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ISSN: 2329-6607
Cardiovascular Pharmacology: Open Access

Commentary

Valvuloaortopathy: Unraveling the Interplay between Valve Dysfunction and Aortic Pathologies

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DESCRIPTION

The valvuloaortopathy known as bicuspid aortic valve has a variety of valvar and aortic phenotypes. These changes are detected in aorta diameters and elasticity. In children with bicuspid aortic valve, medicinal or surgical treatment is seldom necessary, but over 20% of adults with asymptomatic bicuspid aortic valve ultimately experience cardiac problems, such as congestive heart failure, syncope, chest discomfort, or sudden cardiac death. The Bicuspid Aortic Valve (BAV), which is said to have been originally described by Leonardo da Vinci more than 500 years ago, has gradually gained recognition. At first, it was thought to be an odd valvular phenotype with a propensity to develop blockage and insufficiency. However, more recently, the bicuspid aortic valve has been closely related to serious consequences including bacterial endocarditis and aortic dissection, and it is now believed to be the source of around 50% of isolated severe aortic stenosis cases requiring surgery.

The bicuspid aortic valve, a kind of inherited heart disease, has received attention on a global scale. Although the majority of patients with bicuspid aortic valve will experience complications such as aortic stenosis, aortic regurgitation, endocarditis, and heart dysfunction in the late stages of the disease, there are no symptoms in childhood, which prevents us from making a diagnosis and starting treatment when the condition first manifests. Bicuspid aortic valve-associated aortopathy is caused by hemodynamic abnormalities brought on by the malformations of the valves in bicuspid aortic valve patients over a long period of time. This includes progression of aortic dilatation, aneurysm, dissection and rupture, cardiac cyst, and even sudden death.

The most prevalent congenital abnormality, which can manifest clinically in a variety of ways, is characterized by the presence of two leaflets in the aortic position. Some intriguing differences in aortic stenosis have been seen in BAV patients. When compared to those with tricuspid aortic valves that are typically formed, people with BAV frequently experience more severe stenosis along with earlier calcification and/or fibrosis in the aortic leaflets. The Left Ventricle (LV), in addition to the valve, appears to be involved in the difference. After receiving final care by surgical or Trans Catheter Aortic Valve Replacement (TAVR), patients with BAV were observed to experience less severe reverse LV remodeling than those with TAV. Despite these findings suggesting that bicuspid aortic stenosis has unique features, TAV patients and those with bicuspid aortic stenosis are treated similarly today.

The bicuspid aortic valve is an exception, and Paget was the first to identify it. The bicuspid valve, which has just two valve leaflets and two sinuses attached, is distinguished from the more common "bicuspid" valve, which physically has three sinuses and flap pockets but only two of them are fused. Two cusps are situated either anterior-posteriorly with commissure running from left to right or laterally with commissure running from anterior to posterior in the BAV with two sinuses of Valsalva. This is actually the BAV. The BAV typically contains three sinuses of Valsalva. In this case, one cusp has a central thickening (raphe) and is greater than the other. These valves are created from the pre- or postnatal fusion of three applied sinuses or two cusps of a main tricuspid valve. As a result, a so-called functional BAV is produced. BAVs are acquired in postnatal fused cusps. Depending on which cusps are united, the unequal cusp raphe can be found in various orientations, with the right and left cusps being the most common. Additionally, some people with the BAV phenotype advance to developing an ascending aortic aneurysm, which raises concerns about the possibility of an aortic dissection. These associations between the BAV phenotype and aortic enlargement are independent of valve function.

A key risk factor for secondary aortopathy, such as aortic dilatation, is the bicuspid aortic valve. Different dilation patterns connected to the different BAV morphotypes, including Left-Right-Coronary Cusp Fusion (LR), Right-Non-Coronary Cusp Fusion (RN), and Left-Non-Coronary Cusp Fusion (LN), suggest that hemodynamic may play a role in the aortopathogenesis of the

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Received: 02-May-2023, Manuscript No. CPO-23-21420; **Editor assigned:** 05-May-2023, PreQC No. CPO-23-21420 (PQ); **Reviewed:** 19-May-2023, QC No CPO-23-21420; **Revised:** 26-May-2023, Manuscript No. CPO-23-21420 (R); **Published:** 02-Jun-2023, DOI: 10.35248/2329-6607.23.12.348

Citation: Sugeng B (2023) Valvuloaortopathy: Unraveling the Interplay between Valve Dysfunction and Aortic Pathologies. Cardiovasc Pharm. 12:348.

BAV. The *in vitro* investigation shows significant flow anomalies (increased jet skewness, asymmetry, and velocity, turbulence, and shear stress overloads) in non-dilated BAV aortas that are distinct from those seen in dilated aortas but nonetheless correlate with aortic wall areas susceptible to dilatation Bicuspid Aortic Valves (BAVs) cause aberrant flow patterns that might encourage aortopathy. It is not apparent if aberrations in the Positive Helix Fraction (PHF) index, flow angle, flow displacement (d), and Wall Shear Stress (WSS) are caused by the dilated aorta or the aberrant valve structure. Bicuspid aortic valve disease, the most common congenital heart abnormality, causes a significant impact on cardiac care.