Williams-Beuren Syndrome: The Role of Cardiac CT in Diagnosis

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ABSTRACT: Williams-Beuren syndrome is a multisystem genetic disorder associated with cardiovascular abnormalities, the most common of which is some variation of arterial stenosis. We describe a case of Williams-Beuren syndrome with multiple cardiovascular structural and arterial abnormalities and demonstrate the unique role of cardiac computed tomography in diagnosis.

INTRODUCTION

Williams-Beuren syndrome (WBS) is a congenital multisystem disorder that occurs in roughly 1 in 100,000 live births. It is caused by a deletion on chromosome 7q.11 23.[1] Classic features of WBS include elfin facial appearance, growth retardation, and neurologic abnormalities including mental retardation and hypersocial behavior.[1,2] The vast majority (~80%) of patients with WBS suffer from structural cardiovascular abnormalities typically related to arterial stenosis, including supravalvular aortic stenosis (SVAS), pulmonary stenosis, and coronary artery stenosis.[3] Cardiac computed tomography (CT), with its modern multidetector computed tomography (MDCT) scanners, helps clinicians evaluate the complex cardiovascular abnormalities of WBS, aids with diagnosis, and has the potential to be leveraged in a surgical or interventional setting. Understanding the various characteristic features of WBS on MDCT may aid with diagnosis even prior to clinical presentation, creating a unique role for advanced imaging in the diagnostic workup of WBS.[4]

CASE REPORT

A 6-week-old male infant born at full term in a remote village in India presented with failure to thrive and excessive fussiness since birth. On clinical examination, he appeared acutely distressed, was tachycardic to 166 bpm, and had an oxygen saturation of 99%. Chest x-ray was unremarkable, and 2-dimensional echocardiography showed turbulence in the left pulmonary artery (LPA) after the ostium with a pressure gradient of 45 mm Hg. Suspicious for Noonan syndrome, the patient was referred for cardiac MDCT for evaluation of LPA stenosis. Cardiac CT, which was performed on a 64-slice CT scanner with electrocardiographic gating, revealed supravalvular aortic stenosis with hour-glass constriction (Figure 1 A, B) at the sinotubular junction extending upward for 9.3 mm along the ascending aorta. The aortic annulus was normal in size, while the entire aorta to the level of the diaphragm was seen to be significantly small in caliber as assessed by Z scores.

Multidetector CT also revealed a tricuspid aortic valve with thickened valve leaflets (Figure 2 A). The right coronary artery was found to have a high origin at the right coronary sinus, with normal course and caliber. The left coronary also was high in origin, arising at the sinotubular junction (Figure 2 B), and was normal in course and branching, giving way to an enlarged and tortuous

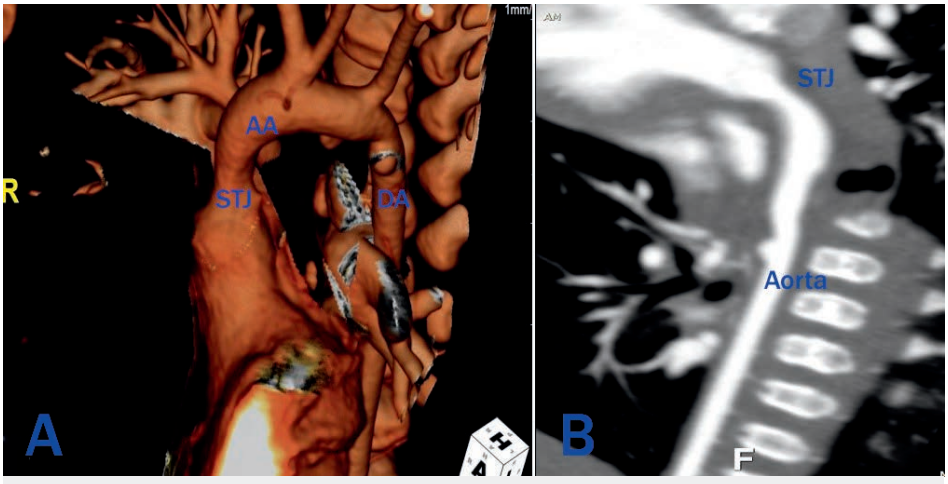

Figure 1.
(A) Three-dimensional reconstruction and (B) maximum intensity projection image showing hourglass narrowing starting at the sinotubular junction extending to the ascending aorta. The entire aorta appears small in caliber.

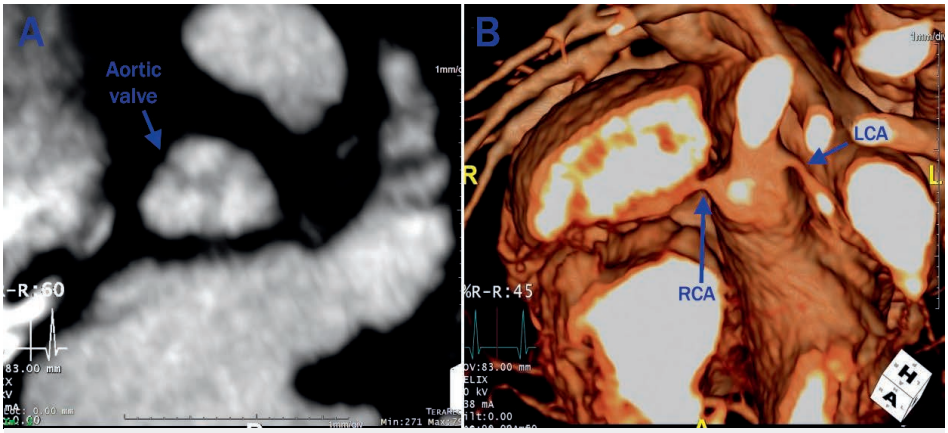

Figure 2.
(A) Maximum intensity projection image of aortic valve showing thickening of leaflets. (B) Three-dimensional reconstruction image showing high origin of the left circumflex anterior artery from narrowed sinotubular junction.

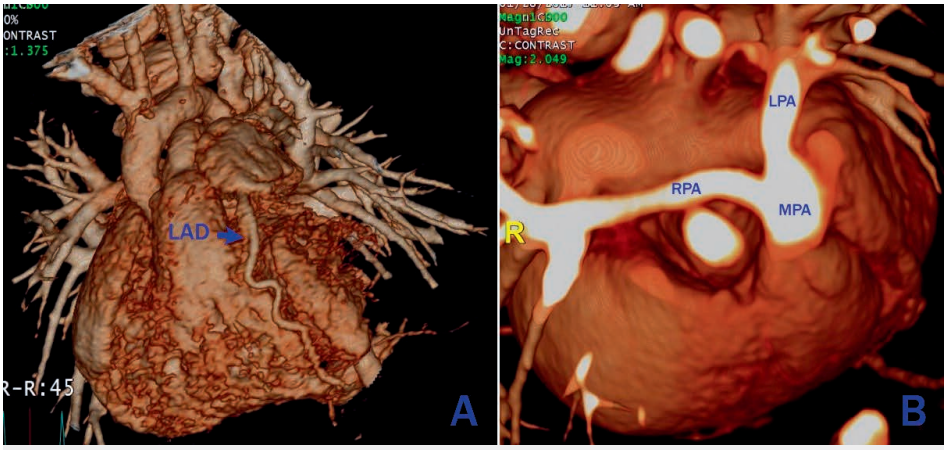

Figure 3.
(A) Three-dimensional (3D) reconstruction showing dilated and tortuous left anterior descending artery. (B) 3D reconstruction image showing small pulmonary arteries.

left anterior descending (Figure 3 A). The pulmonary arteries were small in caliber, with the LPA showing mild focal constriction (Figure 3 B). Other findings included the right superior and inferior vena cava opening into the right atrium, and the left superior vena cava draining into the right atrium via the coronary sinus (Figure 4). These cardiac CT findings were suggestive of WBS. Upon further physical examination, the baby also had physical features consistent with WBS, including a broad forehead, short palpebral fissure, sunken nasal bridge, widely-spaced eyes, and full cheeks.

DISCUSSION

Williams-Beuren syndrome is a rare genetic disorder affecting approximately 1 in 20,000 live births. It has several characteristic physical features and various cardiovascular abnormalities, most commonly including arterial stenosis.[3,5] The pathogenesis of WBS is related to an elastin deficiency resulting from a deleted *ELN* gene. This leads to the arterial manifestations of WBS, including increased stiffness, decreased recoil, and stenosis.[6,7] Patients with WBS present with failure to thrive and developmental delay in infancy and are most commonly diagnosed based on history, physical exam findings, and fluorescence in situ hybridization, which confirms the genetic microdeletion.[8]

The most prevalent cardiovascular structural abnormalities in WBS are supravalvular aortic stenosis (SVAS) and pulmonary artery stenosis, which can be detected on MDCT.[10] Additionally, coronary artery anomalies, including coronary artery stenosis and coronary dysplasia, may occur in isolation or in the presence of other abnormalities such as SVAS; this leads to an increased risk of ischemic heart disease, even in childhood.[11-14] Patients with WBS have also been found to have increased arterial tortuosity, perhaps as a result of elastin deficiency.[15]

Multidetector CT is a powerful diagnostic aid since it can detect a variety of WBS-associated cardiovascular structural abnormalities, including SVAS, pulmonary artery stenosis, coronary artery anomalies, and aortic valve thickening. It also can assess pulmonary vasculature, coronary arteries, the aortic valve, and other cardiac and extracardiac anomalies.[16] In addition, MDCT is increasingly being used in other complex congenital heart diseases and offers unique advantages over echocardiography, such as imaging extracardiac structures.[17] Advances in MDCT, including ECG-gated acquisition and other dose-reducing technologies, have resulted in decreased radiation exposure, which contributes to its increasing use in congenital heart disease.[18] Finally, in addition to diagnosis, MDCT is a useful tool in presurgical or interventional planning in WBS.[19]

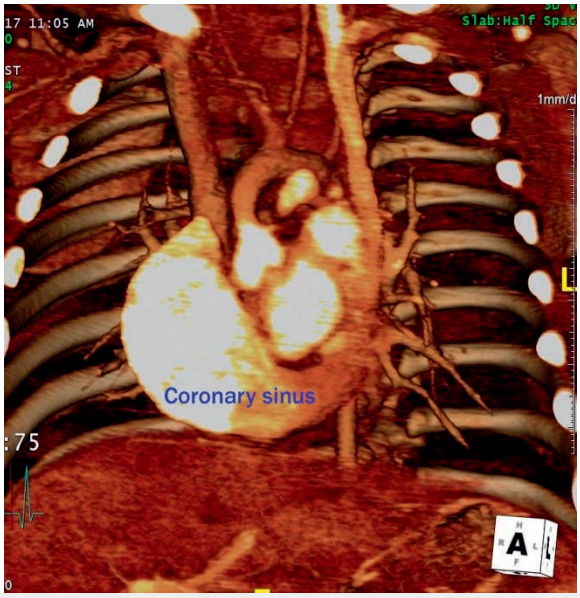

Figure 4.
Three-dimensional reconstruction image showing double superior vena cava (SVC) with left SVC draining into coronary sinus.

CONCLUSION

We described a case of Williams-Beuren Syndrome presenting as failure to thrive and diagnosed by MDCT findings, including SVAS, left pulmonary artery stenosis, abnormal coronary arteries, and aortic valve thickening. In Williams-Beuren syndrome, MDCT is a powerful diagnostic tool beyond echocardiography and clinical findings alone, allowing for noninvasive and detailed evaluation of cardiovascular structural and vascular abnormalities.

Conflict of Interest Disclosure:
The authors have completed and submitted the *Methodist DeBakey Cardiovascular Journal* Conflict of Interest Statement and none were reported.

Keywords:
Williams-Beuren syndrome, cardiac CT, congenital heart disease, aorta

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