Camurati-Engelmann disease (progressive hereditary craniodiaphyseal dysplasia)

Case report

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In a patient with Camurati-Engelmann disease, orbital and optic nerve decompression resulted in improvement of papilledema. Subsequent x-ray films of the optic canals, however, revealed reconstitution of osseous optic canals bilaterally, and papilledema has returned in one eye. Definitive treatment of this dysplastic metabolic bone disorder rests in the control of rapid abnormal bone formation.

KEY WORDS • Camurati-Engelmann disease • papilledema • progressive diaphyseal dysplasia • optic nerve • optic canal • craniotomy

Camurati-Engelmann disease is a dysplastic metabolic disorder of bone associated with increasing osseous thickness primarily involving the base of the skull and diaphyses of long bones. Although the orthopedic and radiological aspects of this disease have been described previously,2,5,9,11,12,15,17,19 little has been written concerning its neurological manifestations and surgical treatment. We wish to present the case history of a patient with Camurati-Engelmann disease and discuss the efficacy of orbital and optic nerve decompression for alleviating progressive osseous encroachment upon these structures.

Case Report

This 5-year-old boy, known to have Camurati-Engelmann disease from 1½ years was referred by the Department of Ophthalmology because of progressive proptosis and papilledema, more marked in the right eye than in the left. The patient was the product of an uncomplicated pregnancy and a normal delivery, and attained his early developmental milestones at appropriate ages. At 2 years of age, however, he had difficulty in walking, and began to complain of leg pain. X-ray films of his extremities disclosed radiographic findings consistent with Engelmann’s disease. The family history was unremarkable except for a strong history of diabetes mellitus on the paternal side.

Examination. On general physical examination the patient was found to be in the 40th percentile for height, 75th percentile for weight, and 99th percentile for head circumference. He had bilateral proptosis, hypertelorism with a saddle nose deformity.
Camurati-Engelmann disease

and bilateral choanal narrowing. He had a soft functional systolic ejection murmur over the aortic area. The spleen was palpable approximately 2 cm below the left costal margin. His genitals were enlarged for his age; the phallus measured 6.5 cm and the testes $2\frac{1}{2} \times 1$ cm. He had flat feet and early clubbing of his fingers. The rest of the general examination was normal.

Neurological examination disclosed bilateral papilledema, greater in the right eye than in the left. Visual acuity was normal, and there was no extraocular muscle paresis. Motor examination showed no evidence of muscle wasting; his reflexes were hypoactive throughout and no pathological reflexes were elicited. He had a wide-base waddling gait. The rest of the neurological examination was normal.

Pertinent laboratory investigation showed the following: hematocrit, 31.3%; hemoglobin, 9.6 gm; white blood cell count, $7 \times 10^3$. The sickle cell preparation was negative and the hemoglobin electrophoresis was normal. He had a total iron binding capacity of 322 $\mu$g/dl and serum iron of 30 $\mu$g/dl. Serum electrolytes, blood urea nitrogen, and blood sugar were normal. The cerebrospinal fluid protein was 25 mg/dl and glucose was 62 mg/dl. Endocrinological investigation demonstrated a functionally intact pituitary-adrenal axis. Growth hormone determination following both insulin and glucagon stimulation were well within normal ranges. Thyroid function studies, plasma testosterone, and parathormone were normal for his age. The luteinizing hormone level, however, was elevated. A 3-day calcium balance study was normal for his age. Electroencephalograms, electrocardiograms, and echoencephalograms were interpreted as normal. Audiograms revealed a mild conductive hearing loss in the left ear; the right ear was normal.

X-ray films of the extremities showed changes typical of Engelmann disease: symmetrical involvement of the long bones including thickening and sclerosis of the diaphyses and sparing of the metaphyses and epiphyses (Fig. 1). Skull x-ray films demonstrated marked sclerosis of the base of the skull and floor of the anterior fossa, extending anteriorly into the frontal bone with absence of the paranasal sinus (Fig. 2). Views of the optic canal on the right were within the

FIG. 1. X-ray film of tibia showing sclerosing and thickening of the diaphyses with sparing of metaphyses and epiphyses, pathognomonic of Camurati-Engelmann disease.

FIG. 2. Lateral skull x-ray film showing sclerosing and thickening of the base of the skull and frontal bone.
lower limit of normal; however, the left optic canal was definitely constricted. Pneumoencephalography showed the ventricles (including the third ventricle) to be of normal size, and no mass was identified in the suprasellar region.

Operation. The patient underwent a right frontal craniotomy with resection of the orbital roof and roof of the optic canal for decompression of the right orbital contents and optic nerve. The temporalis muscle was found to have been replaced by fibrous and fatty tissue. The thickness of the calvaria measured approximately 28 mm and its periosteum measured 6 mm. The orbital roof was very dense and measured 25 mm at its thickest dimension; both the orbital contents and optic nerve were compressed by their osseous enclosures. The lateral wall of the orbit was left intact.

Postoperative Course. The proptosis and papilledema of the right eye gradually improved, but within 2 months the papilledema returned to the preoperative status. Four months later, a more radical procedure was performed on the left side including removal of the roof and lateral wall of the orbit and the entire optic canal. Ten days following the second operation the papilledema had resolved and the disc has remained normal for the duration of the patient’s follow-up period, now over 1 year.

Discussion

Camurati-Engelmann disease was first described by Cockayne in 1920. Two years later, Camurati reported on “bilateral symmetrical osteitis of the lower limbs” of a 7-year-old boy, and Engelmann subsequently described the muscular wasting and sclerosis of the diaphyses of long bones and of the base of the skull, which are characteristic of the disease. In 1948, the radiological criteria were enumerated by Neuhauser, et al., who also stressed the progressive nature of this disease. Sparkes and Graham elucidated the genetic background of this disease in 1972, and critically reviewed the clinical manifestations of 21 affected families and 41 sporadic cases. They hypothesized that the mode of inheritance was autosomal dominant, and that there was no significant phenotypic difference between the familial and sporadic cases.

The basic pathology of this disease is uncertain. Histologically, the absence of osteoclasts and decreased bone absorption as well as thickening of the media of blood vessel have been documented. Cohen and States postulated a disturbance of the normal remodeling process of the involved bones. Wirth and Kay were able to show that net bone deposition is markedly increased, osteoclastic activity is almost non-existent, and the osteoid contains not only normal hydroxyapatite, but also inordinate amounts of calcium carbonate. Whether these derangements are due to specific enzymatic defects causing abnormal metabolic bone activity as suggested by Sparkes and Graham has not been proven.

The clinical manifestations of Camurati-Engelmann disease usually begin in childhood between the ages of 4 and 10 years but have been discovered as early as 3 months of age and as late as 56 years. The initial symptoms are usually muscular weakness, fatigability, and a waddling gait. Other common signs and symptoms include leg pain, bowing of the tibia, difficulty in gaining weight, hepatosplenomegaly, and delayed puberty with retarded secondary sexual characteristics. Some patients demonstrate dry, hard, scaly skin and absence of a subcutaneous fat layer. Neurologically, hypo- and hyperreflexia, ankle clonus, and pathological plantar responses have been described. Peripheral facial nerve paresis and nystagmus have occasionally been seen. In several reported cases, the patients have had either conductive or sensorineural hearing deficits.

Patients developing exophthalmos, papilledema, and optic atrophy have been documented; this triad has been considered by many to be the most significant neurological abnormality. With progressive compression of the optic nerve by proliferation of bone in the region of the optic canal, deterioration of visual acuity can result. Van Buchem, et al., reported two patients in their fifth decade with Camurati-Engelmann disease who had become blind.

Basic to an understanding of the course of events in optic nerve compression and deterioration of vision is an understanding of the pathogenesis of papilledema. Most workers agree that papilledema results from an accumulation of fluid in the extracellular space of the pre-laminar region of the optic nerve. Hayreh reviewed various theories.
pertaining to the causal relationship of raised intracranial pressure to papilledema, but in Camurati-Engelmann disease raised intracranial pressure has not been noted with the possible exception of one case. In a recent general review of disc edema, Wirtschafter, et al., hypothesized that the production of papilledema was based on the impairment of axoplasmic flow, leading to accumulation of axoplasm in the pre-laminar region. Consistent with this theory, Morse, et al., have suggested that the progressive stenosis of the optic canal and compression of the optic nerve in Camurati-Engelmann disease caused disc edema. Decompression of the optic nerve was recommended to preclude subsequent loss of visual acuity.

The progression of papilledema and exophthalmos in our patient led us to do a modified Naffziger procedure and decompression of the optic nerves. A lumbar puncture to determine the intrathecal pressure was not done initially, but was performed following the first and second operations. In both instances, the cerebrospinal fluid pressures determined in a sedated, quiescent patient were elevated to 230 and 280 mm H$_2$O, respectively. Elevated intracranial pressure is a well established cause of papilledema but to postulate intracranial hypertension as the cause of papilledema in this patient may be misleading. The clear improvement of the disc edema following each surgical procedure would rather appear to substantiate a causal relationship between optic nerve compression and papilledema. The absence of recurrence of the disc edema in the left fundus is most likely due to a more extensive removal of the lateral and inferior walls of the orbit and optic canal. Unfortunately, tomograms of the optic canal obtained 8 months after the second operation show virtually complete bilateral reconstitution of the bone of the optic canals (Fig. 3). With this rapid regrowth of bone, it is presumed that left-sided papilledema will again develop.

**Summary**

A case of Engelmann's disease with ocular findings has been presented. The literature concerning neurological manifestations of
Camurati-Engelmann disease has been reviewed. Progressive papilledema and proptosis with the threat of visual impairment requires radical decompression of the optic nerve and orbital contents. However, the procedure may be only temporizing as papilledema recurred in the right eye and the optic canals reformed bilaterally. The definitive treatment will rest in the control of rapid rate of abnormal bone formation.

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References


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