



# Headache with Focal Neurologic Signs in Children at the Emergency Department

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**Objective** To identify predictors of secondary headache in children consulting at the pediatric emergency department (ED) for headache with a focal neurologic deficit.

**Study design** In this prospective cohort study, we enrolled children aged 6-18 years presenting to the ED of a tertiary care hospital with moderate to severe headache and focal neurologic deficit. Enrollment took place between March 2009 and February 2012. Children with a history of trauma, fever, or neurosurgical intervention were excluded from the study. The final diagnosis was made after 1 year of follow-up. Our primary aim was to identify any differences in the frequency of clinical signs between children with a final diagnosis of primary headache and those with a final diagnosis of secondary headache.

**Results** Of the 101 patients included in the study, 66% received a final diagnosis of primary headache (94% migraine with aura), and 34% received a final diagnosis of secondary headache (76.5% focal epilepsy). On multivariate analysis, children with bilateral localization of pain had a higher likelihood (aOR, 8.6; 95% CI, 3.2-23.2;  $P < .001$ ) of having secondary headache.

**Conclusion** Among children presenting to the ED with focal neurologic deficits, a bilateral headache location was associated with higher odds of having a secondary cause of headache. Additional longitudinal studies are needed to investigate whether our data can aid management in the ED setting. (*J Pediatr* 2014;165:376-82).

The prevalence of any type of headache in children ranges from 37% to 51%<sup>1,2</sup> and increases gradually during adolescence.<sup>3,4</sup> Headache is one of the most common reasons for consultation in the pediatric emergency department (ED). Triage systems have been developed and adapted to the pediatric population to differentiate urgent from nonurgent patients, allowing appropriate and efficient management.<sup>5-8</sup> In children with certain brain disorders, headache can be associated with focal neurologic signs or symptoms<sup>9</sup>; these children represent a true diagnostic challenge to physicians, owing to the possibility of severe underlying disease.<sup>10,11</sup>

The differential diagnosis in children with headache and focal neurologic signs includes primary etiologies, such as migraine with aura, and secondary etiologies, such as trauma, infection, and vascular, neoplastic, and epileptic disorders.<sup>9,12</sup> Diagnostic criteria for migraine have been established by the International Classification of Headache Disorders—II revision (ICHD-II).<sup>13</sup> Achieving a diagnosis in children can be challenging at times; important reasons for this include poor description of pain by children and several childhood periodic syndromes that can be common precursors of migraine.<sup>14</sup> As in adults, migraines in children can be classified into 2 major subtypes: migraines without aura, which are headaches with specific features and associated symptoms, and migraines with aura, which are characterized primarily by focal neurologic deficits that usually precede or sometimes accompany the headache. Unlike in adults, however, migraine in children may persist for less than 4 hours, and may have a bilateral distribution in young children.

The aim of the present study was to investigate the etiology of headache with focal neurologic deficits in children, and to identify those clinical features associated with a diagnosis of secondary headache in this population.

## Methods

This was a monocentric prospective cohort study of children presenting to the ED of a pediatric tertiary care hospital in Paris, France with headache associated

CT	Computed tomography
ED	Emergency department
EEG	Electroencephalography
ICHD-II	International Classification of Headache Disorders—II revision
IEH	Ictal epileptic headache
MRI	Magnetic resonance imaging

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with 1 or more focal neurologic deficits. Focal deficits result from the impairments of nerve, spinal cord, or brain function and affect a specific region of the body. These were defined according to the ICHD-II guidelines as symptoms related to focal brain (usual cerebral) disturbance.<sup>13</sup> Patients were enrolled between March 2009 and February 2012. The hospital's Institutional Review Board approved the study protocol. Written informed consent was obtained from parents, and assent was obtained from the children.

All consecutive patients aged 6-18 years presenting to the ED with headache and a focal neurologic deficit were eligible for this study. Age 6 years was chosen as a cutoff because children are usually able to describe their symptoms at this age. No patients were missed, because at least 1 physician who was familiar with the study procedures was constantly present in the ED.

Pain was assessed using the Faces Pain Scale-Revised<sup>15</sup> or the Visual Analog Pain Scale,<sup>16</sup> and the pain level "moderate or severe" was defined as a value  $\geq 4$ . Only children with a history of moderate or severe headache were included in the study. Children with a history of fever in the preceding 24 hours, head trauma in the preceding 7 days, or a history of neurosurgical intervention were excluded from the study.

ED physicians, together with the parents and child, completed a structured questionnaire containing questions relating to demographic information, coexisting medical conditions, previous episodes of headache, symptoms of the current headache attack (ie, duration, localization of pain, quality of pain, nausea, vomiting, phonophobia, photophobia, aggravation by physical activities, trigger factors), and characteristics of associated neurologic signs (further classified into visual, motor, sensory, or a combination) for statistical analysis.

After the child was discharged from the ED, the family received a headache booklet in which to record any further headache attacks, their characteristics, associated signs, triggers, and response to prescribed treatments. Children were followed up over 1 year at the Neurologic Clinic of the same hospital following the current standards of care for their diagnosis.

Neuroimaging (head computed tomography [CT] scan or brain magnetic resonance imaging [MRI]) or electroencephalography (EEG) was performed if clinically indicated. An awake and asleep EEG was performed during the ED consultation to support or exclude a diagnosis of epilepsy if the child was in an altered state of consciousness without a reasonable explanation based on iatrogenic (eg, benzodiazepine administration), clinical, radiologic, or metabolic factors. An awake and asleep EEG was performed during follow-up in children with either a history of signs suggestive of seizures (eg, blinking, ocular jerks, limb twitches, tongue and lip movements, tachycardia, altered respiratory patterns) or episodes of altered consciousness of uncertain etiology.

At the end of the 1-year follow-up period, a final diagnosis of the acute episode was made by a pediatric neurologist who had access to all data and was blinded to the aim of the study. The diagnosis of primary headache was defined according to ICHD-II criteria<sup>13</sup> (Table I).

**Table I. International Headache Society diagnostic criteria for migraine without aura and migraine with aura<sup>13</sup>**

Migraine without aura
A. At least 5 attacks fulfilling criteria B-D
B. Headache attacks lasting 4-72 hours (untreated or unsuccessfully treated). In children, attacks may last 1-72 hours.
C. Headache with at least 2 of the following characteristics: <ul style="list-style-type: none"> <li>• Unilateral location (commonly bilateral in young children)</li> <li>• Pulsating quality</li> <li>• Moderate or severe pain intensity</li> <li>• Aggravation by or causing avoidance of routine physical activity</li> </ul>
D. During headache, at least 1 of the following: <ul style="list-style-type: none"> <li>• Nausea and/or vomiting</li> <li>• Photophobia and phonophobia</li> </ul>
E. Not attributed to another disorder
Migraine with typical aura
A. At least 2 attacks fulfilling criteria B-D
B. Aura consisting of at least 1 of the following, but no motor weakness: <ul style="list-style-type: none"> <li>• Fully reversible visual symptoms including positive features (eg, flickering lights, spots, lines) and/or negative features (eg, loss of vision)</li> <li>• Fully reversible sensory symptoms including positive features (eg, pins and needles) and/or negative features (eg, numbness)</li> <li>• Fully reversible dysphasic speech disturbance</li> </ul>
C. At least 2 of the following: <ul style="list-style-type: none"> <li>• Homonymous visual symptoms and/or unilateral sensory symptoms</li> <li>• At least 1 aura symptom developing gradually over <math>\geq 5</math> min and/or different aura symptoms occurring in succession over <math>\geq 5</math> min</li> <li>• Each symptom lasting <math>\geq 5</math> and <math>\leq 60</math> min</li> </ul>
D. Headache fulfilling criteria B-D for migraine without aura begins during the aura or follows aura within 60 min
E. Not attributed to another disorder

## Statistical Analyses

All data are reported as median (IQR) unless otherwise specified. Categorical variables are described as frequency and percentage. Means of quantitative variables were compared using the *t* test, and categorical variables were compared using the  $\chi^2$  test. The level of significance was  $P < .05$  (2-sided tests). Multivariate logistic regression analysis included variables associated with the outcome with a *P* value  $< .20$  in the univariate analysis and then selected with an Akaike information criterion stepwise procedure. aORs and their 95% CIs were calculated. All statistical analyses were performed using R (R Institute for Statistical Computing, Vienna, Austria).

## Results

During the study period, a total of 79 433 patients aged 6-18 years presented to our ED. Of these patients, 2086 (2.63%) suffered from moderate to severe nonfebrile, nontraumatic headache, and 102 (0.13%) presented with at least 1 associated focal neurologic deficit. One family refused to provide consent (Figure). A total of 101 patients (55 females and 46 males) were enrolled. The median age at presentation to the ED was 11.2 years (IQR, 9.3-13.3 years), with no statistical difference between the sexes. For 77 patients (76.2%), this was the first episode of headache with neurologic deficit; 34 patients (33.6%) had a previous diagnosis of migraine.

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