Assessment of foramen magnum in early infancy is efficient for patients with achondroplasia

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Background
- Achondroplasia (ACH) is the most common form of human short-limbed dwarfism. The most serious complication in children with ACH is narrowing of foramen magnum (FM) that results in cervicomedullary compression (CMC) and sudden infant death.
- To avoid sudden infant death, early monitoring and implementation of the necessary medical intervention are important. However, the optimal method of screening for CMC continues to be debated.

Objectives
- Determination of time and frequency of the screening in the patients with ACH to avoid severe complications due to narrowing of FM.

Materials and methods
- Patients: Children with ACH who were born at or referred to our hospital between April 2002 and June 2014 were collected (18 cases in total).
- Methods: We retrospectively examined for gestational age (GA), birth height, weight, head circumference, age at first screening MRI scan, age at presented radiological cervicomedullary compression, neurological or respiratory symptoms, and surgical history for FM decompression and ventriculo-peritoneal (VP) shunting in the patients.

Results
- **Demographic characteristics**
  - Age at diagnosis: Diagnosed at birth: 16/18 cases. Diagnosed during infancy: 2/18 cases – 8 month (Case 9) and 10 month (Case 10).
  - Age at performed first MRI: Performed between 1-11 month in age in all the cases. Median age: 4 month.
  - The frequency of CMC on MRI and the time presented CMC: 17/18 cases (94.4%) presented CMC. Age at presented CMC: 1 month to 1 year. Average age: 5.8 month. 15/18 cases had first MRI scan before 1 year of age, 9/15 cases (60%) presented with CMC at the time of first MRI.
- **Symptoms and surgery**
  - **FM decompression:** 6/18 cases (33.3%) had severe neurological findings, all of which had surgery. Age of surgery: 4 month to 6 month.
    - Case 1: Number in the hands at 5 month of age - Surgery performed at 6 month of age
    - Case 2: Hypotonia at 8 month - Surgery performed at 9 month of age
    - Case 3: Hypotonia on right side of the body at 4 month - Surgery performed at 5 month of age
    - Case 7: Sleep apnea at 7 month - Surgery performed at 8 month of age
    - Case 13: Hypotonia of upper limb at 8 month - Surgery performed at 11 year of age
    - Case 17: Hypotonia of left upper limb at 2.5 month, cardiopulmonary arrest at 4 month - Emergency surgery performed at 4 month of age
- Other than Case 7, symptoms seen in all other cases resolved after surgery. Because SANS of Case 7 did not improve after FM decompression, he had the adenosinecortex at 3 year of age.
  - **VP shunting:** 1/18 case (5.6%)
    - Case 2: Severe hydrocephalus without neurological symptoms - Surgery performed at 11 month of age

Discussion
- The frequency of children with ACH who required operation
  - **Comparison between rate of FM decompression with that of previous studies**
    - Yamasaki et al. 2015: 6/18 cases (33.3%)
    - This study: 15/18 cases (83.3%)
  - **Comparison between use of shunt placement with that of previous studies**
    - Yamasaki et al. 2015: 1/18 cases (5.6%)
    - This study: 15/18 cases (83.3%)

Criteria for medical intervention and time for examination
- Some advocated routine MRI and sleep study in the first 6 months of life, while others recommenced investigating only if clear clinical evidence exists.
- If no symptoms exist, clinical examination and neuroradiography are recommended at 3-monthly intervals until the age of 2 years.
- Surgery is indicated for ACH patients with progressive hypotonia, central hypopnea, complete lack of CSF flow on MRI, hyperreflexia, or clonus.

Case 2: 11 years 8 months girl
- Family history: Insignificant including short stature
- Disease history: Ultrasound at 35 weeks GA demonstrated shortened upper and lower limbs. Cæsarean section was performed at 38 weeks due to CPD (Apgar score was 8/9).
- The diagnosis of ACH was given based on bedside examination and X-ray finding. First MRI: Performed at 3 month of age.
- Progress: Although no obvious neurological symptoms developed, the expansion of the head circumference worsened – From 56 cm (+2.12SD) at 6 month of age to 49.0 cm (+3.05SD) at 8 month of age.
- Because of no obvious neurological sign was seen, observation was recommended by the brain surgeon.

Case 17: 11 months girl
- Family history: Insignificant including short stature
- Disease history: Ultrasound at 30 weeks GA detected short femurs. She was delivered at 38 weeks through normal vaginal delivery (Apgar score was 8/9).
- The diagnosis of ACH was given based on bedside examination and X-ray finding.
- First MRI: Performed at 2 month of age.
- Progress: At the 4 month visit, her mother explained that she had noticed hypotonia of the left upper limb since the patient was 2.5 month old. She was then scheduled for a head MRI 2 weeks later. She cried at catheherization for venous access at admission, and ten minutes later, fell into sudden cardiac arrest. Cardiopulmonary resuscitation was successfully performed and she was then transferred to another hospital that specialized in pediatric brain surgery.

In this study
- 50% of patients presented with CMC before 4 months of age.
- To avoid the risks of complications due to cervicomedullary compression, careful monitoring of any rapid changes in head circumference and observations of neurological and respiratory symptoms are important in patients with ACH.

Conclusion
We advocate the first MRI scan to be performed before 4 months of age for all children with ACH.

References:
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8) Grabb PA, Neurosurgery 1999; 41: 520-528.