Cervico-oculo-acusticus Syndrome with Pseudopapilloedema

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The triad of the Klippel-Feil anomaly, Duane's retraction syndrome, and deaf-mutism was described by Wildervanck (1960) as the cervico-oculo-acusticus syndrome.

The Klippel-Feil anomaly essentially comprises a variety of bony deformities of the cervical spine, usually involving fusion, which appear clinically as a short neck with a limited range of movements of the head and neck and a low posterior hairline.

The retraction syndrome itself comprises retraction movements of the eyeball, with narrowing of the palpebral fissure on adduction and, in the presence of an apparent lateral rectus palsy, forward movement of the globe, with widening of the palpebral fissure on attempted abduction. Duane (1905) points out that there is often limitation of adduction as well as the usually more marked limitation of abduction. In addition, there is often an upshoot or a downshoot of the globe on adduction.

The term profound childhood deafness is to be preferred to that of deaf-mutism; profound deafness in infancy is now regarded as a socio-educational problem (Fraser, 1964).

Duane's syndrome has usually been considered an isolated phenomenon. Danis (1948) reported on 229 cases from the literature, and did not record a single instance of deafness or cervical spine anomaly. Similarly, most of the published cases of the Klippel-Feil anomaly, reviewed by Gray, Romaine, and Skandalakis (1964), have not been associated with deafness or squint. However, isolated cases of Duane's syndrome with the Klippel-Feil anomaly have been reported by Magnus (1944) and Waardenburg (1953). In her series of 77 patients of Duane's syndrome, Mein (1968) recorded the Klippel-Feil anomaly in 3 and deafness in 2 cases.

Evidence is accumulating that there is a genetic relationship between Duane's syndrome, perceptive

deafness, and the Klippel-Feil deformity. The Klippel-Feil anomaly, with disorders of ocular muscle function, was recorded in a girl and her paternal aunt by Waardenburg, Franceschetti, and Klein (1963). One relative of a man displaying the cervico-oculo-acusticus syndrome reported by Franceschetti *et al.* (1966) was said to be deaf-mute. Wildervanck, Hoeksema, and Penning (1966) stated that they knew of 51 cases of the cervico-oculo-acusticus syndrome, though one of the features was absent in most cases. In the relatives of their cases deafness was a frequent finding. A family affected through 5 generations with perceptive deafness was described by Kirkham (1969), in which two members had Duane's syndrome. Duane's syndrome and perceptive deafness have occurred in the relatives of patients examined by the author. It is felt that the cervico-oculo-acusticus syndrome is due to a pleiotropic gene effect with variable penetrance and expressivity (Kirkham, in preparation).

These cases contrast strongly with instances of Duane's syndrome with atresia of the external auditory meatus, and abnormalities of the external ear with consequent conductive deafness. In these cases there is evidence of a teratogenic as opposed to a genetic cause (Livingstone and Delahunty, 1968; G. H. Livingstone, 1968, personal communication).

Present Series

Between 1949-1968, 126 patients with Duane's syndrome have been seen in the Ophthalmic departments of The United Sheffield Hospitals. It was possible to trace and re-examine 94 of these patients. A further 18 patients replied to a questionnaire and denied the presence of deafness or cervical spine anomaly. The clinical records of the remaining 14 patients made no reference to the presence (or absence) of deafness or cervical spine anomaly.

Of the 112 patients in which clinical information was complete, 12 had perceptive deafness and 5 had the Klippel-Feil anomaly. Only 2 patients showed the

FIG. 1.—Ocular movements of Case 1 to show bilateral Duane's syndrome.

full triad of the Klippel-Feil anomaly, Duane's syndrome, and perceptive deafness; both were unusual in that marked pseudopapilloedema was present. None of the other 92 patients with Duane's syndrome who were examined had pseudopapilloedema, and there is no note of such a finding in the clinical records of the remaining 32 patients.

A further 6 patients with the Klippel-Feil anomaly have been examined; one had perceptive deafness but none had Duane's syndrome or pseudopapilloedema.

The purpose of the present communication is to report the findings in the 2 patients with the cervico-oculo-acusticus syndrome, and to discuss the significance of pseudopapilloedema, a finding that has not been previously noted.

Case Reports

Case 1. A girl aged 10 years. The mother remembered having Asian 'flu in the 4th month of pregnancy. Birth had been normal. An older male sib was entirely normal, and there was no family history of any congenital malformation, deafness, or strabismus.

The child was born with an epibulbar dermoid of the right infero-temporal limbus, skin tags on the right cheek, and a right pre-auricular tubercle, which were excised at the age of 4 months. By the age of 6 months the mother was worried because the child seemed backward. Deafness was detected and the skull was noted to be oddly shaped. At the age of 11 months x-ray examination showed a large cranium, with general thinning of the bones, and the presence of wormian bones in the sutures suggesting a degree of hydrocephalus. All sutures were patent and the anterior fontanelle was wide open. A defect in the occipital bone and a peculiar density in the left petrous bone were noted.

Examination. A well-developed girl who was receiving education at a special school for profoundly deaf children. Intelligence appeared normal; she could read but speech was severely retarded. The head appeared large, suggestive of arrested hydrocephalus, and the occipital region was flat. The measurements of the skull were: head breadth 17.2 cm.; head length 19.5 cm.; skull diameter 48 cm.

The neck was short and the hair was implanted low

on the neck. Flexion, extension, and rotatory movements of the neck were limited to about 30° each.

Ocular examination. Retinoscopy with cyclopentolate 1% revealed a hypermetropic error of right +5.5/+2.25, 135°, and left +3.5/+2.5, 105°. Corrected visual acuity was right 6/24 and left 6/9. In the primary position the cover test showed a small right convergent strabismus, with right hypotropia for near and distance. Bilateral Duane's syndrome (Fig. 1) with a marked 'A' phenomenon* was present. Worth's lights showed suppression of the right eye for near and distance; a Hess chart was not possible.

There was a scar on the right cornea where the dermoid had been excised. The irides were brown and Brushfield's spots were very prominent. The right optic disc was normal, but marked pseudopapilloedema of the left disc was present.

Ear, nose, and throat examination. The right pinna was much squarer in shape than the left which appeared normal. The scar in front of the right pinna was noted. The external auditory meatuses and tympanic membranes were normal. Pure-tone audiography showed an extremely severe perceptive deafness. Hearing was present only in the lower frequencies and the deficit was 80–100 decibels (see Fig. 2).

FIG. 2.—Audiogram of Case 1 showing severe bilateral perceptive deafness.

* The 'A' phenomenon describes the situation where the horizontal distance between the eyes is less on elevation than on depression; a difference of 10 Δ is usually considered significant.

FIG. 3.—X-ray to show Klippel-Feil deformity, platybasia, and Arnold-Chiari malformation (Case 1).

Urinalysis. Protein, none detected; reducing substances, none detected; screening tests for phenylketonuria and for cystine, negative; creatinine, 118 mg./100 ml.; amino acid chromatography, no abnormality. *x-rays* of the skull and cervical spine showed: (1) widening of the vault consistent with arrested hydrocephalus, though the sutures were not splayed; (2) a develop-

mental defect in the mid-line of the occiput adjoining the foramen magnum, with a shallow posterior fossa and a minor degree of platybasia; (3) widening of the neural canal of the upper cervical vertebrae suggestive of the Arnold-Chiari malformation (Fig. 3); and (4) hypoplastic upper cervical vertebral bodies, with overgrowth and partial fusion of the posterior arches typical of Klippel-Feil abnormality and spina bifida of at least C.7.

Tomography of the petrous temporal bones showed some asymmetry, the left one appearing more bulky than the right, with increased bone density within it (Fig. 4); this was felt to represent the capsule of the vestibular canals. On the right side, the tomograms showed the internal auditory meatus which was considered to be a little narrow. The horizontal semicircular canal was well shown, but the vertical canal was not seen. On the left side the internal auditory meatus was not clearly seen. The vertical semicircular canal was clearly outlined but the horizontal semicircular canal was not seen. On the plain Stenver's projection of the left side there was a suggestion of the cochlea and probably the internal auditory meatus.

Case 2. A 5-year-old girl. Pregnancy and birth had been normal. An elder male sib was normal; her paternal aunt had perceptive deafness but there was no other relevant family history.

Examination. A severely-dwarfed, profoundly-deaf, child with a gross speech defect. The child had a marked Klippel-Feil deformity with absence of cervical spine movements. Bilateral Sprengel's shoulder was present, the head appearing to sit firmly on the shoulders with no visible neck. She had a useful range of shoulder movements and could feed herself but could not comb her own hair. Her gait was normal and no abnormal neurological signs were present. She was only 87 cm.

FIG. 4.—X-ray to show asymmetry of petrous temporal bones (Case 1).

tall, and 14 kg. in weight, both of which fall well below the 10th centile range for a girl of her age.

Ocular examination. Retinoscopy with atropine cycloplegia showed a marked hypermetropia, right +6.5 D, and left +7.0 D. Visual acuity was 6/12 in either eye, and was not improved by spectacle correction. In the primary position a left convergent strabismus of 15° was present, the cover test also showing alternating hypertropia. Bilateral Duane's syndrome was present, with marked limitation of abduction, and a degree of limitation of adduction. Retraction of the globe and narrowing of the palpebral fissures occurred on adduction. An 'A' phenomenon was present.

The irides were blue. Marked pseudopapilloedema was present, the discs appearing grey, slightly raised, and blurred at their edges; there were no haemorrhages or exudates and the appearance has remained unchanged for 4 years.

Ear, nose, and throat examination. The pinnae were 'elf-like', the lobes being absent. The external auditory meatuses and tympanic membranes were normal. Severe perceptive deafness was present, there being no evidence that she could hear any sound below 70–80 db. intensity.

Radiological examination was not undertaken in this case.

Discussion

The cervico-oculo-acusticus syndrome is rare, the full syndrome being present in only two out of 126 patients with Duane's syndrome. Pseudopapilloedema was an unusual feature in the two cases of cervico-oculo-acusticus syndrome presented here. In both instances the pseudopapilloedema fulfilled the criteria of Duke-Elder (1964), in that the appearance remained unchanged over a prolonged period in the absence of other neurological signs, there were no haemorrhages or exudates, and the calibre of the retinal vessels was normal. It is believed that the discovery of pseudopapilloedema in these 2 patients is significant and cannot be explained on the basis of coincidence.

It might be argued that in Case 1 there had been a raised intracranial pressure at some period of development, which could account for the presence of arrested hydrocephalus and the appearance of the left disc. However, the pseudopapilloedema in this case was unilateral and there was no evidence of optic atrophy, the visual acuity of the affected eye being the better of the two eyes. There had been no change in the disc appearance over a 4-year period of observation. Further, there was no evidence of intellectual or neurological impairment other than the deafness. In Case 2 there were no abnormal neurological signs and no clinical evidence of hydrocephalus.

An alternative explanation for the appearance of pseudopapilloedema is that both children had

hypermetropic refractive errors. The disc in hypermetropia may appear a dark greyish-red colour, with indistinct margins, the appearance being congenital and unrelated to the degree of hypermetropia (Duke Elder, 1949). Against this explanation is the fact that the more hypermetropic right eye of Case 1 did not show pseudopapilloedema. In two other patients with Duane's syndrome and the Klippel-Feil anomaly and in a further 23 isolated cases of Duane's syndrome with hypermetropic errors of +4 D or more on retinoscopy, pseudopapilloedema was not observed.

One feels that the disc appearance in these 2 patients may be explained on the basis of an extension of the genetic defect responsible for the cervico-oculo-acusticus syndrome. As the expressivity of the gene increases, still more widespread defects might appear. This may explain not only the presence of pseudopapilloedema in these two patients in whom the Duane's syndrome was bilateral and severe perceptive deafness and the Klippel-Feil anomaly were present, but also the presence of the limbal dermoid and the pre-auricular appendages in Case 1.

Pre-auricular appendages and a subconjunctival lipoma were seen in a male patient with the cervico-oculo-acusticus syndrome by Franceschetti and Klein (1954), and a limbal dermoid was present in one of Wildervanck's (1960) female patients.

One of the patients in the present series was a boy with bilateral Duane's syndrome and the Klippel-Feil anomaly, who also had pre-auricular appendages and a coloboma of the left outer canthus. Limbal dermoids and accessory auricles were seen in 2 patients with Duane's syndrome by Douglas (1964). In none of the patients described above were there any pre-auricular fistulae to complete the triad of signs known as Goldenhar's syndrome (Goldenhar, 1952), which comprises limbal dermoids, accessory auricles, and pre-auricular fistulae. Abnormalities of the cervical spine, which include vertebral synostosis, in Goldenhar's syndrome, have recently been stressed by Sugar (1966), and in view of the above findings it may be that the two syndromes are more closely linked than has previously been recognized. Goldenhar's syndrome is usually unilateral, and deafness, when present, is almost invariably conductive in nature, being associated with abnormalities of the outer ear and external auditory meatus (Sugar, 1966).

The radiological findings in Case 1 are of interest in that they corroborate the abnormalities of the internal auditory meatus and bony labyrinth previously described in full cases of the cervico-oculo-acusticus syndrome by Franceschetti and

Klein (1954), Everberg, Ratjen, and Sorensen (1963), and Wildervanck *et al.* (1966).

Since pseudopapilloedema has not been previously described in the cervico-oculo-acusticus syndrome, it would be desirable to examine the fundi of all future reported cases to establish the incidence of pseudopapilloedema in the syndrome. For this to be possible a closer liaison between the specialities involved in the management of these children is essential. With the knowledge that the disc appearances are benign in character, unnecessary neurological investigations may be avoided.

Summary

Two patients with the cervico-oculo-acusticus syndrome, which comprises the Klippel-Feil anomaly, Duane's syndrome, and perceptive deafness, are described. Pseudopapilloedema was present in both patients, which is the first time this appearance has been recorded in the syndrome. The presence of pseudo-papilloedema is ascribed to an extension of the genetic defect responsible for the syndrome.

One of the patients also had a limbal dermoid, which is only the second one recorded where this abnormality was present in a patient displaying the full syndrome.

Tomography of the petrous temporal bones in one patient revealed gross abnormalities of the inner ear.

A closer liaison between ophthalmologist, audiologist, and paediatrician is essential to establish the incidence of pseudopapilloedema in this syndrome, and even of the syndrome itself.

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