

Uhl's Anomaly: Case Report and Differential Diagnosis in an Adult

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Introduction

Uhl's anomaly (UA) is a disorder exclusive to the right ventricle (RV) characterized by the absence of total or partial myocardium, in such a way that the ventricular wall is comprised of the overlapping of the endocardium and the epicardium, with no fatty tissue, or inflammatory or infiltrative process. The muscles of the atria, the interventricular septum and the left ventricle (LV) are not involved in the process.^{1,2}

The clinical manifestations are due to right ventricular failure (RVF). Forms with partial involvement may be mildly symptomatic and remain undiagnosed for long periods, and may be confused with other more frequent pathologies that affect the right heart in adult life.^{3,4}

This study presents a case of a middle-aged patient with previously undiagnosed UA, with a discussion of complementary exams and differential diagnoses with pathologies that evolve with the dilation of the right chambers and RVF.

Case report

A 60-year-old female patient, with no comorbidities for 5 years, began progressive RVF, progressing to idiopathic pulmonary arterial hypertension. In the initial investigation, at our health service, a computed tomography (CT) scan was performed, which showed discrete bronchiectasis in both lung bases and preserved vascular structures. The echocardiogram showed a marked dilation of the right chambers, diffuse hypokinesia, and a significant thinning of the RV wall, with few trabeculations, massive tricuspid regurgitation, and a pulmonary artery (PA) with normal dimensions. The left chambers were normal and the LV ejection fraction (LVEF) was preserved (videos 1, 2, and 3). The coronary arteries did not exhibit significant obstructive lesions on cardiac

catheterization, and the pulmonary vasoreactivity test with nitric oxide showed normal pressure in the AP, with equalized pressures in the right chambers. The findings were complemented with cardiac magnetic resonance (CMR), which showed a marked increase in the right atrium (volume of 121 ml/m², reference value: 27ml/m²), dilated and hypocontractile RV — RV end-diastolic volume (RVDV): 118ml/m²; RV end-systolic volume (RVSV): 90ml/m²; and ejection fraction (EF): 24% —, with thinning of the entire free wall, suggesting an absence of myocardium, with a reduction in its trabeculation. No myocardial contrast uptake was observed following delayed enhancement, compatible with the absence of myocardial fibrosis. The left chambers were normal, as were the AP diameters (Figures 1 and 2).

The patient developed advanced signs of RVF, progressive and refractory ascites, in addition to syncope due to advanced atrioventricular conduction disorders, with pauses of up to 5.8 seconds on a 24-hour Holter monitoring, and with pacemaker implantation (Figure. 3). However, the condition was progressive and refractory, and the patient was referred for palliative care, with a fatal outcome within a few months.

Discussion

UA is classified as a congenital heart disease and was described in 1952 by pathologist Henry Stephen M Uhl.^{5,6} Considered a rare disease, with greater occurrence in the pediatric age group, it has fascinated cardiologists around the world due to its great instructive value in relation to other heart conditions. In recent years, it has become more reported beyond the pediatric age group; however, as of 2021, only 15 cases had been described in adult patients.⁷⁻¹³

Understanding RV maladaptation in insults of any etiology is based on the concept of the hemodynamic importance of the supraventricular crest. As long as this muscular structure remains intact, RV systole and tricuspid valve function will remain preserved, even when the other walls are damaged by a given process. Therefore, a possible explanation for UA remaining silent for long periods of life, as in the case described, would be a selective involvement of the muscles, in which the supraventricular crest remained functional, ensuring the maintenance of right cardiac output.^{8,9}

Pathophysiological hypotheses for UA are derived from individual case studies. Genetic substrate as a determining factor in the process is corroborated by the occurrence in family patterns, including those among twins.⁵ Defects

Keywords

Cardiovascular Abnormalities; Heart Ventricles; Diagnosis, Differential

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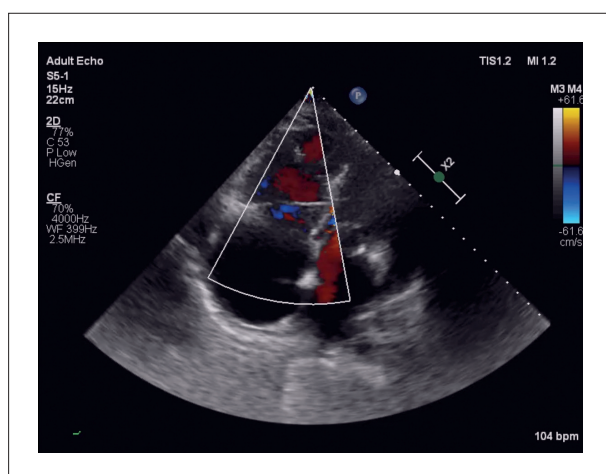
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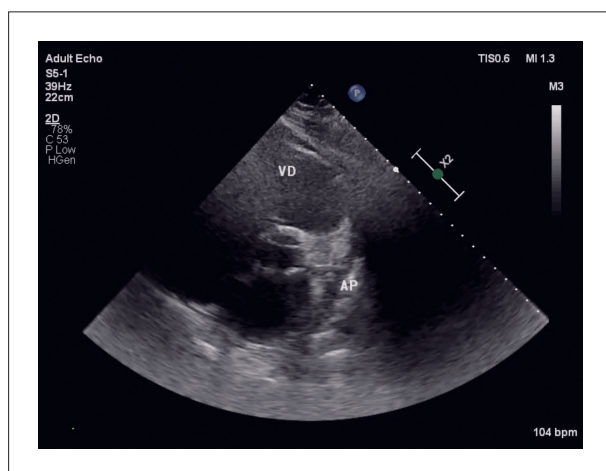
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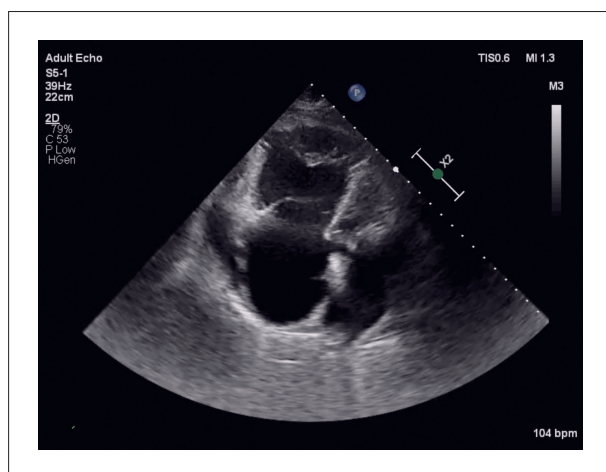
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Video 1 – Link: http://abcimaging.org/supplementary-material/2023/3603/2023-0039_RC_video1_quatro_camaras.mp4



Video 2 – Link: http://abcimaging.org/supplementary-material/2023/3603/2023-0039_RC_video2_eixo_curto.mp4



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in the initial stages of embryogenesis, with failure in the development of the right cardiogenic fold due to an unidentified process, can lead to the congenital absence of myocardium restricted to the RV.⁴ Selective and uncontrolled apoptotic processes after the myocardium has been formed are corroborated by descriptions of serial fetal echocardiograms, in which progressive thinning of the RV anterior wall, inlet tract and apex, and loss of trabeculations during fetal life are detected,^{9,10,11} although electron microscopy and CMR studies have not documented any degree of subsequent myocardial fibrotic degeneration.¹²

The diagnosis must be made based on the clinical picture, associated with imaging methods. In adulthood, treatment-refractory RVF, liver cirrhosis with portal hypertension, sarcopenia, RV aneurysms, arrhythmias, and thromboembolic phenomena are typically observed. Cyanosis can be observed if there is a right-to-left shunt through a patent foramen ovale.^{3,11,13,14} Baseline complementary exams include an electrocardiogram and chest X-ray. The ECG shows nonspecific and varied changes, with low voltage QRS complexes; intraventricular conduction disturbances, generally with right bundle branch block; fragmented ventricular depolarization, corresponding to very slow conduction in the RV; atrioventricular conduction blocks; and ventricular tachycardias and paroxysmal supraventricular attacks, in addition to atrial fibrillation as a very common finding. Chest X-rays commonly show cardiomegaly due to the dilation of the right chambers and the dilation of the vena cava.^{15,16}

The 24-hour Holter and cardiopulmonary test can be part of the evaluation according to the table presented below. There are no reports on the use of nuclear medicine in UA, but the method could be useful in understanding the pathophysiological mechanism of the destruction of the right ventricular myocardium, through the investigation of inflammation, apoptosis, necrosis, cardiac sympathetic activity, and even fibroblast activation. Hence, several mechanisms of muscle destruction can be studied early and non-invasively through molecular imaging.^{17,18}

The echocardiogram usually provides the diagnosis and rules out other possibilities. Characteristically, the left cavities are of normal size, with preserved wall thickness and LVEF. The right atrium is usually markedly dilated, the RV exhibits great dilation and global systolic hypokinesia, and there may be posterior displacement of the interventricular septum during diastole, indicating RV volume overload. The RV wall is markedly thin in circumference, with sparse rudimentary apical trabeculations. The tricuspid ring is quite dilated, with normal insertion, and the leaflets may present mild dysplasia, with restricted movement and complete absence of coaptation, which causes torrential regurgitation and, in more advanced stages, equalization of pressures between the right atrium and the RV. Thrombus formation and slow flow can be observed within the right cavities, in addition to dilation and engorgement of the inferior vena cava and suprahepatic veins, and there may be reverse systolic flow observed on Doppler.^{11,13,15}

Case Report

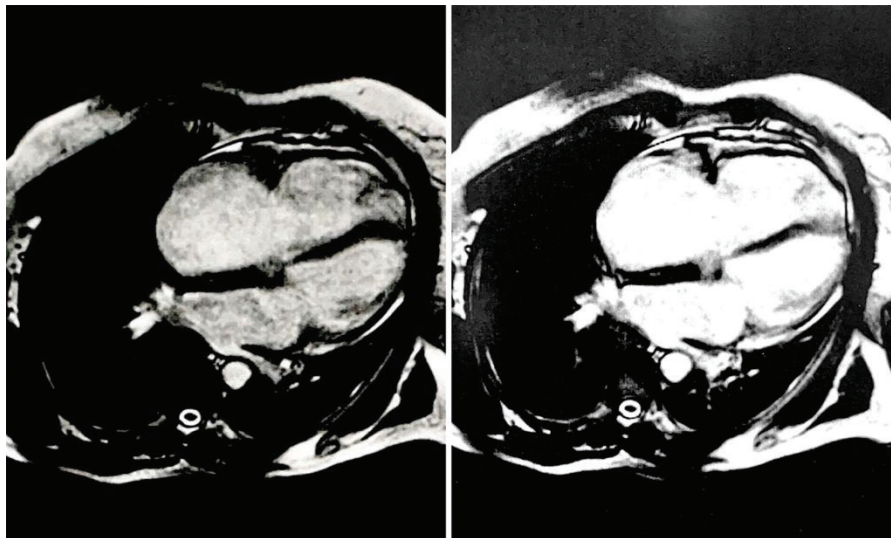


Figure 1 – Cine-RMC 1A and 1B. Horizontal, long-axis, four-chamber image demonstrating absence of myocardium in the RV. Note the straightened interventricular septum and rejected left ventricular cavity. 1B, images acquired late after the administration of gadolinium, without the presence of contrast uptake (absence of late enhancement).

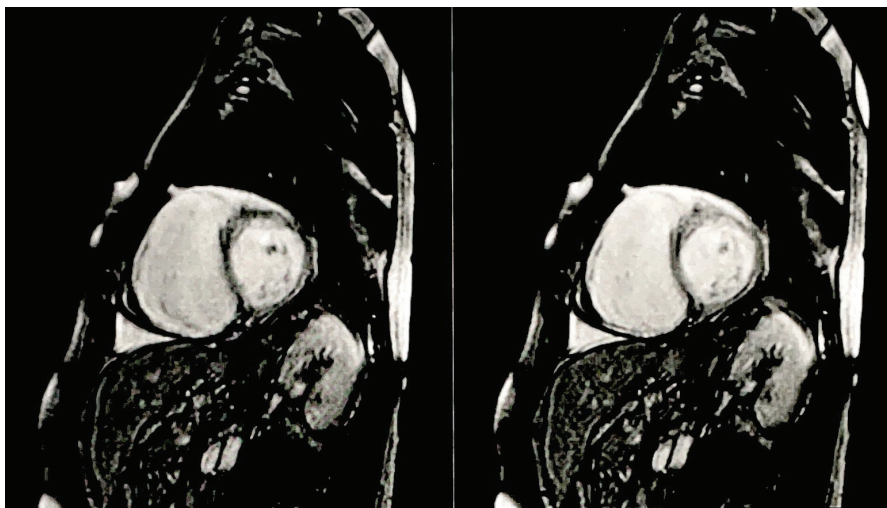


Figure 2 – Cine – CMR section on the sagittal axis weighted in post-contrast T1, with diffuse enlargement of the RV and thinning of the entire free wall due to the absence of myocardium and reduction of trabeculations.

CMR, given its high spatial and temporal resolution, in addition to its three-dimensional nature, has excellent accuracy and reproducibility, and is especially useful in the longitudinal monitoring of patients. The examination demonstrates typical RV dilation, with extremely thin walls due to partial or complete absence of the myocardium, a finding described in anatomical specimens as a “parchment” appearance. There is a shortage of apical trabeculations and the contractile function is severely compromised. The delayed enhancement technique typically shows no

myocardial contrast uptake, indicating the absence of fibrosis, and there are no fatty infiltrations.^{13,16,12} The findings of dilation of the right atrium, normal insertion of the tricuspid valve, deviation to the left of the interventricular septum, and a normal LV can also be seen, similar to what is seen on the echocardiogram.

The less extensive forms of the disease, with partial involvement of the right ventricular cavity, allow for a long asymptomatic phase, with high tolerability of symptoms for decades and late diagnosis,^{10,15,18} with a possible

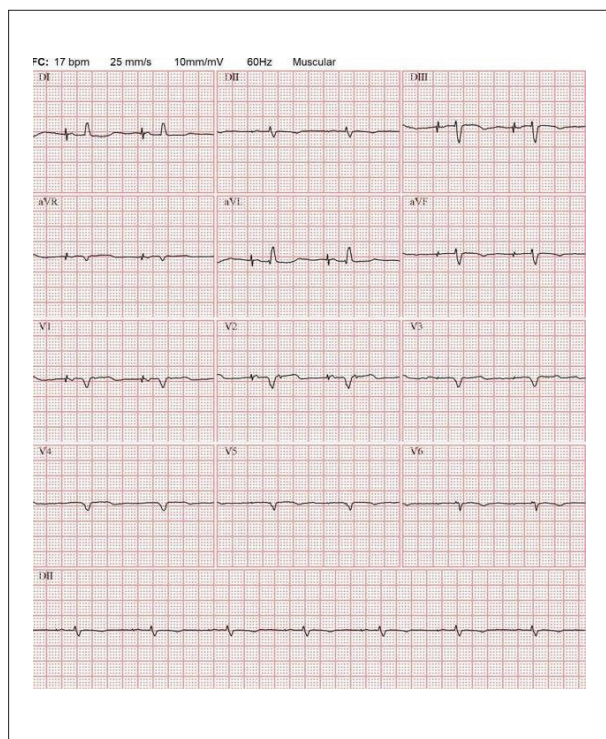


Figure 3 – Electrocardiogram: rhythm controlled by a pacemaker, with low diffuse voltage in the QRS complexes and absence of R waves in the precordial leads.

indication of inadequate treatments due to confusion with pathologies that more frequently affect the right heart in adult life. UA can also be found associated with other cardiac malformations, such as dysplasia and agenesis of the tricuspid and pulmonary valves.¹⁹

Differential diagnosis is made with pathological conditions that result in the dilation of the right heart cavities.^{8,9,20} Idiopathic pulmonary arterial hypertension with RVF can lead to diagnostic confusion, due to the relatively high frequency of the disease in the adult population. Arrhythmogenic RV cardiomyopathy, a rare hereditary disease of the heart muscle that causes sudden death due to arrhythmic events resulting from fibrofatty replacement of the RV myocardium and dilation, is an important differential diagnosis, even from the point of view of pathogenesis.^{3,20} Ebstein's anomaly, a congenital malformation of the tricuspid valve due to the failure of delamination of the septal cusp, also evolves with RV myopathy and arrhythmias.²¹ All of these conditions occur much more frequently than UA and should be considered as a differential diagnosis, both in childhood and in adult life. It is also of interest to differentiate, from a morphological point of view, these forms of serious and potentially lethal involvements of the right heart.

Figure 4 schematically shows the main anatomical characteristics found in the four entities that can establish the differences between them.

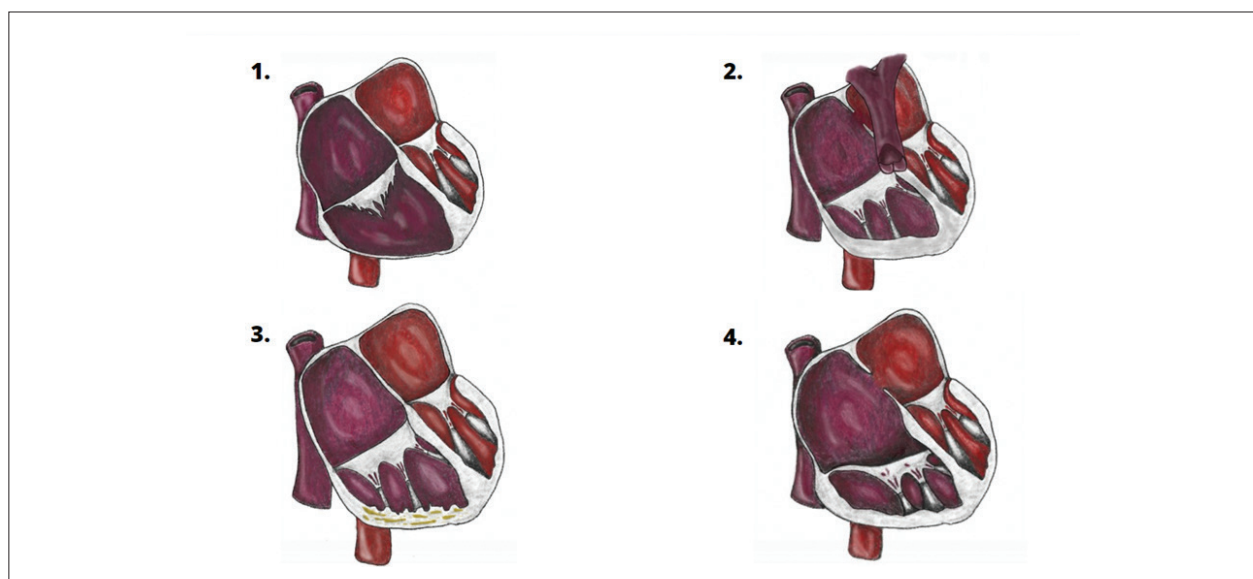


Figure 4 – Schematic drawing illustrating the main anatomical features found in the right heart chambers in UA, pulmonary arterial hypertension, arrhythmogenic RV cardiomyopathy, and Ebstein's anomaly.

4.1. UA: Marked enlargement of the right chambers, thin RV wall, due to absence of the myocardium and few trabeculations, tricuspid valve with normal insertion in the plane of the valve ring.

4.2. Pulmonary arterial hypertension with RVF: enlargement of the right chambers, RV with normal thickness, preserved trabeculations, morphologically normal tricuspid valve, interatrial and interventricular septa with bulges toward the left cavities, dilation of the AP, and inferior vena cava.

4.3. Arrhythmogenic RV cardiomyopathy: enlargement of the right chambers, hypertrabeculation in the apical region, fatty infiltration in the muscles, and normal tricuspid valve.

4.4. Ebstein's anomaly: severe dilation of the right chambers due to "atrialization" of the RV, failure of delamination of the septal leaflet of the tricuspid valve, with apical descent of its orifice, abnormal fenestrations of the anterior leaflet in a "boat sail", and dilation of the right atrioventricular junction.

Conclusion

Advances in complementary imaging methods with the recognition of this rare cardiac anomaly have made diagnosis possible in adult patients. Reporting this case will help disseminate knowledge to professionals involved in the diagnosis and care for these patients, including radiologists, ultrasonographers, neonatologists, pulmonologists, cardiologists, and cardiac surgeons. Recognition, especially in the early stages of asymptomatic forms, may enable more appropriate management and avoid errors in conduct. Screening first-degree relatives enables the identification of asymptomatic carriers and preventive monitoring.

Differential diagnosis with the most common causes of dilation of the right heart chambers is essential in order to avoid errors in conduct, prevent sudden death, indicate surgical treatment when possible, recommend heart transplantation, provide prenatal counseling, and offer palliative care.

Author Contributions

Conception and design of the research: Rocha IEGM; acquisition of data, writing of the manuscript: Rocha IEGM, Siqueira PHB, Rocha BG, Oliveira BF, Martins GEL; analysis and interpretation of the data: Rocha IEGM, Siqueira

PHB, Brandão SCS, Rocha BG, Oliveira BF, Martins GEL; critical revision of the manuscript for intellectual content: Brandão SCS

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Universidade Regional do Cariri (URCA) under the protocol number 65814522.5.0000.5055. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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