The Utility of Neuroimaging in the Evaluation of Children With Migraine or Chronic Daily Headache Who Have Normal Neurological Examinations

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Objectives.—To assess the utility of neuroimaging in the evaluation of children presenting with two of the most common forms of headache, migraine and chronic daily headache, and to determine the utility and pathological yield of neuroimaging in specific headache syndromes in children whose neurological examinations are normal.

Methods.—We retrospectively reviewed the medical records of patients coded for headache (ICD 784) in the Pediatric Neurology Clinic at Children’s Hospital of the King’s Daughters between 1997 and 1999. The age range considered was between 6 and 18 years. The study focused on the two most common types of headache, uncomplicated migraine and chronic daily headache. Only patients with normal physical and neurological examinations were considered in this analysis.

Results.—Three hundred two patients were coded for headache within the defined age group. One hundred seven (35.4%) patients fulfilled IHS-R criteria as having uncomplicated migraine with a normal examination, and 30 (9.9%) patients fulfilled criteria for chronic daily headache. Twenty-nine (9.6%) patients presented with migrainelike symptoms, and 6 (2.0%) presented with chronic daily symptoms, but had neurological abnormalities present on examination. The remainder of the patients with headache had the following etiologies: 50 (16.6%) with secondary headache, 22 (7.3%) with complicated migraine, 20 (6.6%) with posttraumatic headache, 13 (4.3%) with seizure-related headache, 11 (3.6%) with brain tumors, 10 (3.3%) with tension-type headache, and 4 (1.3%) with pseudotumor cerebri.

Of the 107 patients with migraine, 42 (39.3%) received CT scans; 2 (4.8%) of which were considered “abnormal.” One of the abnormalities was an arachnoid cyst and the other was a dilated Virchow-Robin space. Twelve (11.2%) patients with migraine received an MRI, 2 (16.7%) of which were considered abnormal. Both of the abnormal findings were Chiari type I malformations.

Of the 30 patients with chronic daily headache, 17 (56.7%) received CT scans, 3 (17.6%) of which were considered abnormal. The abnormalities consisted of a maxillary opacification, a mucous retention cyst, and an occult vascular malformation. Eight (26.7%) of the patients with chronic daily headache had an MRI, 2 (25.0%) of which were abnormal. One of the abnormalities was a Chiari I malformation, and the other was an occult vascular malformation.

Conclusion.—The yield of neuroimaging in children with uncomplicated migraine and normal neurological examination was 3.7%. The yield in children with chronic daily headache and normal neurological examination was higher at 16.6%. The abnormalities discovered included arachnoid cysts, Chiari I malformations, sinus disease, occult vascular malformations and “dilated Virchow-Robin spaces.” While none of the neuroimaging findings were apparent clinically, their discovery did not influence the diagnosis, management, or outcome of the patients. None of the abnormalities necessitated surgical intervention or were associated with the headache presentation. There-
fore, neuroimaging is not warranted in children and adolescents with defined clinical headache syndrome diagnoses whose neurological examinations are normal.

**Key words:** headache, migraine, CT or MRI, neuroimaging, children and adolescents

**Abbreviations:** CDH chronic daily headache

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Headache is among the most common problems leading parents to seek medical attention for their children and is one of the most frequent reasons children are referred for neurological consultation.

With the proliferation of imaging centers, increasing patient demand for thorough and “high-tech” evaluation, and the increasing pressures to practice “defensive medicine,” neuroimaging in the form of CT or MRI is widely used to evaluate children with headache. Objective data to support this widespread practice is minimal.

Our objectives were two-fold. The pertinent medical literature was reviewed in order to define the yield of pathology when neuroimaging was performed to evaluate children with headache. Our second goal was to define specific clinical subsets of children with headache whose neurological examinations were normal, and to retrospectively review the results of neuroimaging in these populations. The two selected populations were children and adolescents with the clinical diagnosis of migraine and chronic daily headache (CDH).

Up to 7% of school-aged children and as many as 14% to 20% of adolescent girls suffer from migraine. Chronic daily headache is a less well-characterized, but nonetheless common, clinical diagnosis. In the general pediatric population, the prevalence of CDH was reported as 0.2% by Sillanpää et al and 0.9% by Abu-Arefeh and Russell. No specific diagnostic criteria have yet been established to classify children with CDH. We have chosen to define CDH in children or adolescents as 15 or more headaches per month that last 4 or more hours and that are present for 4 or more months.

**PHASE 1: LITERATURE REVIEW**

**Methods.—**A MEDLINE search of the literature from 1976 through 1999 was performed using the following key terms: diagnosis (including CT and MRI) of headache (including migraine) in patients under the age of 18.

All bibliographies of the articles cited were reviewed for additional papers, pertinent textbook references, and more recent journals were checked. Only those articles reporting studies with more than 25 patients were included. The excluded articles consisted of small numbers of case reports of unusual pathologic findings, which would have biased the analysis. Only studies in which the patients’ neurological examinations were documented were included in this project. The information was pooled and analyzed.

**Conclusions.—**Five studies were found and analyzed. All assessed the utility of neuroimaging in children with headache. None specifically focused on clinical subsets (eg, migraine). In one of the studies, only MRI was utilized; in all the others, either CT or both modalities were used. All of the studies were case series; one was prospective. All the data were classified as class III evidence.

A total of 1178 children with headache were evaluated, of whom 526 underwent neuroimaging. Those not imaged were followed clinically and no long-term problems were found. In those patients imaged, abnormalities were found in 55 (10.5%); however, 41 (7.8%) of the abnormalities were considered to be incidental or nonsurgical lesions. The types of nonsurgical abnormalities discovered included arachnoid cysts (10 patients), pituitary adenomas (4), vascular malformations (3), and a variety of “incidental” structural abnormalities (ie, cavum septi, pineal cysts, ventricular asymmetry, “hyperintense” lesions).

Fourteen children were found to have surgically treatable lesions. The total yield of pathology was 2.7%. Ten children had tumors (2 medulloblastomas, 2 cerebellar astrocytomas, and 1 each of choroid plexus papilloma, sarcoma, primitive neuroectoder-
mal tumor [PNET], glioblastoma multiforme [GBM], craniopharyngioma, brain stem glioma). Symptomatic vascular malformations were found in 3 children, and an arachnoid cyst that necessitated surgery was found in 1. In all 14 children found to have CT or MRI lesions considered surgically treatable abnormalities were described on neurological examination and included papilledema, abnormal eye movements including nystagmus, and motor or gait dysfunction.

All five studies conclude with remarks indicating that routine neuroimaging in the child or adolescent with headache and a normal neurological examination is rarely warranted and that clinical follow-up is a reliable and cost-saving alternative to routine neuroimaging.

PHASE 2: CLINICAL REVIEW

Methods.—We retrospectively reviewed records of patients coded for headache (ICD 784) in the Pediatric Neurology Clinic at Children’s Hospital of the King’s Daughters between 1997 and June 1999. The range of ages considered was between 6 and 18 years.

We then focused our study on two of the most common clinical presentations: migraine (with and without aura) and CDH. The clinical criteria used to define migraine were the International Headache Society proposed revisions by Winner et al. Migraine variants were excluded. Chronic daily headache was defined in the children or adolescents as 15 or more headaches per month that last 4 or more hours and that are present for 4 or more months.

Only those patients whose physical and neurological examinations were comprehensively documented to be normal were considered in this analysis. The records were further reviewed to determine if further diagnostic techniques (CT, MRI) were used and, if so, the results and relevance of the various abnormalities determined.

Results.—The search produced a list of 302 patients coded for headache within the age group we specified. From the list, 107 patients (35.4%) fulfilled our criteria as having uncomplicated migraine with a normal examination, and 30 patients (9.9%) fulfilled our criteria for CDH. Twenty-nine patients (9.6%) presented with migrainous symptoms. Six patients (2.0%) presented with chronic daily symptoms but had neurological abnormalities present on examination and thus were excluded. The remainder of the patients with headache had the following etiologies: 50 (16.6%) with secondary headache, 22 (7.3%) with migraine variants, 20 (6.6%) with posttraumatic headache, 13 (4.3%) with seizure-related headache, 11 (3.6%) with various CNS tumors, 10 (3.3%) with tension-type headache, and 4 (1.3%) with pseudotumor cerebri.

Of the 107 patients with migraine, 42 (39.3%) underwent CT scanning, 2 (4.8%) of which were considered “abnormal.” One of the abnormalities was an arachnoid cyst, and the other was a “dilated Virchow Robin space.” Twelve patients (11.2%) underwent MRI scanning, 2 (16.7%) of which were considered abnormal. Both of the abnormal findings were Chiari type I malformations.

Of the 30 patients with CDH, 17 (56.7%) received CT scans, 3 (17.6%) of which were considered abnormal. The abnormalities consisted of a maxillary opacification, a mucous retention cyst, and a vascular malformation. Eight patients (26.7%) had MRI scanning, 2 (25.0%) of which were abnormal. One of the abnormalities was a Chiari I malformation, and the other was a vascular malformation.

CONCLUSIONS

It is imperative for clinicians to have precise evidence-based guidelines for the evaluation and treatment of patients who present with headache. One of the greatest dilemmas in this process is whether or not to use costly imaging procedures.

From review of the literature, the yield for abnormalities was 10.5%. Of these abnormalities, 7.8% were judged to be incidental or nonsurgical findings. Pathological processes warranting surgical intervention were identified in 2.7%. All patients with surgically remediable lesions had objective neurological findings.

In our study, we explored the use of neuroimaging in an attempt to determine the utility and yield of such measures in the diagnosis and treatment of patients presenting with two of the most common forms of headache, migraine and CDH. Our principal goal was to establish whether imaging studies are useful in the evaluation of defined headache syndromes when available history, physical, and neurological examinations do not suggest pathology.
Focusing specifically toward defined clinical sub-sets (migraine and CDH) in whom normal examinations were recorded, the yield for abnormality was 3.7% in the migraine population and 16% in the CDH group. However, none of the findings were judged to be clinically relevant in either group. None of the abnormalities discovered necessitated surgical intervention. All of the abnormalities were judged to have no association with the headache presentation, and the findings did not impact on clinical plans or treatment. The neurodiagnostic studies did not effectively contribute to the evaluation or management of these patients. All abnormalities were clinically silent.

RECOMMENDATIONS

Based on a review of the evidence—which is class III—there is moderate clinical certainty to support the following practice guideline:

In the pediatric patient over 6 years of age with a specific headache diagnosis of uncomplicated migraine or CDH and with a normal general and neurological examination, the routine use of neuroimaging is not warranted.

In children with abnormal neurological examinations or other physical findings to suggest possible central nervous system disturbances (neurocutaneous markers, macrocephaly, etc), CT or MRI may be indicated.

Recommendations for future research include: (1) large prospective studies to define the clinical characteristics of headache in children that would help identify those at higher risk for intracranial disease; (2) large prospective studies of the yield of neuroimaging in children with normal neurological examinations; (3) evaluation of the role of repeated neuroimaging in children with previously negative studies; and (4) large prospective studies to assess the yield of neuroimaging in children with migraine as defined by IHS-R criteria.

REFERENCES