Case Series of Berry syndrome: A rare constellation of fatal cardiac anomalies

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ABSTRACT

Berry syndrome is an extremely rare constellation of several congenital cardiac anomalies consisting of aortopulmonary window, aortic origin of the right pulmonary artery (AORPA), interrupted aortic arch or hypoplastic aortic arch or coarctation of the aorta, and an intact ventricular septum with high neonatal mortality rates. The disease is fatal with high mortality (90%) in the neonatal period with surviving patients mostly developing pulmonary hypertension. We describe the clinical presentation and diagnostic clues in two patients with Berry syndrome.

Keywords: Aortic origin of the right pulmonary artery, aortopulmonary window, Berry syndrome, congenital heart disease, interrupted aortic arch

INTRODUCTION

Berry syndrome is an extremely rare condition, consisting of several rare congenital anomalies. Berry syndrome is a combination of aortopulmonary window (APW), anomalous origin of the right pulmonary artery from the ascending aorta (AORPA), interrupted aortic arch (IAA) or hypoplastic aortic arch or coarctation of the aorta, and an intact ventricular septum. These anomalies were never considered a syndrome until Teresa Berry *et al.* published a report of 8 patients in 1982.[1]

The estimated incidence of Berry syndrome within the general population is very rare, constituting 0.046% of all congenital heart defects (CHDs).[1] The disease is fatal with high mortality (90%) in the neonatal period with surviving patients mostly developing pulmonary hypertension (PH). Thus, it is essential to recognize this disease early in its progression to prevent further complications.

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CASE REPORTS

Case 1

A 1-year-old girl with failure to thrive was referred to our institute. There was a history of feeding difficulty and recurrent respiratory tract infection. Differential cyanosis between the upper and lower extremities was observed, with a pansystolic murmur heard at the apex. Electrocardiography showed no specific abnormalities. Chest X-ray revealed increased vascularization of the lungs. Echocardiography assessment [Figure 1a-d] from a parasternal short axis view revealed a large gap between the aorta and main pulmonary artery (MPA) resembling a "butterfly" figure with a bidirectional shunt, the right pulmonary artery originating from the aorta (AORPA), and a patent ductus arteriosus (PDA) with right-to-left shunt with a pressure gradient of 25 mmHg.

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The suprasternal view revealed interruption of the aortic arch distal to all branches of the arch, resembling type A IAA. From the valvular examination, we found moderate tricuspid regurgitation with a tricuspid valve gradient of 40 mmHg, with severe mitral regurgitation and left atrium and left ventricle enlargement. In conclusion, echocardiography examination found a large AP window from proximal to distal, AORPA, IAA, PDA right-to-left (R-L) shunt, and PH. Catheterization study [Figure 2] showed contrast filling the ascending aorta to the MPA via the APW, then filling the right pulmonary artery (RPA) and branches of the aortic arch but stopping before filling the descending aorta (AoD). From the MPA angiography, the contrast filled the left pulmonary artery (PA) and AoD via the PDA. The patient was planned for bilateral PA banding and was given heart failure therapy. Hemodynamic measurement showed high pulmonary vascular resistance. The case was then discussed in the pediatric cardiology surgical conference, and the decision was to perform a two-stage surgery due to the high pulmonary resistance, especially on the RPA. The patient was planned for palliative therapy with bilateral PA banding and preservation of the PDA.

Case 2

A 7-month-old boy with complaints of bluish skin, feeding difficulty, recurrent respiratory tract infections, and failure to thrive came to our outpatient clinic. Differential cyanosis between the upper and lower extremities was observed. Chest X-ray showed increased pulmonary vascularization. Echocardiography assessment [Figure 3] from a parasternal short-axis view found a large echo gap between the ascending aorta and MPA resembling a "butterfly," with the right pulmonary artery originating from the ascending aorta (AORPA). On the suprasternal axis view, an interruption was found on the distal portion of the aortic arch and PDA with a right-to-left shunt to descending aorta. The cardiac computed tomography (CT) [Figure 4] confirmed a large AP window, AORPA, type A IAA, and AoD originating from the MPA via the PDA. The patient was diagnosed with Berry syndrome. A catheterization study was done with the result of high resistance, reactive to oxygen test. The patient was planned for repair surgery and given optimal heart failure treatment.

Box 1: Key messages

The "butterfly" sign in echocardiography is a diagnostic clue of Berry syndrome revealing the APW and AORPA
PH is the natural history of Berry syndrome, mandating catheterization study before any repair intervention of the disease

APW: Aortopulmonary window, AORPA: Aortic origin of the right pulmonary artery, PH: Pulmonary hypertension

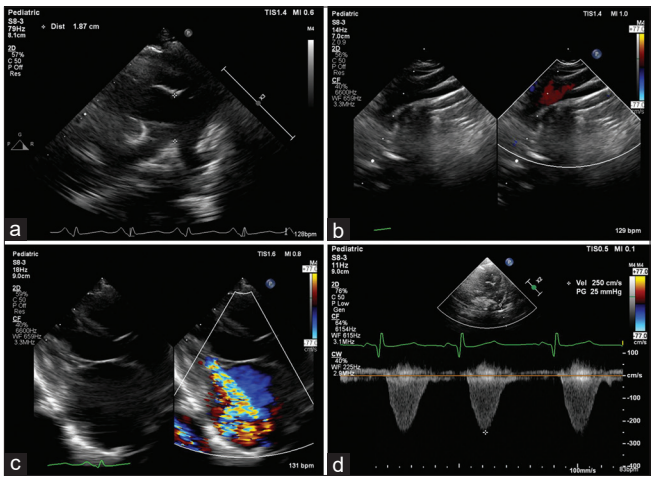

Figure 1: (a) Large gap between the aorta and main pulmonary artery and right pulmonary artery rising from the aorta resembling a "butterfly" figure. (b) Interrupted aortic arch. (c) Severe mitral regurgitation (d) R-L shunt patent ductus arteriosus gradient supplying the descending aorta

DISCUSSION

Berry syndrome is an extremely rare congenital anomaly with an estimated incidence constituting 0.046% of all CHDs. In 1982, Teresa Berry *et al.* found a newly recognized syndrome that had not been reported before. The syndrome comprised an association of distal aortopulmonary septal defect (now known as/APW), anomalous origin of the right pulmonary artery from the ascending aorta (AORPA), intact ventricular septum, and interruption or coarctation of the aorta.[1]

Based on a review by Bi *et al.* which consisted of 52 cases, 59% presented with dyspnea or respiratory tract infection, 40% presented with cyanosis, 39% presented with congenital heart failure or poor peripheral perfusion, and 19% presented with feeding difficulty.[2] In our case, both patients presented with symptoms of lung overflow including recurrent respiratory tract infections, poor feeding, and dyspnea. Both cases also presented with differential cyanosis because the descending aorta was supplied with mixed deoxygenated blood originating from the MPA.

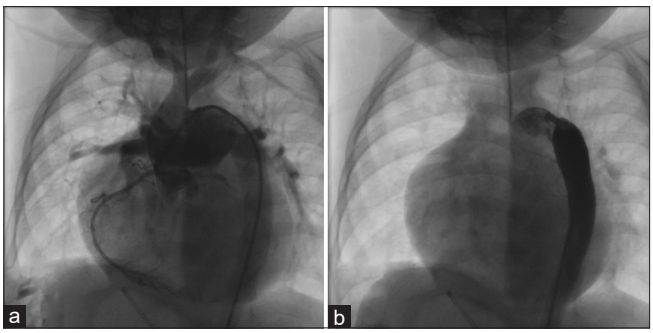

Figure 2: (a) Contrast filling the ascending aorta to the main pulmonary artery (MPA) via the aortopulmonary window, then filling the right pulmonary artery and branches of the aortic arch but stopping before filling the descending Aorta (AoD). (b) MPA angiography, the contrast filled the left pulmonary artery, and descending aorta (AoD) via the patent ductus arteriosus

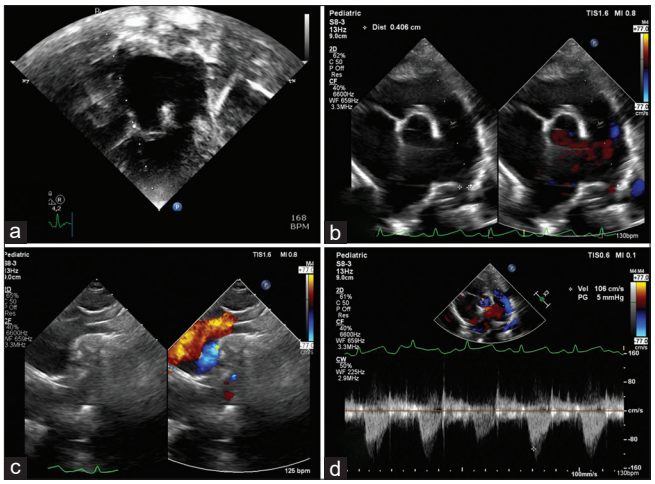

Figure 3: (a) Large gap between the aorta and main pulmonary artery, (b) large gap between the aorta and main pulmonary artery with right pulmonary artery rising from the aorta resembling a "butterfly" figure, (c) Interruped aortic arch, (d) R-L shunt patent ductus arteriosus supplying the descending aorta

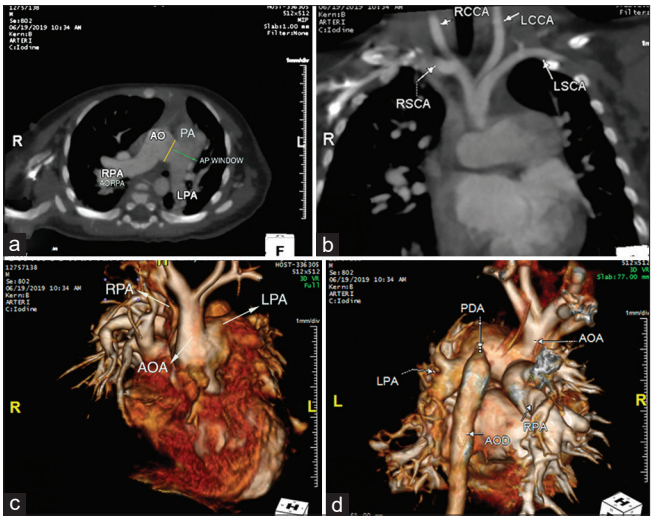

Figure 4: (a) Large AP window with right pulmonary artery (RPA) arising from the aorta, (b) Interrupted aortic arch, (c) three-dimensional (3D) reconstruction showing RPA originating from the ascending aorta, (d) 3D reconstruction showing the connection between the descending aorta and the MPA through the patent ductus arteriosus. RPA: Right pulmonary artery, PDA: Patent ductus arteriosus, PA: Pulmonary artery, AO: Aorta, LPA: Left pulmonary artery, RCCA: Right common carotid artery, RSCA: Right Subclavian artery

Transthoracic echocardiography (TTE) is the initial tool in the postnatal evaluation of Berry syndrome, which is a safe and less invasive modality. Both of our patients were diagnosed mainly by TTE. TTE may show a large echo gap between the aorta and the MPA showing the AP window and also the anomalous origin of RPA from the parasternal short-axis view by the presence of the "butterfly" sign. When a butterfly sign is observed and the diagnosis of AP window and AORPA is made, a detailed echocardiographic examination should be done to confirm the possibility of Berry syndrome.[3] Bidirectional shunt is also observed in the AP window from both cases showing signs of PH. From the suprasternal view, both cases also showed IAA after the left subclavian artery, showing a type A IAA. With the presence of PDA and absence of ventricular septal defect, the diagnosis of Berry syndrome was made. Multi-slice CT may be used to confirm the diagnosis of Berry syndrome since CT has better resolution and can be used to evaluate intracardiac or extracardiac structures or malformations that often complicate the disease.[4]

In the first case, cardiac catheterization was performed not only as a diagnostic modality but also to evaluate evidence of elevated pulmonary vascular resistance.[5] According to some authors, severe pulmonary vascular disease might develop as early as the first 3 months of life due to massive pulmonary blood flow and circulating vasoconstrictors.[2] There are no established guidelines for Berry syndrome specifying the timing of intervention or catheterization, so the decision had to be made based on clinical justification from the symptoms and signs of PH. These lethal constellations made the surgical management more diverse compared to when they occur in isolation. Most centers pursued one-stage surgical correction, but staged repair should be considered in premature or small infants.[6] However, there is still a lack of data reporting outcomes of late-presenter Berry syndrome, especially in infants more than 6 months old.

CONCLUSION

Berry syndrome is a very rare constellation of cardiac anomalies. Patients present with lung overflow symptoms and later present with signs of PH with pathognomonic differential cyanosis. Echocardiography remains the main diagnostic modality with the presence of the "butterfly" sign. While cardiac CT may confirm the diagnosis and assess for other intracardiac and extracardiac anomalies, cardiac catheterization plays an important role in assessing hemodynamic parameters and PH [Box 1].

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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