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Case Report

Atlantoaxial dislocation in a patient with nonsyndromic symmetrical dwarfism: Report of a rare case

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Abstract

Congenital anomalies of the craniovertebral junction (CVJ) are complex developmental defects. We describe a patient with atlantoaxial dislocation (AAD) and short stature whose morphopathologydid not fit into any of the previously described syndromic constellations. The patient underwent a reduction of the AAD followed by fixation with C1-C2 transarticular screws. Although numerous syndromes have been linked to both dwarfism and craniovertebral junction anomalies, this patient did not fit into any of these patterns. It is possible that this may be one of the many as yet unrecognized patterns of congenital anomalies.

Key words: Atlantoaxial dislocation, craniovertebral junction anomalies, dwarfism, short stature

INTRODUCTION

Congenital anomalies of the craniovertebral junction (CVJ) are complex developmental defects. A distinct subset is that of patients who have a combination of short stature and CVJ anomalies. This is a relatively uncommon combination and most of these patients have a definite "syndromic" cause for their morphopathology. We describe a patient whose morphology was distinct from the previously described syndromic constellations.

CASE REPORT

An 18-year-old boy presented with complaints of weakness of the left upper and lower limbs that developed following a trivial fall.

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He did not complain of any sensory loss or urinary disturbances. He was born out of a third-degree consanguineous marriage. His antenatal history, birth, and postnatal period were uneventful. There was no family history of short stature, delayed puberty, or cervical spine problems. On examination, he weighed 19.40 kg; his height was 111 cm (3 feet and 8 inches), arm span 110 cm, upper to lower segment ratio was 0.9, head circumference was 51 cm, and chest circumference was 61 cm. Neck: Body ratio was 1:14, implying that his neck was disproportionately short. Secondary sexual characters were absent (Tanner stage 1).[1] He had mild frontal bossing and a small chin, but no other dysmorphic facial features. Intercanthal distance was normal [Figure 1]. He had restricted mouth opening with a Mallampati score of 4.[2] His bone age was between 13 and 16 years, based on assessment of ossification centers of his wrist joint and hands [Figure 2]. He had an intelligent quotient (IQ) of 94 with uniform performance across all domains tested. Visual acuity was 6/6 in both eyes with normal visual fields and ocular fundi. Audiometry revealed a mixed pattern of sensory loss in the left ear and impedance test was suggestive of ossicular involvement. Neurologic examination revealed normal tone in all limbs. Power was normal (Medical Research Council (MRC) grade 5/5) on the right side and grade 4/5 on the left.[3] The plantar responses were extensor on both sides and all deep tendon reflexes were exaggerated.

Routine blood and serum biochemical parameters were normal. Hormone assay was normal. The serum hormone levels were (normal values in parenthesis): Growth hormone (GH)-2.4 ng/mL (0-6.8 ng/mL), follicle-stimulating hormone (FSH)-3.90 mIU/L (1.41-18.1mIU/L), luteinizing hormone (LH)-2.39 mIU/L (1.5-9.3mIU/L), cortisol-17.10 (4.3-22.4 mcg/dL), testosterone329.7 ng/dL (241-827ng/dL), triiodothyronine (T3)-3.59pg/mL (2.3-4.2pg/mL), thyroxine (T4)-1.39ng/dL (0.89-1.76ng/dL), and thyroid-stimulating hormone (TSH)-5.81mcgIU/mL (0.35-5.50mcgIU/mL). Clonidine stimulation test was done which revealed normal GH levels (Siemens ADVIA Centaur — chemiluminescence method). Serum calcium and phosphate levels were within normal limits. Ultrasonography of the abdomen revealed a left renal calculus (incidental) and no other abnormal finding. The heart appeared structurally normal on echocardiography. Karyotyping revealed a 46XY chromosomal pattern without any abnormality.

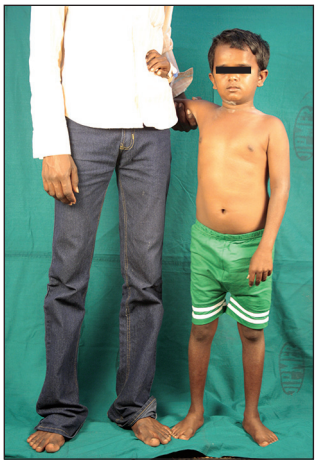

Figure 1: The patient, aged 18 years, standing next to his brother, aged 22 years. He has mildfrontal bossing and hypertelorism. His limbs appear symmetric

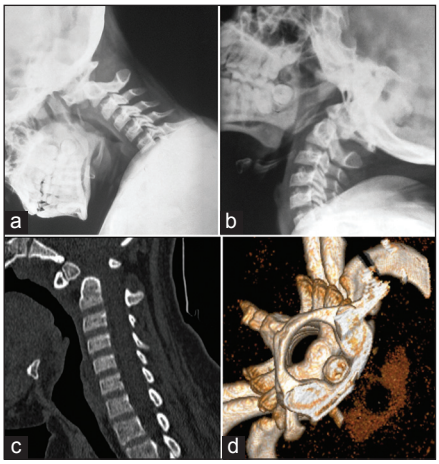

Figure 3: Preoperative radiology of the craniovertebral junction. Lateral X-rays in (a) flexion and (b) extension showing the mobile atlantoaxial dislocation. Note the displacement between the posterior arch of C1 and the spinolamellar line of C2. (c) Sagittal reconstruction of spiral CT of the craniovertebral junction showing the osodontoideum. (d) Reconstructed view of the cervical canal showing the lower half of the dens-C2 complex displaced into the canal. CT = Computed tomography

Skeletal survey of the body was normal. X-ray of the CVJ revealed atlantoaxial dislocation (AAD) with an osodontoideum. Flexion and extension X-ray films of cervical spine revealed a partially reducible AAD [Figure 3a and b]. Magnetic resonance imaging (MRI) demonstrated significant spinal cord compression with T2hyperintense signal changes in the cord at the C1 level [Figure 4]. There was cervical canal compromise due to a posterior displacement of the inferior part of the dens-C2 complex [Figure 3c and d].

He underwent surgery for the AAD through a posterior midline approach. Intraoperative reduction of the AAD and followed by fixation with C1-C2transarticular screws was performed. This construct was strengthened by the addition of sublaminar wires and a bone graft between the posterior spinous processes of C1 and C2. Postoperative recovery was uneventful. Postop-rays and computed tomography (CT) of the CVJ showed good reduction of the AAD and proper positioning of the implants [Figure 5]. He remains neurologically stable on follow-up a year after surgery. Follow-up radiology reveals stable bony fusion at the site of the construct.

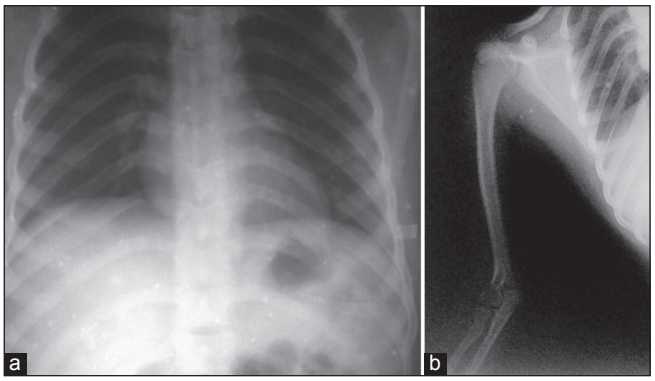

Figure 2: Preoperative X-rays of the chest (a) and upper limbs (b) were unremarkable

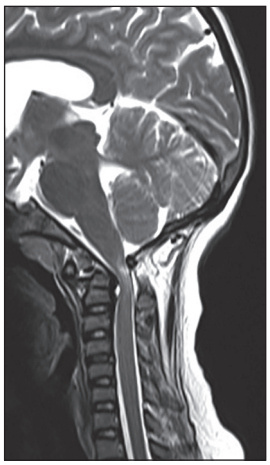

Figure 4: Sagittal MRI image showing the severe compression of the cord at the C1 level withan area of T2hyperintense signal change within the cord. MRI = Magnetic resonance imaging

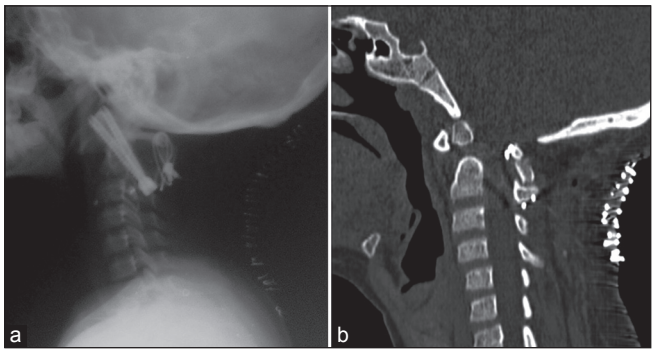

Figure 5: Postop radiology.(a) Lateral X-ray showing the construct. (b) The sagittal reconstruction of the CT scan showing reduction of the atlantoaxial dislocation and an adequately roomy canal

DISCUSSION

There are two sets of problems attendant to the management of patients with short stature with spinal problems. The first issue is adequate clinical and surgical management of the CVJ pathology. Surgical and anesthetic management of a CVJ anomaly in a patient with short stature and low body weight is akin to managing a pediatric patient with spine pathology. The airway is difficult and fibreoptic intubation is usually required. The current patient had a Mallampati score of 4. When bone maturity is delayed in the patient, screw pullout is a real possibility. Thus, screws need to be supplemented with other implants (as was done with sublaminar wires in this instance) or by injecting bone cement or recombinant BMP around the

Table 1: Congenital syndromes associated with short stature and cervical spine anomalies

Syndrome/disorder	Primary defect	Inheritance	Phenotype	CVJ anomaly
Downs syndrome[4]	Trisomy 21		Mongoloid facies, hypotonia, ligamentous laxity, mental retardation and transverse palmar creases, and heart defects	AAD
Achondroplasia[5]	FGF-3 gene mutation	AD	Short extremities, squared iliac wings, narrow sacrosciatic notch, trident hands, and enlarged skull vault and mandible	Foramen magnum stenosis, AAD
Pseudoachondroplasia[6]	COMP mutation	AD	Waddling gait, joint hyperextensibility, brachydactyly, restricted extension at the elbows and hips, valgus and varus deformities of the lower limbs, scoliosis, and lumbar lordosis	Odontoid hypoplasia
Aarskog-Scott Syndrome[10] (faciodigitogenital dysplasia or syndrome)	FGD-1 mutation	X-linked	Facial dysmorphism, short/broad hands, digital anomalies, single palmar crease, broad toes, shawl scrotum, cryptorchidism, hypermetropia, and normal intelligence	Odontoid hypoplasia
Spondylometaphyseal dysplasia[11]		AD/AR	Growth retardation, genu valgum, and scoliosis	Platyspondyly of all vertebral bodies
Congenital spondyloepiphyseal dysplasia[7]	Mutation in COL2A1 gene	AD	Short upper segment, respiratory difficulties, hip dislocation, congenital myopia, congenital cataract, and middle ear infections	Odontoid hypoplasia, AAD
Cartilage hair hypoplasia — anauxeticdysplasia[12]	RMRP gene	AR	Midfacial recession, macroglossia, and dental abnormalities	AAD
Diastrophic dwarfism[13]		AR	Short limbs, joint contractures, scoliosis, and cleft palate	Odontoid hypoplasia, AAD
Chondrodysplasia calcificans congenita[15]		AD/AR	Limb deformities, failure to thrive, polydactyly/ syndactyly, congenital dysplasia of the hips, vertebral wedging, kyphosis, high arched palate, cleft palate, dyskeratotic skin changes congenital cataracts, and optic atrophy	Platybasia
Metatropic dwarfism[14]		AR	Resembles achondroplasia in chhildhood and Morquio's syndrome later	Odontoid hypoplasia, AAD
Kniest syndrome[16]			Corneal clouding, myopia, dislocated lens platyspondyly, and hypoplastic femoral head	Odontoid hypoplasia, AAD
Osteogenesis imperfecta[8]	Mutations in COL1A1 and COL1A2 genes	AD	Frequent fractures, blue sclera, bow legs, hearing loss, and kyphoscoliosis	AAD
Laron syndrome[9]	GH receptor defects	AR	Small genitalia and gonads, underdeveloped facial bones, obesity, and retarded skeletal sexual maturation	Cervical canal stenosis, AAD

GH = Growth hormone; AD = Autosomal dominant; AR = Autosomal recessive; CVJ = Craniovertebral junction; AAD = Atlantoaxial dislocation

screw. These patients continue to grow (if they are not already adults), and thus the construct should permit such growth. The second set of issues pertains to the establishment of a syndromic diagnosis in such patients. This is essential so as to screen other family members as well as to intelligently anticipate future clinical events in the same patient.

This patient had a proportionate body size with short stature and a height-age of approximately 5 years according to World Health Organization (WHO) standards, bone age approaching his chronological age and absence of pubertal changes at 18 years of age. There are numerous syndromes that present with a combination of dwarfism and CVJ anomalies.[4-16] These are all distinct syndromes with easily recognizable clinical features and/or skeletal changes. Their clinical features are summarized in Table 1.

Morphologically, the present patient most closely matched the features of the Laron syndrome. Laron syndrome[9] is caused by deletions or mutations in the GH receptor gene or the post-receptor pathways leading to defective GH signal transmission. This leads to reduced generation of insulin-like growth factor (IGF)-1, which is the effector molecule for GH. This results in a GH resistance. Patients with Laron dwarfism are short in stature, have subnormal erythropoetic indices, acromicria, small genitalia and gonads, lower than normal head circumference, facial recession, obesity, and retarded skeletal and sexual maturation. Laron syndrome is associated with cervical canal stenosis and hypoplastic odontoid (leading to AAD).[9]

All causes of GH resistance including Laron syndrome are associated with elevated GH levels in the blood. The present patient had normal GH levels and a normal GH response to clonidine challenge. MRI showed a normal pituitary gland and pituitary stalk. The sex hormone levels were normal. Despite this, he had not developed secondary sexual characteristics. The cause for dwarfism and delayed puberty in the presence of normal gonadotropin and GH levels is not readily apparent. Thus, the presenting morphologic and endocrine features in this patient are not consistent with any of the recognized syndromes. It is possible that several uncharacterized clusters of morphopathologic features that include short stature and CVJ anomalies as components may exist. These may mark a hitherto undescribed syndrome.

CONCLUSIONS

Although most instances of short stature with AAD can be characterized as part of one of the mentioned syndromes, there are several patients which do not fit into any of the described constellations of morphologic and biochemical abnormalities. These patients are often difficult to manage. With the appropriate surgical therapy tailored to the patient, outcome is good in those patients who are neurologically intact prior to surgery. It is possible that more syndromes combining CVJ anomalies and short stature will be described in the future.

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