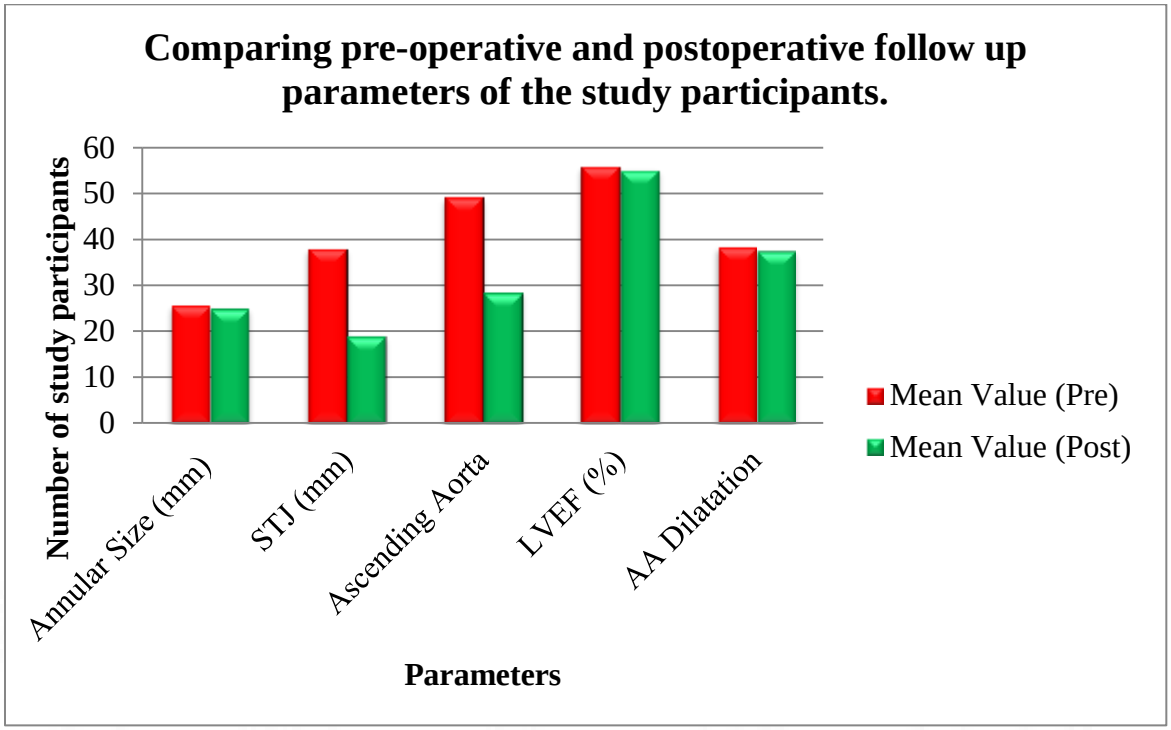
Graph 3: Distribution of study participants according to NYHA functional classification.



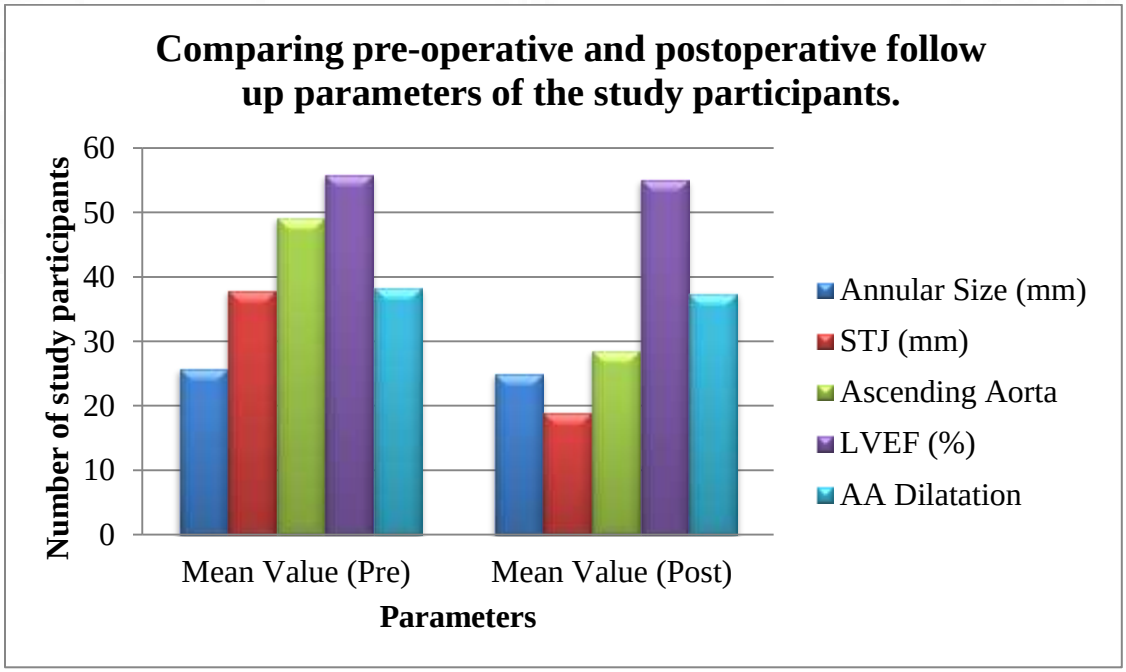
Graph 4: Distribution of study participants according to their developed comorbidity after Aorplastic surgery .



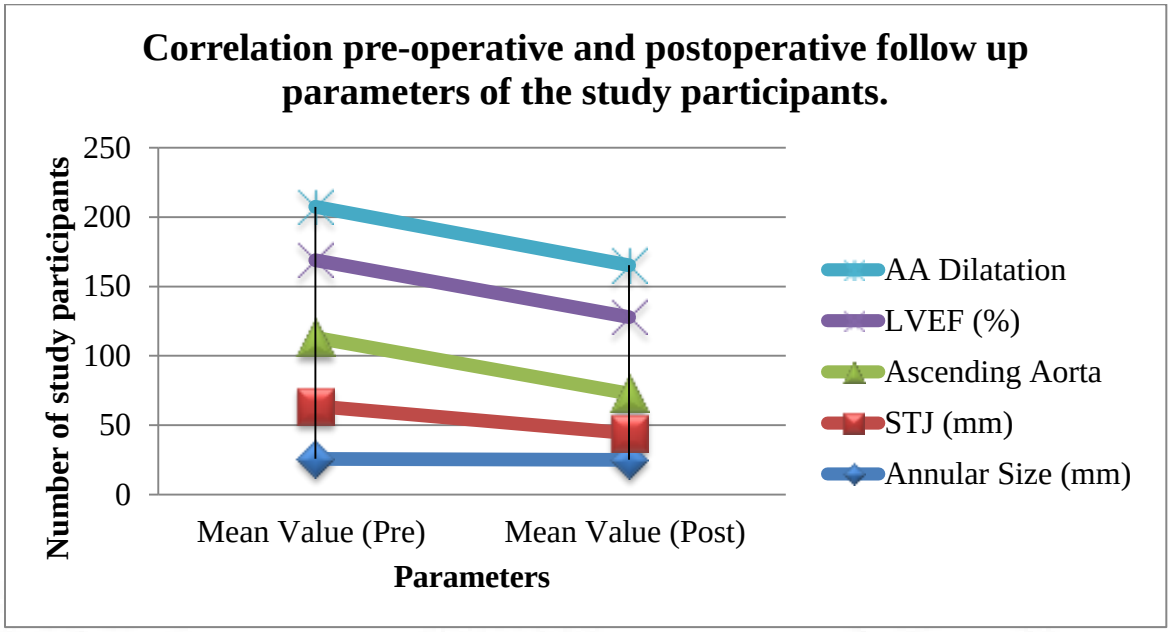
Graph 5: Comparing pre-operative and postoperative follow up parameters of the study participants mean value.



Graph 6: Comparing pre-operative and postoperative follow up parameters of the study participants.



Graph 7.Correlation between pre-operative and postoperative follow up parameters of the study participants.



ANNEXURE I

PATIENT INFORMATION PROFORMA

CASE NUMBER:
AGE GENDER
PRE OPERATIVE PARAMETERS

RISK FACTORS/COMORBITIES:

Hypertension
Diabetes
Peripheral
Arterial
disease
Dyslipedemia
Chronic obstructive
lung diseaseThyroid
dysfunction
Chronic Kidney disease
NYHA FUNCTIONAL CLASS

IMAGING

Annular size
Ascending Aortic size
STJ size
Valve function
LVEF
RWMA

INTRA OPERATIVE PARAMETERS

Total cardiopulmonary
bypass timeDuration
of surgery
Ventricular
function

Emergency
/elective
surgery
Coronary
involvement

POST OPERATIVE PARAMETERS

Mortality
AA dilatation
Aortic dissection
Need for Re-surgery Respiratory failure Renal failure
Anticoagulation regimen Hospital Stay
Arrythmias

FOLLOW UP

1. Ascending aortic, STJ and annular dimensions
2. Left ventricle function
3. RWMA
4. Aortic valve function

CONSENT

രണ്ട് മുടികൾ മാത്രമുള്ള അയോർട്ടിക് വാൽവിൽ അയോർട്ടോപ്ലാസ്റ്റി ശസ്ത്രക്രിയയ്ക്ക് വിധേയരായ രോഗികളിലെ നേട്ടങ്ങളുടെ പുനരവലോകനം

ടെലിഫോൺ വഴി പങ്കാളികളെ ഉൾപ്പടുത്താനും അഭിമുഖത്തിനുമുള്ള കുറിപ്പ്

ഹലോ, എന്റെ പേര് ഡോ. പ്രൃത്വിരാജ് പാട്ടീൽ എന്നാണ്. ശ്രീചിത്ര തിരുനാൾ ഇൻസ്റ്റിറ്റ്യൂട്ട് ഫോർ മെഡിക്കൽ സയൻസസ് ആന്റ് ടെക്നോളജിയിൽ നിന്നും ഒരു ഗവേഷണപഠനത്തിനായി വിളിക്കുകയാണ്. എനിക്ക് ..... (പഠനത്തിലുൾപ്പെടുത്താനദ്ദേശിക്കുന്നയാളുടെ പേര്) ആയോ അല്ലെങ്കിൽ അവരുടെ രക്ഷിതാക്കളുമായോ സംസാരിക്കാനാകുമോ?

ഇല്ലെങ്കിൽ പങ്കെടുപ്പിക്കാനുദ്ദേശിക്കുന്നയാൾ ഫോണെടുക്കുന്നതുവരെ കാക്കുക, അല്ലെങ്കിൽ വീണ്ടും വിളിക്കാൻ പറ്റിയ സമയം ചോദിക്കുക

ആണെങ്കിൽ:

ആശുപത്രി രേഖകളിൽനിന്നാണ് എനിക്ക് താങ്കളുടെ ഫോൺ നമ്പർ കിട്ടിയത്. ഇത് സംസാരിക്കാൻ പറ്റിയ സമയമാണോ.

അനുയോജ്യമെങ്കിൽ, മറ്റൊരു സമയത്ത് വിളിക്കാൻ ഏർപ്പാടുചെയ്യുക.

രണ്ട് മുടികൾ മാത്രമുള്ള അയോർട്ടിക് വാൽവിൽ അയോർട്ടോപ്ലാസ്റ്റി ശസ്ത്രക്രിയയ്ക്ക് വിധേയരായ രോഗികളിലെ നേട്ടങ്ങളുടെ പുനരവലോകനം എന്ന ഒരു ഗവേഷണ പഠനത്തിനായാണ് ഞാൻ വിളിക്കുന്നത്. താങ്കളുടെ ദീർഘകാല നേട്ടങ്ങളെപ്പറ്റിയും ഇപ്പോഴത്തെ അവസ്ഥയെപ്പറ്റിയും അറിയുക എന്നതാണ് ഈ ഗവേഷണ പഠനത്തിന്റെ ഉദ്ദേശം. ഗവേഷണന പഠനത്തിൽ പങ്കെടുക്കുന്നത് പൂർണ്ണമായും സ്വമേധയായാണ്. താങ്കളോ /താങ്കളുടെ കുടുംബാംഗമോ പഠനത്തിൽ പങ്കെടുക്കാൻ താത്പര്യപ്പെടുന്നുണ്ടോ എന്നറിയാൻ, പഠനത്തിന്റെ അടിസ്ഥാന ആശയം വിശദീകരിക്കാൻ ഞാൻ 2-3 മിനിട്ട് എടുക്കുന്നതിൽ കുഴപ്പമില്ലല്ലോ.

താങ്കൾ പങ്കെടുക്കുവാൻ സമ്മതിക്കുകയാണെങ്കിൽ ക്ലിനിക്കിലേയ്ക്ക് വരുവാൻ ആവശ്യപ്പെടുകയും താങ്കളോട് പഠനത്തിന്റെ കൂടുതൽവിശദാംശങ്ങൾ ചർച്ചചെയ്യുകയും, പങ്കെടുക്കണോ വേണ്ടയോ എന്ന് താങ്കൾക്ക് തീരുമാനിക്കാനാവുകയും ചെയ്യും. പഠനത്തിൽ പങ്കെടുക്കുന്നതുകൊണ്ട് അപായമൊന്നുമുണ്ടാകില്ല. പ്രത്യേകിച്ച് ഇടപെടലുകളൊന്നും നടത്തില്ല. പങ്കാളികളുടെ പ്രവർത്തന തകരാറുകളുടെ ഹൃദയസംബന്ധമായ കാരണങ്ങൾ വിശദമായി വിലയിരുത്തും. മോശം നേട്ടങ്ങളുടെയും പ്രവർത്തനപരമായ തകരാറുകളുടെയും അപായഘടകങ്ങൾ കണ്ടെത്താൻ തുടർ പരിശോധനയും വിലയിരുത്തലും നടത്തുന്നത് സഹായകരമാകും. ഇത് പതിവ് വിലയിരുത്തലിന്റെ ഭാഗവുമാണ്.

താങ്കളുടെ വ്യക്തിവിവരങ്ങൾ രേഖപ്പെടുത്താതെ രേഖകൾ പാസ്വേർഡിനാൽ സംരക്ഷിക്കപ്പെട്ട കമ്പൂട്ടറിൽ സൂക്ഷിച്ച് താങ്കളെപ്പറ്റിയുള്ള വിവരങ്ങൾ രഹസ്യമാക്കിവയ്ക്കാൻ ഞങ്ങൾ പരമാവധി പരിശ്രമിക്കും. പിഴയൊന്നും കൂടാതെ താങ്കൾക്ക് ഏതുസമയത്തും പങ്കാളിത്തം അവസാനിപ്പിക്കാം.

ഗവേഷണപങ്കാളിയെന്നനിലയിലുള്ള താങ്കളുടെ അവകാശങ്ങളെപ്പറ്റിയുള്ള ചോദ്യങ്ങൾക്കോ, സാങ്കേതിക വിശദീകരണങ്ങൾക്കോ താങ്കൾക്ക് ബന്ധപ്പെടാം ഡോ. ശ്രീനിവാസ് ജി മെമ്പർ സെക്രട്ടറി, IEC, SCTIMST,. ഫോൺ നമ്പർ 0471-2524689 ഇമെയിൽ iec.mem.sec@sctimst.ac.in

സമ്മതിക്കുന്നെങ്കിൽ, അനയോജ്യമാണെങ്കിൽ യോഗ്യത രേഖപ്പെടുത്തുക,

രോഗി മരിക്കുകയും ബന്ധു "അദ്ദഹം മരിച്ചു" എന്നു മറുപടി നൽകിയാൽ

അദ്ദേഹത്തിന്റെ മരണത്തിൽ ഞാൻ അനുശോചിക്കുന്നു. താങ്കൾക്ക് മരണമടഞ്ഞ സമയം പറയാനാകുമോ, മരണകാരണത്തിന്റെ വിശദാംശങ്ങൾ നൽകാനാകുമോ?

താങ്കൾ സമ്മതിക്കുമെങ്കിൽ ഈ വ്യക്തിയുടെ ആശുപത്രി രേഖകൾ പരിശോധിക്കാമോ.സമ്മതമെങ്കിൽ. നന്ദി. മറ്റുള്ളവരിൽ സമാനമായ സങ്കീർണ്ണതകൾ തടയാൻ വിശദാംശങ്ങൾ സഹായിച്ചേക്കാം. താങ്കളുടെ സമയത്തിന് നന്ദി.

വേണ്ടായെങ്കിൽ. അത് മനസ്സിലാക്കാനാകും. താങ്കളുടെ സമയത്തിന് നന്ദി.

Sr. No.	Age (Years)	Gender Female=1 Male=0	Comorbidity None=0 Hypertension=1 Diabetes=2 PerArterialD=3			NYHA Functional Classification	Pre-Operative Parameters						
							Annular Size (mm)	STJ (mm)	Ascending Size (mm)	Valve 1=Bicuspid Aortic Valve	LVEF (%)	RWMA Absent=0	AA Dilation (mm)
1	30	1	0	0	0	2	24	36	45	1	73	0	39
2	55	0	0	0	0	2	21	38	48	1	62	0	36
3	66	0	1	0	0	2	22	35	46	1	56	0	38
4	53	0	1	2	0	3	24	38	45	1	50	0	40
5	57	1	1	0	0	2	26	39	49	1	48	0	37
6	58	1	1	0	0	2	29	36	51	1	61	0	38
7	61	1	1	2	0	2	25	38	50	1	52	0	39
8	43	1	0	0	0	3	22	37	52	1	58	0	38
9	63	1	1	2	3	2	26	39	49	1	53	0	36
10	87	0	1	2	0	2	24	40	48	1	50	0	39
11	59	1	1	0	0	2	29	36	52	1	69	0	40
12	57	1	1	0	0	3	30	40	52	1	52	0	41
13	51	1	0	2	0	2	26	38	50	1	54	0	39
14	62	1	1	2	0	2	27	36	46	1	49	0	36
15	48	1	1	0	0	2	25	39	48	1	53	0	35
16	56	1	1	0	0	2	28	37	45	1	55	0	37
17	72	1	1	2	0	3	25	40	49	1	48	0	38
18	71	1	1	0	0	3	31	36	52	1	60	0	40
19	62	1	1	0	0	2	26	38	51	1	62	0	39
20	57	1	0	0	0	2	28	40	50	1	57	0	40
21	70	0	1	2	0	3	25	40	48	1	45	0	38
22	45	1	0	0	0	2	22	39	49	1	61	0	37
23	53	0	1	0	0	2	23	38	50	1	59	0	39
24	43	1	1	0	0	2	27	39	51	1	63	0	40
25	56	1	1	2	0	2	22	36	49	1	65	0	38
26	70	1	1	0	0	3	25	37	50	1	49	0	40
27	70	1	1	0	0	2	29	39	51	1	51	0	39
28	57	1	1	2	0	2	30	38	49	1	61	0	38
29	46	0	1	0	0	3	24	40	50	1	47	0	39
30	56	1	1	0	0	2	29	39	51	1	54	0	40

Post-operative Complications No=0 Yes=1					Follow Up						
Need for Re-Surgery	Respiratory Failure	Renal Failure	Anticoagulation Regimen	Arrythmias	Annular Size (mm)	STJ (mm)	Ascending Size (mm)	Valve Function	LVEF (%)	RWMA Absent=0	AA Dilation (mm)
0	0	0	0	0	24	35	13.5	1	74	0	38
0	0	0	0	0	20	37	12.5	1	63	0	36
0	0	0	0	0	21	35	14.5	1	55	0	38
0	0	0	0	0	23	37	15	1	52	0	39
0	0	0	0	0	24	39	16	1	50	0	35
0	0	0	0	0	29	34	14	1	60	0	38
0	0	0	0	0	24	36	18	1	50	0	37
0	0	0	0	0	23	38	19	1	60	0	37
0	0	0	0	0	25	38	20	1	51	0	33
0	0	0	0	0	23	40	15	1	51	0	39
0	0	0	0	0	27	35	14	1	59	0	36
0	0	0	0	0	28	39	12	1	53	0	40
0	0	0	0	0	24	37	35	1	55	0	39
0	0	0	0	0	26	36	36	1	50	0	35
0	0	0	0	0	24	3.8	39	1	50	0	35
0	0	0	0	0	24	3.1	36	1	54	0	37
0	0	0	0	0	26	3.6	38	1	49	0	37
0	0	0	0	0	28	3.3	36	1	56	0	39
0	0	0	0	0	21	3.2	36	1	59	0	38
0	0	0	0	0	29	3.1	39	1	55	0	38
0	0	0	0	0	25	3	40	1	46	0	38
0	0	0	0	0	25	3.4	40	1	61	0	37
0	0	0	0	0	24	3.1	36	1	60	0	38
0	0	0	0	0	28	4.3	38	1	61	0	39
0	0	0	0	0	23	4	35	1	61	0	37
0	0	0	0	0	24	4.1	37	1	47	0	39
0	0	0	0	0	30	4.1	39	1	52	0	38
0	0	0	0	0	28	3.1	36	1	63	0	38
0	0	0	0	0	25	3.2	38	1	45	0	39
0	0	0	0	0	27	3.5	39	1	51	0	39

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INTRODUCTION

In adults, a bicuspid aortic valve (BAV) is one of the most frequent cardiac defects. Ascending aortic dilation is commonly seen in patients with BAV, however the reason for this relationship is unclear. Two possible explanations exist for this strong correlation. Aortic dilation is one consequence of BAV-related aortic stenosis (AS) or aortic regurgitation (AR), both of which place additional demands on the heart's hemodynamics.1 The aorta can be dilated by either the increased stroke volume caused by AR or the forceful ejection jet caused by AS (post stenotic dilatation). Another is a weak aorta present at birth. McKusick2 noted the presence of BAV and Erdheim's cystic medial necrosis in the same patient in 1972. The doctor hypothesised that the link wasn't coincidental, and instead represented an arterial tree abnormality at birth. Patients with BAV show a substantial connection, which has been supported by other writers, and the hypothesis of an underlying congenital abnormality has been presented.

Most recently conducted studies have linked BAV to hastened deterioration of the aortic media. This theory might be supported by the observation that BAV is often accompanied by other aortic anomalies such aortic coarctation, Marfan's syndrome, and aortic dissection. Aortic surgery, such as aortic replacement or wrapping in conjunction with aortic valve replacement, may be necessary for patients with BAV who have experienced aortic dilation (AVR).3 It is unknown if aortic dilatation persists following AVR, and there is ongoing debate over when and how to treat aortic dilation using balloon valvuloplasty (BAV). If the aortic dilatation is caused by hemodynamic loads,

AVR may stop the aorta from expanding any further. Congenital aortic fragility may cause dilatation to persist despite AVR. We compared patients with BAV who had tricuspid AO and the same risk factors before and after AVR using echocardiography, however the extent of the aortic resection is still up for discussion.1

Primacy of competency and long-term repair stability in aortic valve reconstruction cannot be attained with a monolithic approach. Alternatively, doctors may use a cocktail of strategies to overcome the unique obstacles presented by the dysfunctional aortic root. Pathologies of the aortic annulus and root, the ascending aorta, and the aortic leaflets and commissures are commonly seen in patients with bicuspid aortic valves. It may therefore come as no surprise that aortic valve reconstruction results are less gratifying than those attained by mitral repair.4 It wasn't until 1991 that the procedure for fixing bicuspid aortic valves was detailed in detail by Cosgrove et al 5 The procedure included a triangle excision of the prolapsing aortic leaflets and a commissural plication. This method was linked to an unsatisfactory rate of re-operations and residual aortic regurgitation at midterm follow-up. A strip of autologous glutaraldehyde-fixed pericardium was employed to augment the free edge of the fused leaflet and increase the region of leaflet co-aptation.6