CASE REPORT

Congenital limb deficiency requiring transfemoral amputation

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SUMMARY

A healthy female infant was born from a twin pregnancy with an isolated congenital lower extremity malformation. Aside from prenatally diagnosed polyhydramnios, the infant had normal prenatal and postnatal diagnostic workup. She underwent transfemoral amputation and healed uneventfully. Congenital limb anomalies may be the result of an unidentified amniotic band, thromboembolic event or twin–twin transfusion syndrome, though in this case, prenatal screening did not indicate any evidence of a limb anomaly and postnatal workup was negative.

BACKGROUND

Congenital limb reduction or deficiency can affect 7 out of every 10 000 newborns.^{1 2} The aetiology can be highly variable, including de novo mutations, chromosomal abnormalities, genetic syndromes, teratogens, vascular occlusion, fetal cardiovascular abnormalities and intrauterine structural abnormalities.^{2–7} Intrauterine abnormalities including oligohydramnios, amniotic bands and twin–twin transfusion syndrome may lead to isolated limb deficiencies. The limb anomalies can vary widely and include constriction bands, fingertip necrosis, syndactyly and amputation of an entire extremity.^{6–8} We present a case of an otherwise healthy infant who was born with a unilateral lower extremity deformity with soft tissue underdevelopment and necrosis distal to the proximal thigh with hypoplastic, non-viable osseous structures.

CASE PRESENTATION

The patient is an otherwise healthy 9-hour-old girl born via scheduled caesarean delivery at 36 weeks, 6 days twin gestation to a healthy mother who had two prior caesarean deliveries. The twins were mono-chorionic and diamniotic. Pregnancy and delivery were uncomplicated. Weight at birth was 2148 g. Immediately after birth, the patient was noted to have an obvious deformity of her right lower extremity, with an exposed hypoplastic femur, tibia, fibula and foot. Distal to the clear demarcation line at the proximal thigh, there was no overlying viable soft tissue or neurovascular structures (figure 1). The femur length at birth as measured on the radiograph was 5.8 cm. The foot measured 3.5 cm from heel to toes on pathological examination. Radiographs revealed an underdeveloped femur, tibia, fibula and foot, as well as dislocated knee and ankle joints (figure 2). Vascular ultrasound examination

on the first day of life showed borderline abnormal and resistive blood flow in the unaffected left lower extremity, aorta and renal artery Doppler signals. This did not require further follow-up. The unaffected twin weighed 2275 g at birth and had no abnormalities on physical examination.

INVESTIGATIONS

Routine ultrasound studies in the prenatal period were performed every other week from weeks 13 to 21, followed by weekly ultrasounds until delivery. While the twins did have amniotic fluid discrepancy first noted at 22 weeks that progressed to isolated polyhydramnios in the affected fetus diagnosed at 25 weeks, the criteria for twin–twin transfusion syndrome were never met and umbilical cord vasculature was normal in both twins. On prenatal ultrasound scans, there was no mention of any abnormality of the lower extremities of either twin. There were no other abnormalities. Though the infant did not have other evidence of thromboembolic disease, to evaluate for thrombosis as a possible cause of the limb anomaly, laboratory studies were performed 2 days after birth to assess for coagulopathy, specifically by testing protein C and S levels, factor VIII activity, antithrombin III levels, antiphospholipid antibodies, lipoprotein(a) level and homocysteine level. These were within normal limits. The patient's genetic workup to evaluate for hypercoagulability, specifically for factor V Leiden and prothrombin gene mutations, was unremarkable.

DIFFERENTIAL DIAGNOSIS

Several conditions have been described as causes of limb anomalies in utero. Amniotic band syndrome is the most common condition leading to in utero amputation, but generally results in intrauterine resorption of amputated structures.^{7 9 10} Other described causes of limb anomalies leading to a gangrenous residual limb include thromboembolic events and twin–twin transfusion syndrome.^{6 11}

TREATMENT

On the first day of life, the patient underwent a transfemoral amputation at the level of the proximal thigh (figure 3). Pathology examination revealed an underdeveloped extremity, but did not reveal any osseous abnormalities. Examination of the placenta and umbilical cord did not show any significant abnormalities.

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Figure 1 Clinical photographs of the lower extremity deformity.

OUTCOME AND FOLLOW-UP

The patient healed uneventfully after the transfemoral amputation (figure 4). At 1 year follow-up, the patient had no further issues.

DISCUSSION

Intrauterine gangrene of the limb is an uncommon event with relatively few documented cases.¹² Hypercoagulability, as seen in conditions such as polycythaemia or factor V Leiden, has been reported to cause thromboembolic events leading to intrauterine extremity gangrene as well as cerebral infarction.^{3 6 13} Our patient had no genetic mutations known to result in coagulopathy and no evidence of haematological abnormalities. Extremity ischaemia can also be caused by placental infarcts, cardiac anomalies such as tetralogy of Fallot or maternal conditions including hypertension and diabetes.^{4 5 13 14} Syndromes associated with lower extremity deficiency are rare and associated with other abnormalities, often in the kidney, hands and craniofacial structures.¹⁵ The lack of osseous or histological abnormalities, aside from underdevelopment, without any genetic or additional physical abnormalities make a syndrome-associated congenital limb deficiency unlikely.

Twin–twin transfusion syndrome is also identifiable on prenatal ultrasound using flow velocity Doppler signals; however, no signs of abnormal Doppler signals were present in this infant.^{16 17} This condition leads to a multitude of abnormalities for both twins, with the recipient twin at higher risk for polycythaemia and hyperviscosity, which could lead to arterial thrombosis and decreased perfusion to the extremities resulting in gangrene.^{8 11} In monochorionic twins, in utero acquired limb ischaemia is higher than the general population, and can

Figure 2 Radiograph of the lower extremity deformity revealing dislocated knee and ankle joints, minimal soft tissue about the lower extremity and hypoplastic femur, tibia, fibula and foot bones.

Figure 3 Immediate postoperative photographs after transfemoral amputation.

occur with or without twin–twin transfusion syndrome.¹⁸ Fetoscopic surgery also has utility in treating twin–twin transfusion syndrome diagnosed in the prenatal period by selectively coagulating placental vessels.¹⁹ This patient did have polyhydramnios, and though she was evaluated for possible coagulation of placental vessels, she did not meet the criteria for twin–twin transfusion syndrome and the perinatologist determined that intervention was not indicated.

We present a case of a healthy infant with isolated lower extremity malformation that was not detected in utero and ultimately required proximal transfemoral amputation. However, there is subjectivity in evaluating prenatal ultrasounds, which is unreliable in diagnosing extremity defects, and up to 75% of extremity defects are missed prenatally.²⁰ Moreover, prenatal screening by ultrasound is less accurate in twin pregnancies.²¹ The foot measurement of 3.5 cm is consistent with a gestational age of 20 to 21 weeks based on anatomic studies of stillborn infants, suggesting the insult to the patient's leg occurred near that time.^{22 23} The 5.8 cm-long femur is consistent with a gestational age of 30 weeks; however, only part of the femur was involved in the exposed dysplastic leg.²⁴ Postnatal workup was negative and prenatal screening was only definitive for isolated polyhydramnios. Given the polyhydramnios, it is possible that the patient had subclinical twin–twin transfusion syndrome. As the recipient twin became polycythaemic, an arterial thrombus may have formed, roughly around 20 to 21 weeks based on the foot length at birth. This time estimate is within 2 weeks of the gestational age when amniotic fluid discrepancy was noted between the twins. A large arterial thrombus at the level of the midfemur would have led to soft tissue necrosis and the

Figure 4 Photograph of healed amputation.

cessation of development of the extremity distal to that point. This lack of soft tissue development in addition to increased intrauterine pressure secondary to polyhydramnios may have led to joint malformation explaining the patient's knee and ankle dislocations. Treatment was performed early to prevent systemic infection from the unviable extremity and the patient's first year of life was without further complications.

Learning points

- Prenatal imaging must be reviewed carefully, especially if any abnormalities such as polyhydramnios are present.
- Polyhydramnios may be a sign of subclinical twin–twin transfusion syndrome.
- Even in the absence of twin–twin transfusion syndrome, a monochorionic twin may have a limb anomaly.

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