Case Report

Anatomy

A Fatal Case of Potter's Syndrome- A Case Report

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ABSTRACT

Potter's Syndrome is a rare congenital disorder which is diagnosed at birth. It refers to a group of findings which are associated with the lack of amniotic fluid due to renal failure in an unborn infant. It is characterized by the typical physical appearance of a foetus, which is associated with pulmonary hypoplasia. In oligohydramnios, the foetus is not cushioned from the walls of the uterus. The pressure of the uterine wall leads to an unusual facial appearance, abnormal limbs, or limbs that are held in abnormal positions or contractures. The foetus will die soon after the birth due to respiratory insufficiency.

Key Words: Potter's Syndrome, oligohydramnios, Potter's facies, pulmonary hypoplasia.

INTRODUCTION

Potter's Syndrome refers to the typical physical appearance of a foetus which is associated with pulmonary hypoplasia as a direct result of kidney failure. After 16 weeks of gestation, the amount of amniotic fluid which is present, mainly depends on the foetal urine production. In normal foetal development, the foetus continuously swallows the amniotic fluid, which then gets reabsorbed by the gastrointestinal tract and is then reintroduced into the amniotic sac by the kidneys. Oligohydramnios occurs if the volume of the amniotic fluid is less than normal for that period of gestation. This may be due to decreased urine production which is caused by bilateral renal agenesis or the obstruction of the urinary tract and the occasional prolonged rupture of the membranes[1]. The foetal urine is critical for the proper development of the lungs by aiding in the expansion of the airways, the alveoli by means of hydrodynamic pressure and by also supplying Proline, which is a critical amino acid for lung development. If the alveoli and thereby the lungs, are underdeveloped at the time of birth, the infant will not be able to breathe air properly and will go into respiratory distress shortly after the birth due to pulmonary hypoplasia. This is the primary cause of death in the Potter's Syndrome infants, which is secondary to renal failure. The foetal urine also serves to cushion the foetus from being compressed by the mother's uterus as it grows. The resulting oligohydramnios is the cause of the typical facial appearance of the foetus, which is known as "Potter's facies" which consists of a flattened nose, recessed chin, epicanthal folds and low-set abnormal ears [2]. The underlying cause of this condition is often undetermined, but is genetic in some cases, and the inheritance pattern depends on the specific genetic cause. It is more common in infants with a positive family history of kidney malformation.[3] It has a fatal outcome and is incompatible with life, but the Potter's sequence due to a non-renal cause has a higher survival rate. Though it is rare, it is believed to be more common because the infants are either stillborn or may die soon after the birth. There is no known prevention for this fatal condition. So, an ultrasound screening for oligohydramnios and the absence of the foetal kidneys is recommended for couples with a previous affected pregnancy between 16-18 weeks of gestation, so that the termination of the pregnancy may be offered before it becomes viable. If the baby survives, it has to be resuscitated at delivery and treated for any urinary outlet obstruction, but the outcome is poor.[3]

CASE REPORT

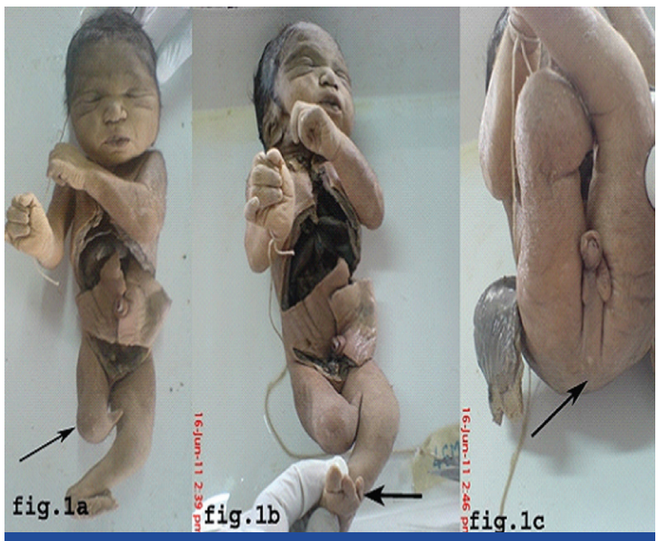
A stillborn, male foetus was brought to the Department of Anatomy, MIMS, Nellimarla. On examination, the foetus was found to have caudal acromelia of the right lower limb [Table/Fig.1a] and congenital talepus equino varus with trifid toes on the left side [Table/Fig.1b]. The foetus had a flattened nose and low set ears. Hypoplasia of the external genitalia was observed, which showed a micropenis, cryptorchidism and anal atresia (imperforate anus) [Table/Fig.1c].

The foetal autopsy revealed a liver of normal size, with an embedded gall bladder. The differentiation of the gastrointestinal tract upto the sigmoid colon and undivided cloacae were associated with the anomalies of the genitourinary system (urogenital dysplasia). The kidneys were cystic, with no renal parenchyma [Table/Fig.2a]. The ureters of both the kidneys were joined together in the pelvis and they opened on the posterior aspect of the cloaca [Table/Fig.2b]. The cloaca was undivided, having a common opening into the penis [Table/Fig.2c]. The patent urachus was present.

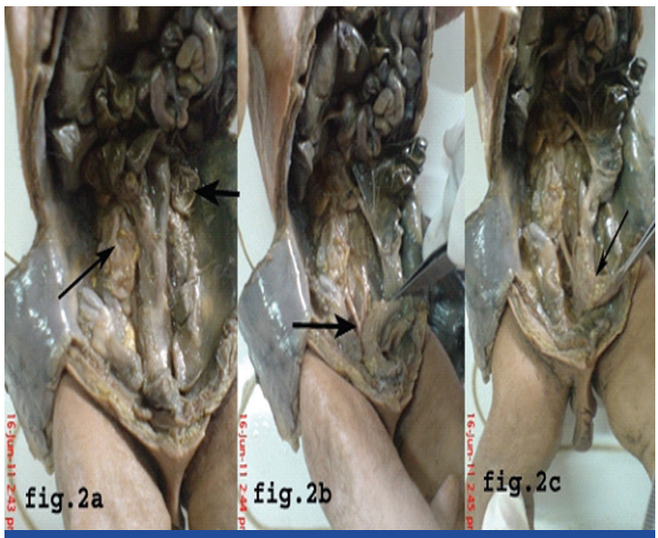
In the thorax, the heart was small in size, which was associated with pulmonary hypoplasia [Table/Fig 3a]. The arch of the aorta showed four branches from the right to the left; they were, the right common carotid artery, the left common carotid artery, the left subclavian artery and the right subclavian artery [Table/Fig-3b]. The right subclavian artery was the last branch which came from the posterior aspect of the arch which passed in front of trachea behind the superior vena cava[Table/Fig-3c].

DISCUSSION

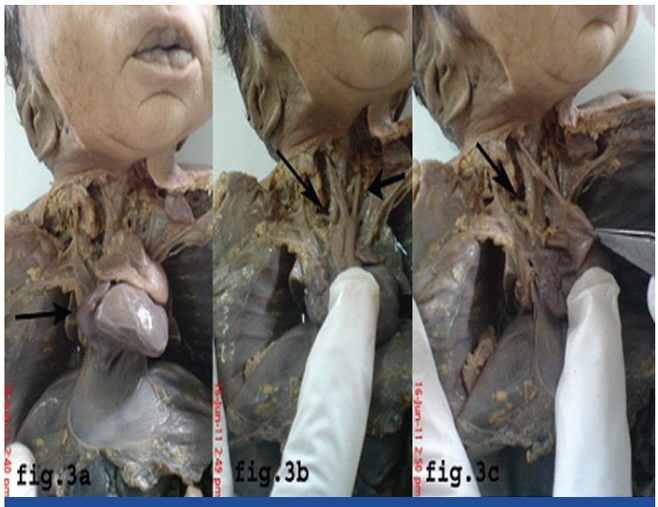
The 'Potter's syndrome' was described by Edith Potter [4] in newborns with bilateral renal agenesis or other kidney abnormalities, including renal aplasia, dysplasia, hypoplasia, or multicystic disease. Potter found the incidence of this syndrome to be 1 in 4,000 births, with a predominance in males. The male to female



[Table/Fig-1]: 1a-Showing caudal acromelia,
1b- Showing trifid toes,
1c- Showing imperforate anus



[Table/Fig-2]: 2a- Showing cystic kidneys
2b- Showing union of two ureters
2c- Showing undivided cloaca



[Table/Fig-3]: 3a- Showing hypoplasia of lungs
3b- Showing four branches from arch of aorta
3c- Showing right subclavian artery as the last branch of arch

ratio was 2:1, suggesting that certain genes of the Y-chromosome could act as modifiers. Potter's syndrome can also be seen in infants with normal kidneys due to the prolonged leakage of amniotic fluid during the middle gestational weeks[5] .The nonrenal features of Potter's syndrome include altered facies, aberrant hand and foot positioning, late foetal growth deficiency, and pulmonary hypoplasia, which are known as the oligohydramnios tetrad, as they are the consequence of foetal compression due to prolonged oligohydramnios [6]

Scott and Goodburn[7] found no renal malformations in 50% autopsied second- or third-trimester foetuses with the features of Potter's syndrome There was a high incidence of chorioamnionitis, suggesting that the mechanism of oligohydramnios was occult amniotic fluid leakage.

The ultrasonographic findings of foetuses with severe kidney disease from 23 families showed persistent oligohydramnios, severely decreased or absent renal function, and the features of Potter's syndrome and the affected infants usually died within hours to days after their birth [8] .

Genetic abnormalities like autosomal recessive polycystic kidney disease, autosomal dominant polycystic kidney disease, hereditary renal adysplasia which may be due to mutations in the RET gene and the UPK3A gene and chromosomal abnormalities may cause developmental abnormalities which may lead to Potter's syndrome. This syndrome occurs sporadically, but when it is caused due to the autosomal dominant triad, it may be inherited.

A majority of the possible pathways are autosomal recessive in nature and additionally, these candidate pathways would be expected to involve the genes which are expressed in the developing urogenital system (UGS).[1] [9]

Knudsen[10] reported a 38-year-old man with unilateral renal agenesis and an ipsilateral seminal vesicle cyst, whose sister had embryologically analogous malformations, a Gartner duct cyst, a bicornuated uterus, and renal agenesis. Buchta et al. [11] postulated a relationship between renal adysplasia and vaginal atresia, which is also known as the Mayer-Rokitansky-Kuster syndrome. Schimke and King[12] observed a three-generation transmission of renal agenesis-dysgenesis with a uterine anomaly. The woman was found to have a didelphic uterus with a blind-ending left vaginal pouch, and an absent left kidney. She subsequently gave birth to a premature female infant who had dolichocephaly, low-set ears, and a deformed nose. The baby died soon after its birth. Its autopsy showed pulmonary hypoplasia and nearly total renal agenesis. The vagina, uterus, and the fallopian tubes were grossly normal. The woman's father had unilateral renal agenesis. These findings suggested that developmental defects in the mesonephric and the paramesonephric ducts may have a common genetic basis and Schimke and King used the term 'hereditary urogenital adysplasia' for the combination of anomalies of the mullerian duct with developmental errors of the urinary tract.

Non working or mutated genes on the long arm of chromosome 10(10q) result in the abnormal development of the urogenital tract. [13]

Ogata et.al [14]reported ten Japanese patients with the monosomy of chromosome 10q26, six patients had urinary anomalies such as vesicoureteral reflux and hypoplastic kidney, and 8 had genital anomalies such as micropenis, hypospadias, cryptorchidism, and hypoplastic labia majora. Miyamoto et al [15] found defects

of urogenital development in mice who lacked the Emx2 genes on the distal 10q chromosome. Skinner et al. [16] identified 10 different heterozygous mutations in the RET gene. In vitro functional expression studies showed that the mutations resulted in either constitutive RET phosphorylation or absent phosphorylation. Yang et al. [17] observed a significant association between the primary vesicoureteral reflux and a G691S polymorphism in the RET gene among French Canadian patients with Potter's syndrome. The stillborn foetus which was under study was a destitute (unclaimed child, without parents), which was brought to the department and as such, his prenatal history could not be probed. As the foetus had cystic kidneys with urogenital defects, a possible genetic condition was thought of and it could not be further probed as the parents could not be traced.

EMBRYOLOGY

During nephrogenesis, genes, transcription factors, and growth factors control the essential interaction between the ureteric bud and the metanephric mesenchyme. The genetic disorder often occurs prior to day 31 of the foetal development. The ureteric bud which forms the kidneys, fails to develop and the absence of the kidneys causes a deficiency of the amniotic fluid after 12 to 16 weeks. The decreased volume of the amniotic fluid causes the growing foetus to become compressed by the mother's uterus. This compression can cause many physical deformities in the foetus.

CONCLUSION

Potter's syndrome refers to the typical facial characteristics and associated pulmonary hypoplasia of a neonate as a direct result of oligohydramnios due to the renal pathology. Severe respiratory insufficiency leads to a fatal outcome in most of the infants. Though it is not inherited, sometimes the primary cause may have a genetic reason like autosomal dominant polycystic kidney, which may run in families. So, if there is any family history of renal malformation or a previous affected pregnancy, a mid gestation ultrasound examination is advised for the amount of amniotic fluid, the foetal kidneys and the urinary tract. As there is no known method of prevention, the mortality rate is high. This reported case of Potter's syndrome was fatal as it was associated with bilateral cystic kidneys and an undivided cloaca.

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