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Pulmonary artery thrombosis in preterm infants born to a diabetic mother: a case report

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Abstract

Background Pulmonary artery thrombosis in neonates is a rare entity. We describe a neonate with this diagnosis as well as his presentation, evaluation, and management. This case highlights the importance of cardiac ultrasound screening for neonates with high risk factors for pulmonary artery thrombosis without clinical symptoms, as it is not easily detected.

Case presentation Here, we present an unusual case of a Chinese premature infant, born to a diabetic mother, in whom thrombosis developed in the main pulmonary artery 12 days after an exploratory laparotomy. The preterm infant had no clinical manifestations of pulmonary artery thrombosis, which was found by reexamination of cardiac ultrasound before discharge; after treatment with low-molecular-weight heparin sodium, the embolus became smaller, and follow-up examination was conducted after discharge, and the baby is now developing well.

Conclusion Pulmonary artery thrombosis is rare in newborns, and asymptomatic manifestations are even rarer in this age group. For newborns with high risk factors, early cardiac ultrasound screening is very important.

Keywords Pulmonary artery thrombosis, Premature infant, Diabetic mother

Background

Pulmonary artery thrombosis (PAT) is rarely reported in preterm neonates. The incidence of thrombosis in neonates is increasing because of early recognition of the condition and advances in the supportive care of neonates at high risk. Arterial thrombosis accounts for 24–34% of clinically apparent thromboses in newborns, and the estimated incidence is 0.25 per 10,000 live births [1]. The risks for developing thrombosis phenomena among children are highest among the neonatal population owing 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 literature are due to an underlying disease or to one of many secondary risk factors, such as maternal diabetes, sepsis, polycythemia, asphyxia, and indwelling vascular catheters [3].

PAT is rare and likely to be underdiagnosed in the neonatal period. The clinical presentation is variable, and the signs and symptoms can mimic those of other morbidities, including persistent pulmonary hypertension, congenital heart disease, and respiratory failure [1, 4]. Such thrombotic events, albeit rare, are more common in premature neonates with life-threatening clinical manifestations [5, 6], but PAT without clinical manifestations has not been reported in neonates. Herein, we present an unusual case of a premature baby, born to a diabetic mother, in whom thrombosis developed in the main pulmonary artery 12 days after an exploratory laparotomy. The preterm infant had no clinical manifestations, and PAT was found by reexamination of cardiac ultrasound before discharge.

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Case presentation

A male Chinese infant was born by cesarean delivery owing to acute fetal heart-type intrauterine distress at 35 weeks plus 4 weeks of gestation, to a 33-year-old gravida 1, para 1 mother. He was admitted to the neonatal intensive care unit (NICU) for treatment immediately after birth. His mother had poorly controlled type 2 diabetes mellitus, and high blood pressure and obesity during pregnancy. No evidence of congenital malformations was found on prenatal ultrasounds. No family history of spontaneous thrombosis was known. The birth weight was 3690 g, large for gestational age. After birth, he displayed dyspnea and poor responsiveness. Chest radiograph revealed a full heart shadow. Brain natriuretic peptide (BNP) was > 5000.00 pg/ml, and a blood coagulation routine test showed a D-dimer of 2240 ng/ml. The infant was noninvasively ventilated to assist ventilation. An echocardiogram at 10 hours of life revealed right ventricular dilatation and hypertrophy with flattening of the ventricular septum, consistent with persistent pulmonary hypertension of the neonate (PPHN). It also showed left atrial dilatation and left ventricular enlargement.

The infant developed abdominal distension less than 24 hours after birth, and was progressive on the fourth day after birth. The symptoms were obvious abdominal pain, palpation crying, and painful facial appearance with no stool. Abdominal radiograph showed obvious intestinal gas. The umbilical vein catheter was pulled out. The pediatric surgeon recommended exploratory laparotomy to exclude congenital intestinal malformations, such as intestinal atresia. With the consent of family members, surgery was performed on the same day under general anesthesia. The whole intestine was flatulent with yellow exudate in the abdominal cavity; no obvious organic lesions were observed during intraoperative exploration. Intraoperative blood pressure was unstable, and dopamine and dobutamine were given as pressure-enhancing treatments. Postoperative endotracheal intubation was performed before the infant was transferred back to the neonatal ward. The endotracheal intubation was removed 2 days after the operation and replaced with a noninvasive ventilator, being discontinued 5 days after the operation.

An echocardiogram at 5 days of life revealed left ventricular hypertrophy and right ventricular hypertrophy with no PPHN. Peripherally inserted central catheter (PICC) was performed 3 days after the operation. The baby's heart rate increased to 200–210 beats/minute that day, and electrocardiograph (ECG) examination showed supraventricular tachycardia (SVT). The PICC position was adjusted, and a beta-blocker, betalloc, was administered orally once; the baby's heart rate then gradually decreased to normal. Partially hydrolyzed milk powder feeding was started 4 days after surgery. Feeding was tolerated, and total enteral nutrition was achieved 10 days after surgery.

Cardiac ultrasonography (Fig 1A) was performed before discharge, 12 days after the operation. The echocardiogram showed an abnormal echo of the main pulmonary artery (and thromboembolus formation was considered), left ventricular hypertrophy, right ventricular hypertrophy, mild mitral regurgitation, and mild tricuspid regurgitation. The internal diameter of the main pulmonary artery was normal, and a hyperechoic mass, with size of 1.3 cm × 0.9 cm, was seen at the distal bifurcation of the main pulmonary artery. The shape was normal, and the location was fixed. The left pulmonary artery was slightly obstructed. Blood coagulation routine tests showed: D-dimer of 1480.00 ng/mL, fibrinogen of 3.42 g/L, prothrombin time of 13.00 seconds, activated partial thromboplastin time of 33.40 seconds, and thrombin time of 19.40 seconds. Low-molecular-weight heparin sodium (150 IU/kg per day) was used subcutaneously for anticoagulant symptomatic treatment, and no obvious thrombosis of upper or lower limbs was observed by ultrasonography. Regular reviews of cardiac ultrasound (Fig 1B) and blood coagulation routine screening were used to guide the application of low-molecular-weight heparin sodium, resulting in a smaller thromboembolus than before treatment. An echocardiogram (Fig. 1C) conducted 5 weeks subsequent to the identification of the thrombus revealed a main pulmonary artery thromboembolus (indicated by a red arrow). The diameter of the main pulmonary artery was normal. The external dimensions of the aberrant echogenic mass located at the distal bifurcation measured approximately 1.1 cm × 0.6 cm, exhibiting a reduced thickness compared with the initial posttreatment assessment. The core showed hyperechogenicity and had dimensions of roughly 0.5 cm × 0.4 cm, being slightly diminished in size from the initial post-treatment assessment, with no significant alteration in its position. In addition, the blood coagulation profile was essentially normal. Low-molecular-weight heparin sodium was reduced to 50 IU/kg per day. Brain magnetic resonance imaging was consistent with brain changes in the neonate at the corrected gestational age of 42 weeks plus 4. The neonate was discharged home on daily subcutaneous low-molecular-weight heparin. At present, during follow-up after discharge, routine blood coagulation screening and cardiac ultrasonography are performed weekly. Computed tomography (CT) angiogram (Fig. 1D) showed no dilation or filling defect in the pulmonary aortic trunk and pulmonary arteries after 4.5 months.

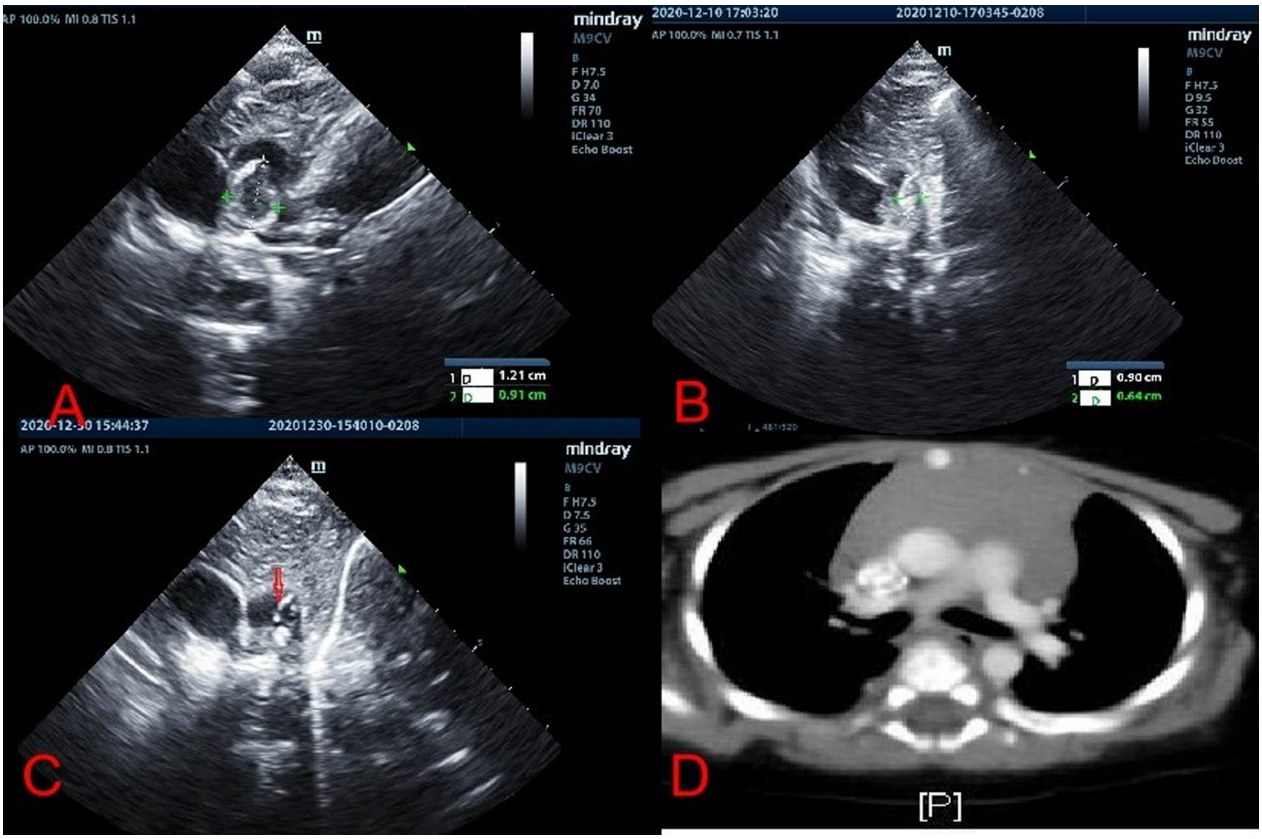

Fig. 1 **A** Echocardiogram showing abnormal echo of the main pulmonary artery, normal internal diameter of the main pulmonary artery, and a hyperecho mass with size of 1.3 cm × 0.9 cm at the distal bifurcation of the main pulmonary artery. **B** Echocardiogram showing that the thromboembolus was smaller than before (0.9 cm × 0.6 cm). **C** Echocardiogram conducted 5 weeks after the identification of a thrombus revealing a main pulmonary artery thromboembolus (red arrow). The external dimensions of the aberrant echogenic mass located at the distal bifurcation measured approximately 1.1 cm × 0.6 cm. The core, characterized by hyperechogenicity, had dimensions of roughly 0.5 cm × 0.4 cm. **D** The computed tomography angiogram showed no dilation or filling defect in the pulmonary aortic trunk and pulmonary arteries after 4.5 months

Gene analysis of hemostasis and thrombotic diseases found no gene variants related to clinical manifestations, all of which is sufficient evidence of a cure.

The final diagnosis was pulmonary artery thrombosis in a preterm neonate born to a diabetic mother, complicated by neonatal asphyxia, postoperative status following exploratory laparotomy, supraventricular tachycardia, and neonatal respiratory distress syndrome.

Discussion

PAT is a rare disease in childhood, especially in the neonatal period, and has been rarely reported abroad, and pulmonary embolism may be present. The clinical manifestation is not typical and easy to misdiagnose or overlook. The current data available on modes of presentation in neonates with pulmonary artery thrombosis are very limited. There are case reports of neonatal pulmonary arterial thrombosis presenting as PPHN in newborns and in respiratory failure [7, 8]. Neonatal arterial thrombosis presenting as congenital heart disease, particularly coarctation of the aorta, has also been reported [9], and spontaneous neonatal pulmonary arterial thrombosis has also been reported [10].

Risk factors are arteriovenous catheterization, infection, arrhythmias, diabetic mothers and newborns, dehydration, pulmonary hypertension, asphyxia, polycythemia, surgery, and congenital heart disease. The risk of thrombosis is increased for several reasons: (1) the relatively low flow of the infusate through the catheter compared with full-term infants, (2) the size of the catheter relative to the vessel is such that it occupies a more significant portion of the cross-sectional area of the vessel, and (3) decreased plasma levels of antithrombin III and plasminogen and, consequently, an impaired ability to lyse thrombi [11]. Echocardiography is important in the diagnosis of acute pulmonary embolism, showing direct signs and intermittent signs. The former can diagnose the thrombosis in the main pulmonary artery, and the left and right pulmonary arteries directly.

The latter presents as enlargement of the right ventricle, left ventricular septum shifts, left ventricle decrease, right ventricle movement decrease, pulmonary artery widening, tricuspid regurgitation, and pulmonary artery pressure increase. The diagnosis of pulmonary thrombosis in our case, as well as in other recent reports, was first suspected on the basis of abnormal findings on an echocardiogram [1, 7].

Treatment of neonatal pulmonary embolization mainly includes anticoagulation with heparin, low-molecular-weight heparin, or thrombolytic therapy with tissue plasminogen activator, surgery, and catheter-based embolectomy [7]. A systematic review provided no conclusions about the most appropriate treatment, as no eligible studies were found [9]. Thrombolytic therapy seems to be the most preferred treatment option, particularly in the case of hemodynamically compromising pulmonary embolism [11, 12].

In this case, there was no abnormality in the main pulmonary artery during the first and fifth day of admission. On the 12th day after surgery, the ultrasound showed an abnormal echo of the main pulmonary artery, and thromboembolus formation was considered. This was a typical direct sign of ultrasound diagnosis and did not need to be differentiated. Possible causes of thrombosis are as follows: Firstly, enlargement of the heart and thickening of the right ventricle resulted in decreased compliance of the right heart. Increased heart rate leads to a relative decrease in cardiac output, changes in hemodynamics, and changes in the direction of blood flow near the bifurcation of the main pulmonary artery confluence, which are important factors for thrombosis. Secondly, factors such as having a diabetic mother and undergoing surgery during the early neonatal period were present. Other factors, including umbilical catheterization, PICC, and SVT, are more complicated. The thrombosis gradually became significantly smaller after heparin thrombolysis. The infant was stable after 5 weeks, and his blood routine and coagulation routine tests were normal. The patient was followed up once a week to monitor cardiac ultrasound and coagulation routine, and the dose of heparin was adjusted in the clinic.

Conclusion

The symptoms and signs of neonatal PAT lack specificity and vary widely from asymptomatic to hemodynamic instability, and even sudden death. It is suggested that clinicians should dynamically monitor the ultrasonography of children with high risk factors for PAT to detect pulmonary artery thrombosis early and enable timely treatment to prevent pulmonary embolism.

Abbreviations

EEG	Electrocardiography
PAT	Pulmonary artery thrombosis
PICC	Peripherally inserted central catheter
PPHN	Hypertension of the neonate
SVT	Supraventricular tachycardia

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Author contributions

YXY and XHM drafted the initial manuscript. MLL critically reviewed and edited the manuscript. LWG was responsible for the cardiac ultrasound examination. LXH and LLL critically reviewed and edited the manuscript, and supervised the study. All authors significantly contributed to the work and approved the final manuscript as submitted.

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Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Written informed consent was obtained from the patient's legal guardian for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors declare that they have no competing interests.

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