



Clinical and Cytogenetic Analysis of a Baby with Vestigial Tail and Limb Defects

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Abstract

Vestigial tail otherwise called the neuroectodermal appendage is a rare occurrence. Very few cases have been reported in literature. Several congenital anomalies may coexist with vestigial tails. Associated cutaneous stigmata like dermal sinus, lipoma, hyperpigmented skin, hair patch have also been documented. In this study an attempt has been made to investigate the clinical and cytogenetic profile of a female infant with a tail like structure in the lumbosacral region associated with multiple limb defects. Cytogenetic profiles of family members were studied by performing karyotype analysis to look for chromosome level involvement in the development of this condition. The cytogenetic profiles were found to be normal. The tail was excised successfully without neurological deficits and limb defects were surgically corrected.

Keywords- Vestigial tail, Limb defects, Symbrachydactyly, Club foot, Karyotyping.

Introduction

Human tail is a rare congenital anomaly which has raised several questions on evolutionary issues. Very few cases of human tail with limb defects have been reported worldwide and it has been considered as a vestigial organ with loss of function. There are two schools of thought regarding its ontogenesis. Human tails have been classified into true and pseudotails^{[1],[2]}. Distinction between the two is important in deciding the treatment and prognosis. Careful microsurgical excision has to be performed in cases associated with spinal defects to avoid any neurological deficits^[3]. In this study we present a detailed clinical and cytogenetic profile of a female child with vestigial tail in the lumbosacral area accompanied by limb defects. Abnormal embryogenesis involving cell death and vertebrate

development may be the reason for association of human tail with limb defects in our patient^{[4],[5]}. Chromosomal alterations in congenital and developmental anomalies have been studied extensively with a variety of cyto-molecular techniques. Studies in the past five decades have shown genomic imbalances resulting from chromosomal abnormalities to be a major contributory factor for congenital malformations^[6]. A thorough investigation of balanced or unbalanced chromosomal rearrangements and identification of the associated genes is important for syndrome recognition and genetic risk assessment.

Materials and Method

A detailed medical and family history of the affected child and family members were collected after obtaining informed consent. Clinical and

surgical procedures were performed in the concerned departments of Jubilee Mission Medical College and karyotype analysis was performed in Jubilee Centre for Medical Research. Four family members [Figure 1] including the affected child were selected for cytogenetic studies. [Figure 2]

Case Presentation

A one week old female term infant born by normal vaginal delivery to a primigravida mother was referred to our institution for investigation of a tail like structure. The baby was born to non consanguineous parents. Prenatal and antenatal period was uneventful without any evidence of radiation exposure or intake of teratogenic drugs.

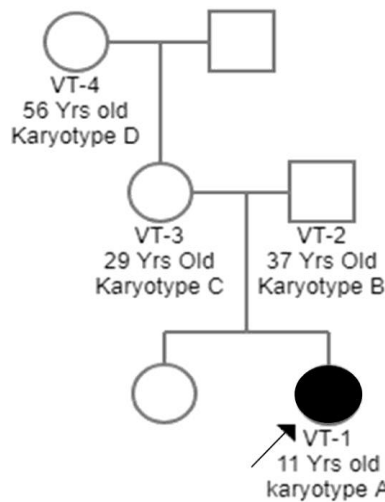


Figure 1. Pedigree of the family shows members selected for karyotyping: Four members (VT-1 to VT-4 as shown in the pedigree) were selected for thorough cytogenetic analysis

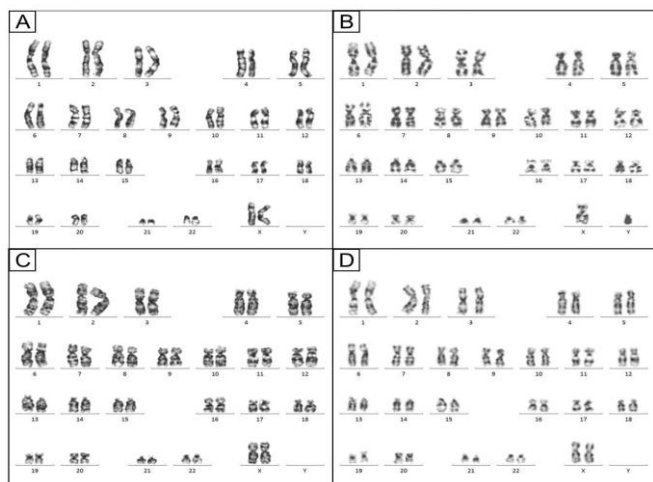


Figure 2. Banding cytogenetics of the family: Karyotypes of A)VT-1, B)VT-2, C)VT-3, D)VT-4

The family history was not contributory in any way. On examination the baby had a tail - 3 cm long soft, non tender, non pulsatile skin covered appendage in the lumbosacral area situated just off the midline [Figure 3 A]. The tail did not show any movements voluntarily or on stimulation. The baby also had a congenital talipesquinovarus deformity of left foot, symbrachydactyly involving the middle 3 fingers and toes bilaterally and a duplicated rudimentary foot on the left lower limb [Figure 3 B & C]. Systemic examination did not reveal any other congenital or developmental defects. Echo cardiogram and ultrasound abdomen were normal. An ultrasound examination of the lumbosacral region showed a subcutaneous soft tissue mass with no intraspinal extension. MRI was not performed due to financial constraints. The child underwent microsurgery at 15th day of life and the tail was excised successfully. She recovered without any complication and was discharged after 2 days. Histopathological examination of the appendage revealed the presence of adipose tissue, connective tissue, blood vessels and nerves [Figure 3 D]. There was no evidence of bone or spinal cord structures. Surgical release of syndactyly, excision of the rudimentary foot and CTEV surgery was performed at 6 months. She was subsequently put on corrective footwear and regular follow-up surgeries were performed [Figure 4 A&B]. The child is now 11 years of age, is developmentally normal, with average intelligence and going to school without any neurological deficit. The couple has another child who is perfectly normal.

Banding Cytogenetic investigation

Peripheral blood (3 ml) was collected in heparinized vacutainers from each of the individuals participated in the study. Peripheral blood samples were processed immediately on sampling and cultured. Chromosome preparations were made according to the procedure standardized in Human Genetics and Genomics Research Laboratory, a Division of Jubilee Centre for Medical Research. Cultures were set up by mixing 0.5 ml of whole blood with HiKaryoXL (Himedia) medium, which is a medium developed for the short term *in vitro* culture of

peripheral blood lymphocytes for cytogenetic studies. Lymphocyte cultures were harvested after 72 hours from the time of initiation. The cells were arrested at metaphase with 0.001% colchicine (Sigma) for 20 minutes and treated hypotonically for 11 minutes with 0.075 M KCl (Merck), followed by fixation with methanol-acetic acid (3:1). Fixed cells were dropped onto clean microscopic slides, air dried and GTG banding procedure was performed. Fifty well spread metaphases were karyotyped to look for possible numerical and structural chromosomal defects.

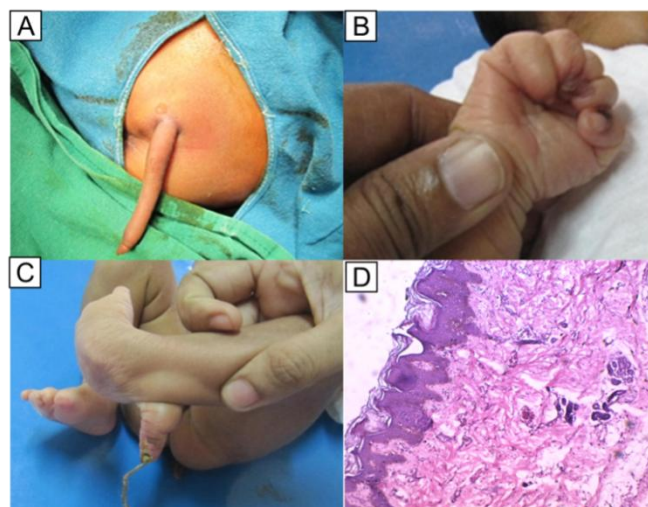


Figure 3. A) Vestigial tail [a skin covered appendage] in the lumbosacral area B) Symbrachydactyly hand with small hand and short digits C) Left lower limb showing duplicated rudimentary foot. D) Histopathology of tail showing skin with connective tissue, blood vessels and nerves (H&E,10x)

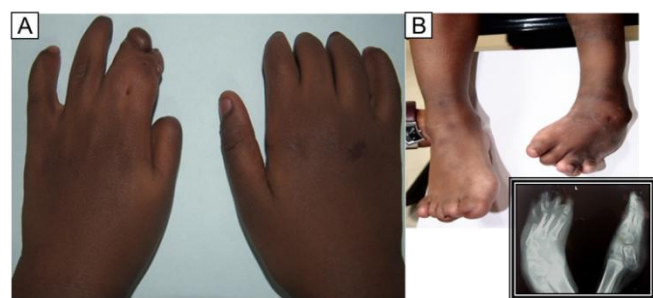


Figure 4. A) Both hands at 5 years [Post surgical release for syndactyly] showing hypoplastic hands with nubbins at the tips of digits. B) Both legs at 5 years showing club foot on the left side in the course of surgical correction. Inset- Radiograph left foot [AP view] showing severe adduction and supination of fore foot.

Results and Discussion

Cytogenetic analysis showed no visible chromosomal defects in the samples analysed. There are meagre studies in literature which state the cytogenetic nature of caudal appendages. The presence of caudal appendage in a newborn is rare and vestigial tail is one among them. Less than 100 cases of human tails have been reported worldwide in literature. It is otherwise called a neuroectodermal appendage^[7]. Apart from cosmetic disfigurement, it is also a cause of psychological trauma and social stigma to parents and family members^[3]. Most tails are situated in the lumbar or sacrococcygeal region. However tails have also been reported in the thoraco cervical region^[7]. Familial cases have also been reported, some of which are associated with congenital syndromes. Dao and Netsky in 1984 have classified human tails into true (vestigial) and pseudo tails^[2]. True tail is simply seen as a midline protrusion from the lumbosacral region and contains adipose tissue, connective tissue, blood vessels and nerves covered by skin. They do not contain bone, cartilage or spinal cord remnants. Pseudotails are osseocartilagenous structures containing bone, cartilage, adipose tissue, remnants of notochord and even teratoma elements. True tails are not associated with congenital malformations while pseudotails are frequently associated with spinal dysraphism^[8]. This distinction is important for planning the treatment strategies. Treatment of choice is simple surgical excision for true tails but careful micro surgical excision may be necessary in cases associated with spinal defects^{[3],[9]}. There are two schools of thought regarding its ontogenesis. Karl Giberson, an evolutionist with strong belief in Darwin theory of evolution believes in this theory that the instructions for producing human tails have been shut off in our genomes and that human tails represent the simple “turning on” of genes retained from our ancestors. He believes that babies with tails are otherwise healthy and that these tails can be easily removed surgically without residual effects^[1]. However recent studies and research have furnished sufficient evidence to disprove the

Darwinian doctrine. The current medical thinking is that human tails are considered as developmental birth defects and not due to “turning on” of vestigial genes as a part of evolutionary regression^[10]. The evidence to reinforce the 2nd school of thought is the high association of tails with congenital anomalies like lipoma, clubfoot, cleft palate, imperforate anus, syndactyly, limb defects, meningocele, spina bifida, tethered spinal cord, teratomas etc. contradicting the earlier school of thought^{[11],[12],[13]}. 49% cases of vestigial tails are associated with spinal dysraphism and 20% patients present with tethered cord according to available literature. However, the most common coexistent anomaly found is spina bifida^[14]. Anorectal malformations when they occur with vestigial tails are seen to be associated with various syndromes^[15]. A gelatinous variety of human tail has also been described^[16].

During normal human development, a number of structures form and subsequently regress completely. When an organ is lost from our body, genes are switched off, however their blue prints are still there in genetic storage^[10]. There are lot of evidence in literature suggesting that these genes once switched off can again be switched on after several millions of years. Similarly the human embryo has a tail bud during the 5th-6th week of gestation which is indistinguishable from the embryonic tails of animals^{[2],[8]}. The tail bud is composed of paired somites, mesenchyme, neural tube extensions and notochord. However this human tail disappears due to macrophage induced phagocytosis by the 8th week of gestation. The pathogenesis behind vestigial tail is due to immature closure of neural tube which exposes the paraxial mesoderm to neural ectoderm which in turn leads to formation of adipose tissue. This adipose tissue then fuses with the neural structures leading to tethering of cord^[11]. Abnormal embryogenesis involving cell death may be the reason for the presence of human tail along with limb defects in our patient. The Hedgehog signalling pathway is essential for many aspects of normal embryonic development including formation and patterning of the neural tube^[17]. A few studies show Sonic Hedgehog (Shh) to be an important

protein that plays a critical role in organogenesis, patterning of many systems including limb and midline structures in the brain, spinal cord and teeth^[18]. Polymorphisms and transcriptional modifications in this gene have been implicated as a risk factor in congenital anomalies including human anenphaly, spina bifida and cutaneous appendages. A wealth of information is available regarding the hedgehog signalling in mice and drosophila. Sonic Hedgehog (*Shh*) gene plays an important role in encoding the antero posterior pattern in developing vertebrate limbs^[19]. The presence of Shh transcripts in the polarising region of chick wing bud^[20] and posterior margin of mammalian limb buds^[21] could explain the importance of this polarising morphogen. According to Wolpert (1969), the polarising region produces long range morphogens that set up a concentration gradient across the antero-posterior axis of the wing bud and their threshold concentrations govern digit identity^[22].

Conclusion

All caudal appendages have been divided into true and pseudo tails. Careful preoperative assessment has to be done in all the cases and the operating surgeon need to be aware of the potential pitfalls in treatment. The association of vestigial tail with limb defects in this patient highlights a common embryonal pathogenesis. More cytogenetic and molecular studies should be conducted to analyse the involvement of genetic factors in the ontogenesis of human tail.

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