Hajdu–Cheney syndrome and syringomyelia

Case report

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This 7-year-old boy with Hajdu–Cheney syndrome presented with cervical syringomyelia related to rapidly progressing platybasia. Decompressive craniectomy provided temporary improvement, and his clinical status was eventually stabilized after external immobilization, according to findings at 2.5 years of follow up. In a review of the literature the authors found 57 cases of the syndrome, only three of which were associated with syringomyelia. The youth of the patient, the severe form and rapid course of the disease, and the very specific anatomical conditions related to cranial and facial deformities raised various therapeutic problems.

KEY WORDS • Hajdu–Cheney syndrome • syringomyelia • acroosteolysis • platybasia • basilar invagination • basilar impression

Hajdu–Cheney syndrome is a rare disease that was first described in 1948 by Nicholas Hajdu and Ralph Kauntze under the designation “cranio-skeletal dysplasia.” The first familial case involved a mother and her four children who suffered from acroosteolysis. Most reported cases are sporadic forms of the disease, and one third are familial forms with probable autosomal-dominant transmission. The syndrome is characterized by facial dysmorphism (smooth and long philtrum, thin lips, depression of the tip of the nose, thick eyebrows and coarse hair, and ptosis); maxillofacial anomalies (microretrognathism, premature loss of teeth, alveolar resorption, and mandibular hypoplasia); joint laxity; significant osteopenia of the entire skeleton, with fractures occurring particularly at the level of the fifth metatarsus; short stature; and dysplasia of the spine and long bones. This syndrome may be associated with anomalies of the urinary system (polycystic kidney disease), cardiac malformations (existence of the arterial channel and interventricular communication), and/or hearing loss (transmission deafness). The diagnosis can be confirmed on x-ray films, which show acroosteolysis of the distal phalanges and dysplasia of the skull (wormian bone, bathrocephaly, open sutures, widening of the sella turcica, prominent occipital ridge, and platybasia).

Fifty-seven cases of Hajdu–Cheney syndrome have been reported in the literature; nine patients presented with neurological signs related to malformation of the craniovertebral junction (Table 1). Platybasia, which is not specific to this syndrome, but was found in 53% of patients, is responsible for basilar impression followed by ascending luxation of the odontoid process. Neurological complications can occur in childhood, generally after 10 years of age; hydrocephalus is the most common complication.

Syringomyelia associated with this disease has only been reported three times in the literature (in one adult and two 10-year-old children). We report on a 7-year-old boy with a sporadic form of Hajdu–Cheney syndrome involving very early and rapidly developing syringomyelia, who has now been followed for 3 years. The therapeutic problems related to rapid deformation of a growing spine and the anatomical problems specific to this syndrome made surgical treatment quite hazardous.

Case Report

History. This 7-year-old boy with Hajdu–Cheney syndrome had been diagnosed at 6 years of age according to the following criteria: facial dysmorphism (narrow palpebral slits, hypertelorism, microstomia, retrognathism, microglossia, and hollow palate); orthopedic problems (shortness of stature and fractures of the fifth metatarsus); acroosteolysis of the third phalanges of the hands, with clinodactyly of the fifth fingers (Fig. 1 upper); cranial dysmorphosis (broad aspect of the cranial bone sutures, multiple wormian bones, and frontal sinus agenesis; Fig. 1 lower); and bilateral deafness. His chromosomal chart and those of his parents were normal. Renal exploration revealed no polycystic kidney disease.
At 5 months of age the patient underwent surgery to repair his cardiac malformation, with closure of the interventricular communication. Intubation was particularly difficult because of his microstomia. Initial encephalic and cervical MR images obtained in May 1998 at the time of diagnosis of Hajdu–Cheney syndrome revealed no hydrocephalus or syringomyelia (Fig. 2). No basilar impression was apparent, but there was very slight platybasia: the basal angle (or sphenoid angle) was 145° for an upper limit of 152° (normal 121–152°).21 The upper end of the odontoid process was 2 mm below the Chamberlain 4 and McGregor 17 lines (Table 2).

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**TABLE 1**

**Literature review of patients with a malformation of the craniovertebral junction and neurological complications***

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Patient Age (yrs), Sex</th>
<th>Neurological Signs</th>
<th>Hydrocephalus</th>
<th>Syringomyelia</th>
<th>Op</th>
<th>Immobilization</th>
<th>Outcome</th>
<th>Follow Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hajdu &amp; Kauntze, 1948</td>
<td>37, M</td>
<td>headache, lat nystagmus, visual disorders, abducent nerve palsy palate paralysis &amp; anesthesia of pharynx, voice deep &amp; croaking, cerebellar incoordination</td>
<td>yes</td>
<td>uncertain</td>
<td>no</td>
<td>no</td>
<td>little alteration in symptoms or signs</td>
<td>8 mos</td>
</tr>
<tr>
<td>Williams, 1977</td>
<td>18, M</td>
<td></td>
<td>yes</td>
<td>no</td>
<td>foramen magnum decompression w/o pst cervical fusion</td>
<td>no</td>
<td>improved, except for voice; died of pneumonia</td>
<td>2 yrs postop</td>
</tr>
<tr>
<td>Chodoroff, et al. (2022)</td>
<td>21, F</td>
<td>lower-extremity weakness; bilat Babinski signs</td>
<td>yes</td>
<td>uncertain; spinal cord compression</td>
<td>VP shunt; foramen magnum decompression, C-1 laminctomy &amp; pst cervical fusion</td>
<td>halo traction</td>
<td>improved after halo traction</td>
<td>2 mos</td>
</tr>
<tr>
<td>Kawamura, et al., 1991 &amp; 1981</td>
<td>32, M</td>
<td>depressed corneal reflexes, diplopia, hearing loss, low-pitched unclear speech, depressed gag reflexes bilat abdominal pain &amp; vomiting</td>
<td>no†</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>severely disabled &amp; daily activity markedly restricted</td>
<td>9 yrs</td>
</tr>
<tr>
<td>Pellegrini &amp; Widdowson, 1991</td>
<td>15, F</td>
<td></td>
<td>yes</td>
<td>uncertain</td>
<td>ND</td>
<td>no</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Ades, et al., 1993</td>
<td>10, M</td>
<td>optic disc swelling</td>
<td>yes</td>
<td>lower cervical &amp; upper thoracic spinal cord</td>
<td>C2–T11</td>
<td>no op</td>
<td>ND</td>
<td>stabilization of ventricular size</td>
</tr>
<tr>
<td>Nishimura, et al., 1996</td>
<td>10, M</td>
<td>normal</td>
<td>no</td>
<td>no</td>
<td>foramen magnum decompression &amp; C-1 laminectomy, occipitocervical fusion w/ iliac bone graft &amp; titanium wires</td>
<td>Philadelphia collar</td>
<td>improvement, reduction of segmental cavities at C-2 &amp; C5–T6</td>
<td>3 mos postop</td>
</tr>
<tr>
<td>Tanimoto, et al., 1996</td>
<td>41, F</td>
<td>quadripareisis &amp; sensory disturbance after neck injury</td>
<td>no</td>
<td>C-2 &amp; C5–T6</td>
<td>foramen magnum decompression &amp; C-1 laminectomy, occipitocervical fusion w/ iliac bone graft &amp; titanium wires</td>
<td>Milwaukeee corset</td>
<td>normal neurological status</td>
<td>2.5 yrs postop</td>
</tr>
<tr>
<td>Golnik &amp; Kersten, 1998</td>
<td>53, M</td>
<td>bilat optic nerve sheath meningoceles</td>
<td>no</td>
<td>no</td>
<td>optic nerve sheath decompression</td>
<td>no</td>
<td>bilat high-frequencyc hearing loss</td>
<td>2 yrs postop</td>
</tr>
<tr>
<td>Present study</td>
<td>7, M</td>
<td>stiff neck, headache</td>
<td>no</td>
<td>C5–T2</td>
<td>foramen magnum decompression w/o osteosynthesis</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

**TABLE 2**

**Platybasia measurement on MR images***

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Chamberlain line (mm)</th>
<th>McGregor line (mm)</th>
<th>basal angle (°)</th>
<th>clivus length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamberlain line (mm)</td>
<td>–2</td>
<td>16</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>McGregor line (mm)</td>
<td>–2</td>
<td>16</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>basal angle (°)</td>
<td>145</td>
<td>150</td>
<td>154</td>
<td>162</td>
</tr>
<tr>
<td>clivus length (mm)</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
</tbody>
</table>

* ND = not detailed; pst = posterior; VP = ventriculoperitoneal.
† This patient was also described in an article by the same authors in 1981. He has no hydrocephalus but anterior compression of the midbrain and pons.

* ND = not done.
rise of 18 mm compared with the earlier findings on MR imaging (Table 2). There was no sign of spinal trauma. Results of thoracic MR imaging were normal, but a horizontal position of S-1 and S-2 was observed at the lumbar level, as well as spondylolisthesis of L5–S1 and hypoplasia of the last sacral vertebrae. The spinal cord ended at the L-1 level.

**Operation.** Surgery was recommended because of the rapid clinical course (the presence of stiff neck suggested compression of the left spinal nerve by cerebellar tonsil impingement) and the occurrence of spinal cord edema with syringomyelia within 10 months of the initial symptoms. The operation was performed on May 7, 1999, when the patient was 7.5 years old. Posterior fossa decompression was performed with occipital craniectomy, C-1 laminectomy, and duraplasty. The procedure was difficult because of the shortness of the occipital squama and the presence of a bulky occipital venous sinus that caused considerable hemorrhaging on opening of the dura mater. Occipitocervical fusion was not performed.

**Postoperative Course.** The patient’s postoperative course was uneventful, and his headache and stiff neck improved progressively. The child refused external immobilization. Phonation disorders and a loud voice were apparent immediately after the operation. Examination of the cranial nerves yielded normal results, and no explanation was found for these abnormalities. In October 1999, MR imaging confirmed regression of the syringomyelic cavity, but indicated a worsening of platybasia (Fig. 4 and Table 2), with a basal angle of 154°. The child appeared to be well.

**Orthopedic Treatment.** After 9 months of clinical improvement, cervical pain and headache recurred. In March 2000, MR images demonstrated the reappearance of the syringomyelic cavity and a clear worsening of platybasia (Fig. 5); thoracolumbar scoliosis developed concomitantly. Figure 6 indicates the rapid course of platybasia before and after surgery. Orthopedic treatment involving a Milwaukee corset was required starting in April 2000. At the same time, infusions of bisphosphonates (pamidronate 1 mg/kg every 4 months) were initiated to accelerate the spinal ossification process and improve bone density. Osteodensitometry studies showed bone density of 0.415 g/cm, that is, below the normal curves for his age.

The child is now 10 years old and tolerates his corset.
well, which relieves cervical pain and headache considerably. The progression of platybasia was arrested by orthopedic treatment (Fig. 6). The patient does not report any pain and has no limitation of mobility of the cervical spine. The phonation disorders have regressed. Results of the neurological examination are strictly normal: all reflexes are present and symmetrical, and thermalgesic sensitivity is normal. Height and weight development remain regular at negative four standard deviations.

The last MR image obtained in October 2001 demonstrated stabilization of platybasia, with a basal angle of 165°; however, there was a slight enlargement of the syringomyelia cavity. The improvement and stability of the clinical status of the patient after 2.5 years of follow up, as well as the normal results of the neurological examination, indicate that orthopedic treatment should be continued while very regular clinical and MR monitoring is maintained.

Discussion

Hajdu–Cheney syndrome is a rare congenital affliction that can be sporadic or familial.5,11 The 57 cases reported in the literature (38 sporadic, 19 familial) are listed in a recent article by Brennan and Pauli.2 Nine of these patients showed neurological signs (Table 1), generally in relation to basilar impression. Among the three patients with syringomyelia described in the literature,1,18,24 two involve 10-year-old children.1,18 Details are scarce and the outcome is unknown.

For our patient, we were able to show that syringomyelia was acquired, because the first MR image obtained at 6 years of age demonstrated normal findings. Our case tends to confirm the theory of Williams28 that formation of the syringomyelic cavity is caused by the appearance of a basilar impression with Chiari I malformation. Indeed, the course of platybasia in our patient involved an impingement of the cerebellar tonsils in the foramen magnum and then an incomplete blocking of cerebrospinal fluid circulation.

After surgical decompression of the posterior fossa, without opening the syrinx, the cavity regresses. Nevertheless, the continuing development of platybasia favors the impingement of the cerebellar tonsils in the spinal canal and the reappearance of the syrinx.

The mechanism of skull base inflection leading to platybasia seems to occur at the expense of the intersphenoidal and sphenooccipital synchondroses. Ossification of the intersphenoidal synchondrosis normally occurs between the ages of 8 months and 6 years,19 and that of the sphenooccipital synchondrosis later in adolescence. A delay in ossification of the growth cartilages of the skull base or hyperlaxity in the synchondroses could account for the deformations, although this mechanism has not been clearly determined. The malformations of the craniovertebral junction encountered in Hajdu–Cheney syndrome are not specific to this disease. Osteogenesis imperfecta is a more common disease that differs from Hajdu–Cheney syndrome. However, that is, basilar impression.22 Two cases of syringomyelia associated with osteogenesis imperfecta have been reported.14,23

For large basilar impressions, several authors have recommended the performance of anterior decompression by a transoral approach associated with occipitocervical internal fixation.7,12,23 It is necessary, however, to take into account significant oral anomalies in children with Hajdu–Cheney
Syringomyelia in a case of Hajdu–Cheney syndrome

The development of the basilar impression and the course of platybasia can be stopped or delayed by very rigorous orthopedic treatment. For this reason, it is important to start orthopedic treatment early and delay surgery as long as possible. This requires considerable cooperation from the child, because immobilization is required until spinal growth ends.

Occipitocervical arthrodesis was considered for our patient, but we avoided it because such blocking in a young child would be likely to have more serious consequences on spinal growth than simple occipital craniectomy. Even though many authors recommend occipitocervical fusion, this does not prevent the progression of basilar impression in 80% of cases. Posterior fusion could also act as a hinge by allowing inflection to the bottom of the anterior skull base and thus worsening the anterior compression of the cephalic trunk. Only orthopedic treatment seems to be truly capable of slowing down the progression of basilar impression. If the orthotic device is effective in immobilizing the anatomy in question while the ossification centers solidify, then internal occipital stabilization will not be necessary.

Our clinical case followed the natural history of a serious form of platybasia in Hajdu–Cheney syndrome for more than 3 years. The age of the patient at the time of clinical manifestations, the very rapid development of skull base deformations, and the neurological complications illustrate the difficulties encountered in determining therapeutic strategy. The improvement and subsequent stabilization of the clinical status of our patient could only be obtained by occipital craniectomy, once the disease progression reached a critical point, followed by highly rigorous external immobilization. If the neurological signs reappear despite the external immobilization, a new posterior fossa decompression will be necessary and in this situation we will provide an occipitocervical internal fixation.

Conclusions

This case illustrates the therapeutic problems involved in rapidly progressing syringomyelia complicating Hajdu–Cheney syndrome in a very young child. Posterior fossa deformations, platybasia, and basilar impression were all manifestations of a very rapidly developing complex malformation. Priority should be given to orthopedic treatment throughout the growing years of the child. Decompressive surgery is indicated only in the event of neurological complications and as an adjunctive treatment with spinal immobilization.

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References


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