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CASE REPORT

ANTENATAL DETECTION OF SIRENOMELIA – A CASE REPORT WITH REVIEW OF LITERATURE

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ABSTRACT

Sirenomelia is a rare congenital anomaly of caudal regression of body characterised by variable fusion of lower limbs associated with genitourinary, gastrointestinal, cardiovascular, neural tube anomalies in most cases. We report a case of sirenomelia diagnosed antenatally in 2nd trimester with associated bilateral renal agenesis and marked oligohydramnios with single umbilical artery. Our aim is to review the literature available in order to make earlier diagnosis and terminate pregnancy safely in advance.

INTRODUCTION

Sirenomelia (mermaid syndrome) was originally described by ROCHEAS in 1542 and PALFYA in 1553 and named after mythical Greek Siren. [1]The Sirens were three creatures with head of a woman and body of a bird from the wings down. They narcotized sailors with enchanting music and voices to kill them and thus were dangerous. These bird-women were portrayed as aquatic creatures and eventually with a full mermaid like appearance. [2]HOMER explained the tempting singing creatures that seduced sailors to their deaths for first time. [1] Most striking finding of this malformation is complete or partial fusion of lower limbs. Most of sirenomelia cases come to an end as still births. [1] Only few of them have been cited to be alive after birth. [1, 3]It is a rare congenital malformation with an incidence of between 1 in 60000 [4] and 1 in 100,000 births. [5] Males are predominantly affected with sex ratio of 2.7:1. It is seen commonly in one of the two monozygotic twins. [5] Single or fused lower limbs with associated severe lethal anomalies like bilateral renal agenesis is characteristic of this anomaly in vast majority of cases. [6] Minor renal abnormalities or even normal kidneys have been reported in exceptional cases in surviving newborns. [5] It is commonly associated with agenesis of external genitalia and anorectal atresia.

Case report

A 22 years old mother was referred for anomaly scan in 5th month. There was marked oligohydramnios with crowding of foetal parts. Hence, it was difficult to evaluate all foetal parts. Placenta was posterior. Head appeared flattened from side to side likely due to marked oligohydramnios. Small foetal stomach was seen due to marked oligohydramnios. Urinary bladder was persistently not seen. Bilateral kidneys were not seen in renal fossae suggestive of bilateral renal agenesis (Figure 1). Both upper limb long bones were normal. Separate two femora and two tibia & fibulae were not visualized. Instead, a single femur split in its distal two thirds with only two leg bones were seen (Figure 2, 3, 4). Single foot was seen, however evaluation of bones in foot was difficult due to marked oligohydramnios. Abnormal sacral curvature with sacral dysgenesis was noted (Figure 5). Rest of spine was normal. Color Doppler showed single umbilical artery (Figure 6). Foetal biometry corresponded to 19 weeks gestation.

A diagnosis of Sirenomelia (Type IV or V) with bilateral renal agenesis and marked oligohydramnios. Termination of pregnancy was done. The aborted foetus (figure 7) confirmed findings of sirenomelia.

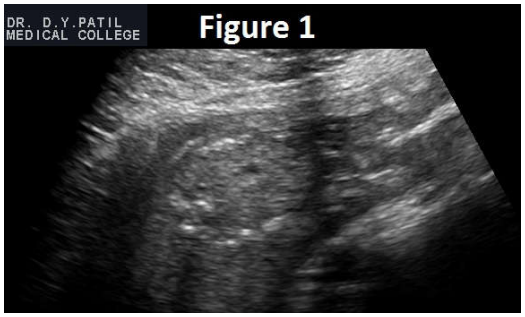


Figure 1showing bilateral renal agenesis.

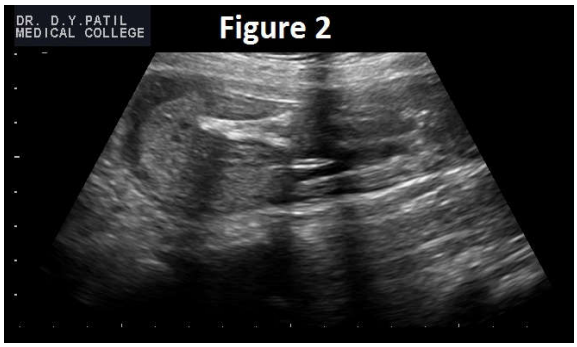


Figure 2 Longitudinal image of thigh showing (USG) 2 femora fused proximally and forked distally. Soft tissue shadow around these bones forms the common thigh.

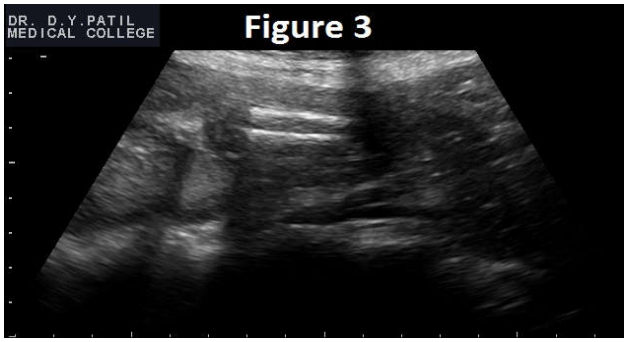


Figure 3 Longitudinal image of leg showing 2 tibiae lying parallel to each other forming a common leg.

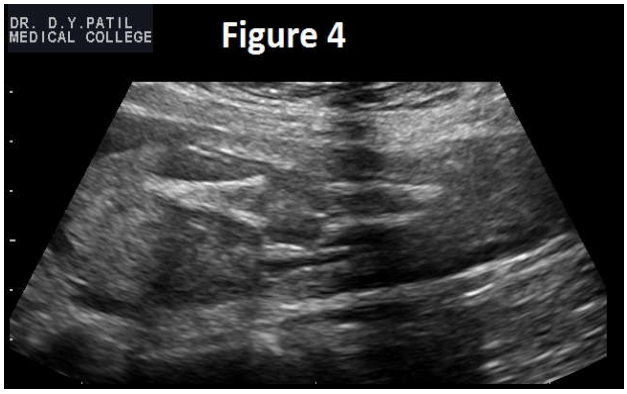


Figure 4 Longitudinal image of thigh and leg showing common thigh (with 2 femora fused proximally) and common leg (showing 2 tibia parallel to each other).

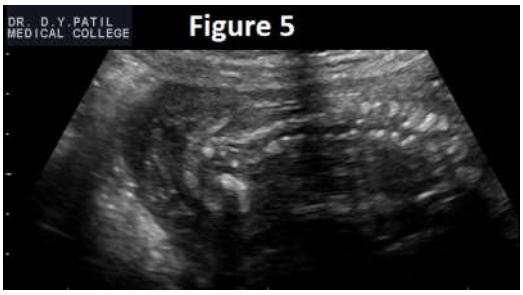


Figure 5 Longitudinal image of spine showing abnormal sacral curvature with sacral dysgenesis.

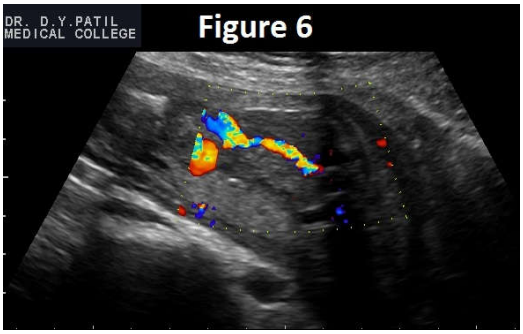


Figure 6 Color Doppler showing single umbilical artery.

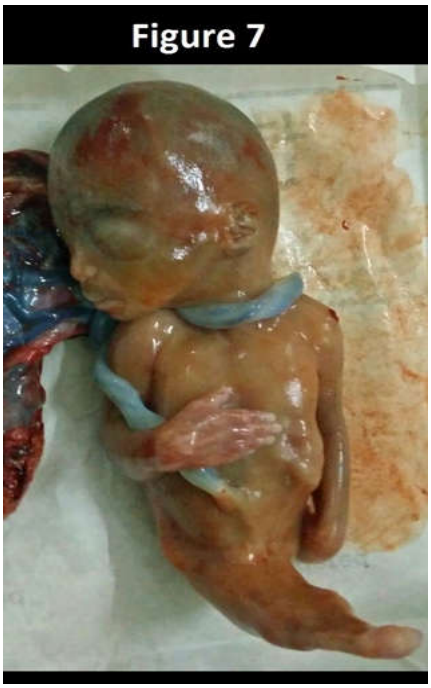


Figure 7 showing post-delivery sirenomelic foetus.

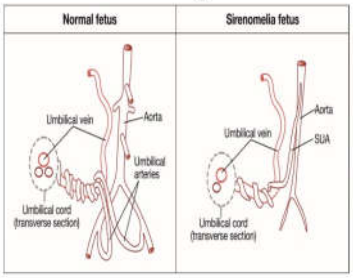
DISCUSSION

Risk factors: Different theories like genetic and environmental factors are noted. [1, 7] Teratogenic agents like lead and cadmium elements may cause sirenomelia in golden hamster. Teratogenic effect of vitamin A, cocaine and radiation exposure is also mentioned. There is an association of sirenomelia with new reproductive technologies like ICSI (intra cytoplasmic sperm injection).It is reported in twins with 100-150 times higher incidence in monozygotic twins. No chromosomal defects are discovered in sirenomelia. Risk of recurrence of sirenomelia is 3-5 %. [1] Hence, genetic counselling should be suggested.

Etiopathogenesis: Primary defect at molecular level underlying sirenomelia is unknown. However, certain hypothesis can explain the causal mechanisms. [1, 2]

1. An embryological insult (Defective blastogenesis). Caudal mesoderm damage occurs between 28-32 days of foetal life resulting in renal agenesis, imperforate anus, lack of genital organs, vertebral dysgenesis and lower limb atrophy.
2. Vascular steal theory/hypothesis. Single umbilical artery of vitelline origin diverts blood flow to placenta with resultant severely deficient circulation to lower part of body. It steals blood from structures located inferior to its origin from tissues of caudal part of foetus (Figure 8). Deficient blood flow and nutrient supply to caudal mesoderm result in agenesis of midline structures and fusion of lower limbs. However, the evidence gathered is not sufficient to establish abnormal vascular pattern as primary cause. Possibility of an earlier indifference with developmental event is likely.

Figure 8



Vascular pattern in a normal versus sirenomelia fetus. Schematic drawing of the fetal umbilical cord vasculature in a normal and a sirenomelia fetus. Note the abnormally high origin of the SUA in sirenomelia and the hypoplasia of the aorta caudal to its origin.

Courtesy - Garrido-Allepuz C1, Haro E, González-Lamuño D, Martínez-Frías ML, Bertocchini F, Ros MA. A clinical and experimental overview of sirenomelia: insight into the mechanisms of congenital limb malformations.Dis Model Mech. 2011 May;4(3):289-99. PMID: 21504909.

3. As part of caudal regression syndrome – A rare congenital anomaly – features include misplaced lower limbs, urinary incontinence, sacrum dysgenesis and spinal cord defect. Inconstant features are renal dysgenesis and imperforate anus.
4. As part of VACTERL syndrome (vertebral defects, anal atresia, cardiac defects, trachea-oesophageal fistula and limb abnormalities). A major overlap is observed in phenotypic features of sirenomelia and VACTERL.
5. External forces acting on caudal extremity – like lateral compression of caudal body by amniotic folds and medial compression by over distension of neural tube. This theory is not accepted on the whole.

Since all cases of sirenomelia in humans were sporadic cases, it is likely to have a combined genetic and environmental component. High incidence of sirenomelia is observed in diabetic mothers and those with exposure to heavy metals. [8]

Clues for antenatal ultrasound diagnosis: Bilateral renal agenesis in sirenomelia causes severe oligohydramnios which hinders evaluation of lower extremity on USG in 2nd and 3rd trimester. In few cases, bilateral renal agenesis is the only antenatal sonographic finding, and diagnosis of sirenomelia is made after termination of pregnancy. Marked oligohydramnios is a sonographic marker of bilateral renal agenesis or non-functioning kidneys from 2nd half of pregnancy onwards. In earlier stage of gestation, other contributors to production of amniotic fluid are present. Hence, detection of abnormal lower limbs can be done in early 2nd trimester due to adequate amount of liquor. Other findings include absence of urinary bladder, anorectal atresia, undetermined external genitalia, lumbo-sacral agenesis, abnormalities involving abdominal wall, hypertrophy of right ventricle occurring in later stages due to renal agenesis and oligohydramnios and two vessel umbilical cord. In presence of bilateral renal agenesis, malformed lower limbs and single umbilical artery early antenatal diagnosis of sirenomelia may be suspected. These sonographic signs are readily apparent in 18th week of gestation in presence of adequate liquor, beyond which marked oligohydramnios hinders diagnosis of malformed lower limbs. Early diagnosis allows termination of pregnancy at early stage with minor risk and discomfort for the mother. [5]

Malformations associated with sirenomelia [2]
Visceral malformations [6] – 1) Variable degree of renal and urethral dysplasia, with total renal agenesis most frequently reported.2) Ectopic renal tissue in pelvis reflecting as defect in normal migration of metanephric tissue.3) Genital malformations – eitherindistinct tag of tissue or absent. Gonads are usually unaffected.4) Gastrointestinal anomalies – imperforate anus, rectal atresia and blind ending colon.

Vascular abnormalities/ malformations- [2] vascular abnormalities in sirenomelia play a role in pathogenesis. Sirenomelia foetus have a single umbilical artery which has an abnormal origin, branching of abdominal aorta high in the abdomen immediately below the coeliac branch. Aorta distal to origin of single umbilical artery becomes abnormally narrow and lacks number of branches that normally supply the kidney, large intestine and genitalia.Single umbilical artery in sirenomelia is called persistent vitelline artery due to possible derivation from vitelline plexus thus distinguishing from other causes of single umbilical artery that are found in about 1 % of newborns with normal origin and no other malformations. [9]

The presence of single umbilical artery of vitelline origin is considered as characteristic and pathognomonic of sirenomelia, thus differentiating it from caudal regression syndrome. Occasional cases of sirenomelia with two symmetrical umbilical arteries of abnormal origin and single umbilical artery of normal origin have been reported. [10]

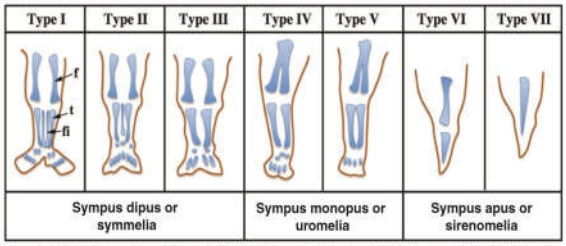
Other associated malformations – 1) Lumbosacral and pelvic malformations – commonly observed include sacral agenesis, malformed vertebrae and hemivertebrae with corresponding anomalies of CNS. [6]2) Malformations of upper part of body – occur less frequently – they include cervical and upper thoracic vertebral anomalies, cleft palate, cardiac defects and pulmonary hypoplasia. [11]

Difference between Sirenomelia and Caudal regression syndrome (CRS).

Characteristic findings	Sirenomelia	Caudal regression syndrome
Umbilical artery	Single aberrant	Two
Lower limbs	Single or fused extremities	Two, hypoplastic
Renal anomalies	Agenesis, dysgenesis	Non-lethal
Anus	Absent	Imperforate/ Normal
Amniotic fluid	Reduced	Normal/ increased

Sirenomelia is usually incompatible with life due to visceral abnormalities and deaths occur in perinatal period. A few exceptional cases have survived recently owing to presence of functional kidney and reconstructive surgery to restore pelvic organs and separate the legs. [2] These babies had normal neurological development.Classification of sirenomelia. [2]

Figure 9



Schematic depicting the seven types of sirenomelia. Classification is according to Stocker and Heifetz (Stocker and Heifetz, 1987). Alternative nomenclatures, used more frequently in the past, are indicated underneath. f, femur; fi, fibula; t, tibia. Adapted from Stocker and Heifetz (Stocker and Heifetz, 1987)

Courtesy - Garrido-Allepuz C1, Haro E, González-Lamuño D, Martínez-Frías ML, Bertocchini F, Ros MA. A clinical and experimental overview of sirenomelia: insight into the mechanisms of congenital limb malformations.Dis Model Mech. 2011 May;4(3):289-99. PMID: 21504909.

STOCKER and HEIFETZ classified sirenomelia into type I to type VII according to presence of skeletal elements in thigh and leg. [6]Figure 9.

1. All thigh and leg bones are present.
2. Single fibula.
3. Absent fibula.
4. Partially fused femurs and fused fibulae.
5. Partially fused femurs.
6. Single femur, single tibia.
7. Single femur, absent tibia.

In type I (mildest form), all bones in the two fused limbs are present with fusion affecting only superficial tissues. In type VII (most severe form) only a single bone is present with no indication of legs or feet.

Other classifications which focus on degree of development of fused legs denoted by presence of feet is essentially abandoned. It is classified as

1. Sympusdipus (Symmelia) – Two feet were present.
2. Sympusmonopus (Uromelia) – Only one foot is discernible.
3. Sympusapus (sirenomelia) – No evidence of distal foot element.

The severity of fusion negatively correlates with integrity of feet with most severe cases typically presenting with fewer or even absence of toes.

CONCLUSION

Sirenomelia is a rare congenital lethal anomaly. Early antenatal diagnosis is needed for timely therapeutic abortion. Clues for antenatal diagnosis in early and late second trimester in the presence of normal liquor and marked oligohydramnios respectively must be known for its timely detection.

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