Dehydration as a Rare Cause of Pulmonary Artery Thrombosis in a 2-Week-Old Term Neonate

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Abstract

Keywords

- pulmonary arterial thrombosis
- neonate
- dehydration
- cyanosis
- pulmonary hypertension

Pulmonary arterial thrombosis is an extremely rare occurrence in the neonatal population. We describe a 2-week-old female neonate who presented in critical condition with severe cyanosis and dehydration and was found to have a large thrombus in the main branches of the pulmonary arteries. She was successfully treated with surgical embolectomy. Pulmonary arterial thrombosis should always be considered in the differential diagnosis of a dehydrated neonate presenting with severe cyanosis and evidence of pulmonary hypertension.

Introduction

Pulmonary thrombosis is rare in neonates. The first description of pediatric pulmonary thromboembolism was by Stevenson and Stevenson in 1949.¹ The risks for developing thromboembolic phenomena among children are highest among the neonatal population due to the considerable differences in the neonatal hemostatic system, such as changes in protein synthesis, protein function, increased clearance, and different platelet function.² Most of the cases described in the literature are due to an underlying disease or to one of many secondary risk factors, such as dehydration, sepsis, polycythemia, maternal diabetes, asphyxia, and indwelling vascular catheters.³ There are several case reports of distinct pulmonary artery thrombosis, most of which are due to an inborn clotting abnormality,^{4,5} or in association with a congenital heart or lung disease.^{6,7}

Such thrombotic events, however rare, are more common in the premature neonates.^{8,9} There are only a few reports of neonates with arterial thrombosis due to dehydration but none with pulmonary arterial thrombosis.^{10,11}

Here, we describe a neonate who was severely dehydrated and developed significant respiratory and cardiovascular compromise following pulmonary artery thrombosis and presented to the pediatric intensive care unit (PICU) in critical condition. She survived to discharge thanks to a definitive diagnosis and aggressive management.

Case

A 2-week-old female neonate was admitted to the PICU due to severe cyanosis. She was a term newborn with normal birth weight and Apgar scores. Although the patient did not have a prenatal follow-up, there were no known perinatal complications. She was of Bedouin/Arab origin, and her parents were second-degree relatives. The mother had had five spontaneous miscarriages in the past and she had not undergone a thrombophilia workup. One daughter had died from an undiagnosed congenital heart defect at the age of 3 years. Our patient had six healthy siblings.

Our patient was presented to another hospital with dehydration, lethargy, hypotension, low oxygen saturation,

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Fig. 1 Color Doppler echocardiogram demonstrating the main pulmonary artery thrombus, at the bifurcation site, with flow around it.

bradycardia, and hypothermia. Initial blood chemistry results showed a sodium level of 154 mEq/L, a creatinine level of 0.71 mg/dL, and a blood urea nitrogen level of 50 mg/dL. Resuscitation efforts led to only partial stabilization. After 24 hours in the PICU, there was evidence of severe pulmonary hypertension along with a right-to-left atrial shunting on cardiac echocardiography. She was started on venoarterial (VA) extracorporeal membrane oxygenation (ECMO) support and transferred to our institute. Upon admission, a repeat echocardiogram revealed normal cardiac anatomy, normal left ventricular function, and an enlarged right ventricle with severely reduced contractility. A 9×4 mm pulmonary arterial thrombus was demonstrated, with evidence of blood flow to both left and right pulmonary arteries (**► Figs. 1 and 2**). A computerized tomographic (CT) angiogram was then performed to evaluate the vasculature (**► Figs. 3 and 4**).

A day after her admission to our PICU, the patient underwent a surgical thrombectomy and was able to be weaned off ECMO support postoperatively. There was a significant improvement in right ventricular function following the surgery. A hemostasis work-up for the mother found that

she had slightly low protein S levels (54% of normal, range 60–150%). An identical hemostatic work-up for the infant showed that she was homozygous for the MTHFR mutation and also had increased levels of β -2-glycoprotein immunoglobulin (IgG, 23.5 U/mL; range 0–15).

On the second week of hospitalization, she suffered cardiac arrest secondary to an acute severe pericardial effusion for which she was resuscitated and underwent an emergent thoracotomy with creation of a pericardial window. In addition, multiple pulmonary emboli appeared several days later which were treated nonsurgically with low-molecular-weight heparin (LMWH). After 2 months of hospitalization, she was discharged without any respiratory support and continued on LMWH treatment. At the hematology follow-up, 7 months later, her hemostatic workup was repeated, which was normal. LMWH treatment was discontinued after her second follow-up, a year after her discharge.

Fig. 2 Two-dimensional echocardiogram demonstrating the size of the pulmonary artery thrombus.

Fig. 3 Axial view of a computerized tomographic angiogram scan showing the arterial thrombus with a near complete occlusion of both the right pulmonary artery (long arrow) and the left pulmonary artery (short arrow).

Fig. 4 Axial view of a computerized tomographic angiogram scan showing the thrombus occluding a significant portion of the right pulmonary artery (arrow).

Discussion

We describe a neonate who presented with severe cyanosis due to a large thrombus in the main pulmonary artery that was diagnosed by an echocardiogram and verified by a CT angiogram. Conventional angiography is considered the “gold standard” for diagnosing thromboembolism in adults, but it is an invasive procedure and usually avoided for neonates and infants. Other modalities such as echocardiography and CT pulmonary angiography (CTPA) are therefore considered more suitable as the initial imaging tests in cases of unexplained cyanosis in neonates. Since echocardiography can sometimes miss certain important diagnoses, as did the first echocardiogram in our case, the preferred method for diagnosing a pulmonary embolism or thrombus is CTPA, and it has long been the recommended method for diagnosis in adults.¹² Moreover, it has become the most common radiologic method for diagnosis in the pediatric population, according to a recent systematic review by Rajpurkar et al.¹³ It should be noted, however, that distinct pulmonary artery thrombosis (also known as pulmonary artery thrombosis in situ) is currently considered a separate entity from pulmonary embolism in children and neonates. Additional diagnostic methods include ventilation/perfusion scans and magnetic resonance imaging angiograms (MRI-As).

The common practice in thromboembolism involves conservative treatments, such as LMWH, unfractionated heparin, and fibrinolytic and thrombolytic agents (e.g., tissue plasminogen activator). However, the decision to take a more aggressive approach, such as surgical embolectomy and catheter-directed thrombus fragmentation, must be seriously considered when delay in treatment could result in severe cardiovascular deterioration. Management choices in children are not clearly defined; however, common practice dictates the use of surgical embolectomy for high-risk patients and the use of anticoagulation in low-risk patients.¹⁴ The choice for surgical embolectomy in our case was made based on the evidence of severe hemodynamic instability caused by the thrombus

that required ECMO support for stabilization, as well as the imaging tests that showed the extent of the vascular occlusion.

The use of CT angiography in our case helped to establish the extent of the thrombus and the involved vasculature, and its application was invaluable for planning the successful surgical treatment.

Although the maternal history was suspicious for thrombophilia, the mother’s blood workup showed only slightly low protein S levels. The finding that the infant was homozygous for a MTHFR mutation does not explain the extensive thrombus formation. In addition, her initial increased levels of β -2-glycoprotein IgG did not confirm the presence of a clotting abnormality, since those levels increase with stressful conditions as a part of the acute phase response and, according to the current guidelines published by Miyakis et al,¹⁵ tests should be repeated several months following the acute event to confirm the presence of antiphospholipid syndrome, as was done in this case.

The specific risk factors that predispose to thrombus formation in otherwise healthy neonates include dehydration, sepsis, polycythemia, maternal diabetes, asphyxia, and indwelling vascular catheters.³ We suspect that our patient’s primary risk factor had been severe dehydration, as was evident from her first physical examination at the first hospital in which she was seen, as well as from her initial laboratory results of hypernatremia and prerenal azotemia. It should be noted that the other risk factors for thrombosis were excluded as she had negative initial blood cultures, no evidence of polycythemia following her original stabilization, and no maternal history of diabetes. In addition, neither there was any history of perinatal asphyxia nor was any history of presence of vascular catheters on her original admission.

Conclusion

Although dehydration among neonates is not uncommon, pulmonary artery thrombosis is rare in this age group. The differential diagnosis of a dehydrated neonate presenting with critical cyanosis and evidence of pulmonary hypertension should nevertheless include ruling out pulmonary artery thrombosis.

Conflict of Interest
None.

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