

CASE REPORT

Sirenomelia: two cases in Cali, Colombia

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SUMMARY

We report two cases of sirenomelia, a rare congenital defect with a prevalence rate of 1:100 000 births; both cases were observed in Cali, Colombia. Both pregnant women were referred from Buenaventura, Colombia. The expecting mothers shared multiple adverse sociodemographic factors. Their homes were located in a city where the entire population is of low socioeconomic status living under conditions of extreme poverty. They were uneducated, with nutritional deficiencies and no access to drinking water most of the time. Both were exposed to water and fish from a nearby river contaminated with leachate from a poorly managed landfill. A similar relation was previously reported in Cali in 2005 between environmental factors and sirenomelia. We suggest that there is a common aetiological factor of environmental origin between these two sirenomelia cases and propose that exposure to derivatives from landfills should be included among the factors for this rare defect of multifactorial aetiological origin.

CASE PRESENTATION**First case**

A 33-year-old primigravida woman from Buenaventura, at 28 weeks gestation, according to her last menstrual period, with estimated conception date 12/20/2011, was living under low social class conditions without access to clean drinking water. She frequently used water from the nearby river for personal hygiene and daily requirements. She had an incomplete elementary level of education and held government subsidised health insurance. She had been referred to Cali, Colombia, due to findings of an ultrasound reporting high-resistance flow of the left uterine artery, intrauterine growth restriction (IUGR) and oligohydramnios; she also presented severe preeclampsia. She had four antenatal follow-up appointments during her pregnancy. An O'Sullivan test reported normal glycaemic levels; none of the other prenatal screening tests revealed any anomalies. An ultrasound performed on admission to the institution in Cali reported anhydramnios, pulmonary hypoplasia, IUGR and a single umbilical artery (SUA); findings suggested a possible diagnosis of sirenomelia. The patient was rushed into the operating room and a caesarean section was performed. The premature newborn weighed 930 g (percentile 3–10), had an Apgar score of 5/10 at the first minute and 0/10 at 5 min, presented dolichocephaly, absence of external genitalia and anus, fused lower limbs and fused feet (figure 1) with oligodactyly (two toes on each foot) (figure 2). In addition to the morphotype abnormalities, the autopsy described renal hypoplasia, atrophic bladder and urethra, blind bowel and ovarian tissue. The X-ray showed sacral agenesis, paired femora and tibiae and a single fused fibula,

classified as type II sirenomelia according to Stocker and Heifetz classification (figure 3).¹

Second case

A 32-year-old woman, on her second pregnancy, at 37 weeks gestation according to her last menstrual period and with estimated conception date 10/22/2011 living under low social class conditions without access to clean drinking water. She frequently used water from the nearby river for personal hygiene and daily habits. She also had an incomplete elementary level of education and held government subsidised health insurance. She had been referred from Buenaventura to Cali, Colombia, for further fetal evaluation. She started antenatal control at 14 weeks and continued it for 6 weeks; neither the glucose curve nor any of the prenatal screening tests carried out showed alterations. Her medical history revealed an episode of fever and vesicular skin rash lasting at least 5 days during the first trimester of the current pregnancy. Additionally, she had four ultrasounds reporting IUGR. On arrival at Cali, an ultrasound confirmed IUGR, and oligohydramnios and a caesarean section were performed. The newborn weighed 1970 g (less than percentile 1), with Apgar score of 7/10 at the first minute, 3/10 at 5 min and 0/10 at 10 min. The infant presented Potter's face, a SUA, absence of genitalia and anus, fused lower limbs (figure 4), fused feet in extreme dorsiflexion, with oligodactyly eight toes, with lateral location of the hallux. The baby had monopus according to Forster (figure 5).² X-ray showed vertebral dysgenesis (L4–L5), sacral agenesis, fused femora in their proximal two-thirds and a single fibula. The case was classified as type IV sirenomelia according to Stocker and Heifetz (figure 6).¹ Shortly after birth 3 cc of blood was taken from the umbilical



Figure 1 Case 1, newborn with sirenomelia. Note dolichocephaly, absence of genitalia and a single midline limb.



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Figure 2 Case 1, distal end of lower limbs of newborn with sirenomelia dipus according to Forster classification. Notice oligodactyly two toes each foot.

cord but cellular growth was not achieved in the lymphocyte culture, therefore it was not possible to carry out the karyotype. The newborn's parents did not give consent to perform an autopsy.

GLOBAL HEALTH PROBLEM LIST

- ▶ Sirenomelia is a rare congenital defect for which the pathophysiology and aetiology have not been conclusively determined.
- ▶ Economic poverty and adverse sociodemographic conditions have been associated with congenital anomalies.



Figure 3 Case 1, X-ray of newborn with sirenomelia type II—according to Stocker and Heifetz classification. Note paired femora and tibiae and a single fibula.



Figure 4 Case 2, newborn with sirenomelia. Note low-set ears, absence of genitalia, fused lower limbs at midline and fused feet in extreme dorsiflexion.

- ▶ Sirenomelia cases have been reported from mothers who have been exposed to polluted water due to the inappropriate disposal of trash from mishandled landfills.

GLOBAL HEALTH PROBLEM ANALYSIS

The global prevalence of sirenomelia is 0.98 in 100 000 births, as reported by The International Clearinghouse for Birth Defects Surveillance and Research. The data were gathered from 19 birth defect surveillance system members, who identified 249 cases with sirenomelia out of 25 290 172 reported births.³

Among the possible factors associated with increased risk of sirenomelia, maternal diabetes is the only maternal disease found.⁴ In the cases being reported, the mothers did not present any alterations in the glycaemic tests performed during the antenatal control, eliminating diabetes as the aetiological agent. Furthermore, exposure to teratogens, such as retinoic acid, cadmium, cyclophosphamide, cocaine and the antiepileptic drug lamotrigine, has been previously reported in association with sirenomelia.³ The patients in this report did not ingest any of these agents. On the other hand, risk decreases with advancing maternal age⁵; the gestating mothers were in their early 30s, therefore the cases were presented within a non-increased prevalence age group (0.87/100.000 births, 95% CI 0.63 to 1.17) for sirenomelia.⁵

The sirenomelia findings might be explained by two main hypotheses that can account for the abnormal development of



Figure 5 Case 2, distal end of lower limbs of newborn with sirenomelia monopos according to Forster. Notice fused feet in extreme dorsiflexion, eight toes and lateral position of hallux.

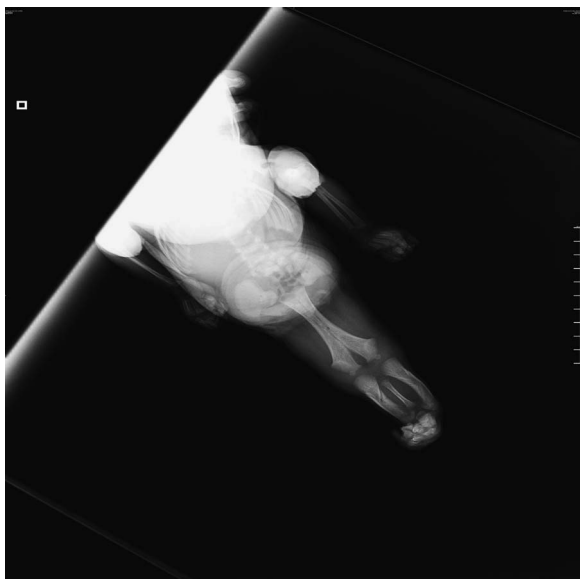


Figure 6 Case 2, X-ray of newborn with sirenomelia. Type IV according to Stocker and Heifetz classification. Note femora partly fused and a single fibula.

the embryo. These hypotheses are: the vascular steal hypothesis and the defective blastogenesis hypothesis.³ The vascular steal hypothesis suggests the existence of an anomalous vessel impeding proper blood flow to the caudal end of the embryo.^{6, 7} One of the most important early findings in prenatal imaging is a SUA of abnormal origin, with SUA of vitelline origin being considered characteristic of sirenomelia.⁸ SUA is the most common abnormality of the umbilical cord and largely associated with cardiac and urogenital malformations.⁹ Also associated with SUA is an unusual narrowing of the aorta and privation of several of the branches that normally provide sufficient blood supply to the kidneys and genitalia and the caudal part of the fetus in general.¹⁰ Both of the reported cases presented a SUA, suggesting that a vascular event necessarily took place in both embryos.

Table 1 Sirenomelia classification

Classification system	Limbs	Feet
(A) Stocker and Heifetz ¹		
Type I	Paired femora, tibiae and fibulae	
Type II	Single fibula	
Type III	Absent fibulae	
Type IV	Femora partly fused, single fibula	
Type V	Femora partly fused, absent fibulae	
Type VI	Single femur and tibia	
Type VII	Single femur, absent tibiae	
(B) Förster ²		
Apodal symmelia (apus)	Fused, one femur and one tibia	None
Monopodal symmelia (monopus)	Partially fused, two femora or two tibiae	One foot or severe fusion of both feet
Dipodal symmelia (dipus)	Non-fused femora and tibiae	Two feet

The defective blastogenesis hypothesis suggests a primary anomaly in the mesoderm that the caudal end of the embryo will derive from.¹¹ This will produce renal, sacral, genitourinary and lower limb abnormalities.¹¹ Sirenomelia sequence was classified by Forster in 1865 based on the absence or presence of feet. In 1987, Stocker and Heifetz grouped the syndrome into seven types of semicontinuous progressive levels of severity based on the presence of skeletal structures of thighs and legs (table 1). Our first case presented two femora, tibiae and single fibula (figure 3) and partially fused feet (figure 2), it was classified as type II according to Stocker and Heifetz and dipus according to Forster. The second case presented fused femora in their proximal two-thirds, tibiae, single fibula (figure 6) and severely fused feet (figure 5), it was classified as type IV according to Stocker and Heifetz and monopus according to Forster.

The relationship between adverse social determinants and risk for congenital anomalies has been described previously in the world and in Latin America specifically. The living conditions of the mother at the time of conception, such as her health status, nutritional condition, educational and socioeconomic level, age, number of previous children, number of prenatal visits and type of insurance, among other factors, can critically influence the perinatal outcome. These factors may precipitate a specific exposure such as diabetes or drug use in the periconceptional period and affect the development of the embryo in the period of organogenesis.^{12, 13} Both mothers in the cases reported lived in a city where the entire population is of low socioeconomic status living under conditions of extreme poverty. They were uneducated, with nutritional deficiencies, and did not have basic facilities such as access to drinking water.

In 2008, ECLAMC reported a non-random, time-space cluster of four sirenomelia cases in the city of Cali, Colombia, within a 55 day period, born at a single maternity hospital in 2004–2005, after the expecting mothers' were exposed to a polluting active landfill along the Cauca River, the most probable aetiological common factor.^{14–16} Both the cases of sirenomelia being reported were engendered within a period of 8 weeks during the last trimester of 2011, with a distance between their homes no greater than 2 km in Buenaventura; this city is located on the west coast of Colombia, 122 km from Cali (where the prior cluster was reported during 2004–2005). The expecting mothers did not have any exposure to the active landfill along the Cauca River located in Cali. However, the city of Buenaventura also has a landfill that, similarly to the reported landfill of Cali, does not have appropriate structural conditions and of which the management is poor. The leachate from the landfill drains to a stream that is less than 300 m away from it, rendering changes in the ecosystem, particularly in fish. This stream drains to the Dagua River, which is the main water source of the region and of the city of Buenaventura.

What these cases have in common with the former cases are the geographical proximity of the patients (they did not change residences during the periconceptional period). During their normal daily activities they were exposed to the river that flows near their homes, where they would wash their clothes and perform personal hygiene activities. Other considerable factors are their low social and economic conditions with consequent nutritional deficiencies due to a non-balanced diet and the consumption of fish from the Dagua River. Being a very rare congenital defect it is unlikely that there is no existing relation between these two cases. In these women we postulate that the sum of nutritional deficiencies and exposure to leachate from the landfill in the nearby river by the consumption of fish and/

or direct contact with the water had an aetiological relationship with the fetuses with sirenomelia.

Learning points

- ▶ The two reported cases shared geographical proximity of patients, close-dated estimated conception dates, low social and economic conditions with nutritional deficits and exposure to a contaminated river by an inadequately managed landfill.
- ▶ Two cases of sirenomelia are described, the first type II and dipus, and the second type IV and monopus, according to the classification of Stocker and Heifetz, 1987, and Forster, 1865.
- ▶ We propose that as sirenomelia is a rare defect of multifactorial aetiology, exposure to landfill derivatives should be included among the aetiological factors.

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Competing interests None.

Patient consent Obtained.

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