

Emergency Department Management of Migraine Headache in Children after Publication of National Practice Guidelines

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Abstract

Objective: To determine the effect of the publication of consensus-based practice guidelines for Emergency Department (ED) management of severe migraine headache (September 2005) in an academic pediatric ED.

Methods: All eligible visits for migraine to an urban pediatric tertiary medical center by patients aged 3-16 years in 2003-2006 were identified by searching the electronic medical records using an electronic text tool followed by manual review. Data recorded from the medical charts included demographics, headache characteristics, past medical history, family history, ED management, response to therapy, and disposition. The primary outcome measure was the pharmacologic intervention provided before and after September 2005.

Results: Of the 324 eligible visits, 192 (59%) occurred before September 2005 and 132 after. Median patient age was 13.8 years (IQR 12-15.2); 61% were female. Prior migraine was reported in 38%. The most common first-treatment drugs were nonsteroidal anti-inflammatory agents (n=185), phenothiazines (n=61), metoclopramide (n=55), and ondansetron (n=34). Comparison of the two periods yielded a significant increase in the use of ketorolac and/or prochlorperazine (p=0.03), and a decrease in the rate of persistent pain (p<0.05). The change occurred gradually over the whole study period rather than instantaneously at the time of guideline publication (effect of time in the model, p=0.005).

Conclusions: Significant changes have occurred in the management of migraine headache in children, in accordance with national practice guidelines. The gradual change observed in the use of ketorolac and/or prochlorperazine, starting already before publication of the guidelines, suggests a gradual diffusion of knowledge and its application over time.

MeSH Words: migraine, NSAIDs (nonsteroidal anti-inflammatory agents), ketorolac, prochlorperazine, guidelines

Introduction

Migraine headache is a common but challenging diagnosis in children, with an estimated prevalence of 2.7% to 10% across pediatric age groups [1,2]. The rate rises towards adolescence [3,4]. The diagnosis of childhood migraine is based on a classification system created by the International Headache Society [1] (Figure 1), but its accuracy is limited by the poor ability of

children to reliably describe their symptoms. Once the diagnosis is made, there are many established methods for outpatient management that include both pharmacologic and lifestyle interventions tailored to individual patients and disease characteristics.

In September 2005, based on a comprehensive review of pediatric clinical trials, Damen et al. [5] formulated the first widely published

consensus statement addressing the approach to acute migraine in children. Until then, there had been no uniform treatment regimen, and emergency physicians and pediatric emergency physicians were forced to rely on the results of research in adult patients. One of the major recommendations of the document was the use of ketorolac and prochlorperazine as the primary parenteral therapies.

Consensus guidelines have the potential to rapidly and uniformly alter the clinical approach to disease processes. This is true for the emergency department (ED) setting as well. Examples include periodic changes in advanced cardiac life support algorithms [6], management of febrile infants [7], and management of closed head injuries in young children [8].

The aim of this study was to determine whether the 2005 systematic review led to significant changes in the pharmacologic management of migraine in an academic pediatric emergency department, with greater use of ketorolac and prochlorperazine.

Figure 1. International Headache Society criteria for migraine

International Headache Society Diagnostic Criteria for Migraine

Diagnostic Criteria

- A. At least 5 attacks fulfilling criteria B-
- B. Headache attacks lasting 4-72 hours (untreated or unsuccessfully treated)
- C. Headache has at least two of the following: characteristics.
 1. Unilateral location
 2. Pulsating quality
 3. Moderate or severe pain intensity
 4. Aggravation by or causing avoidance of routine physical activity
- D. During headache at least one of the following:
 1. Nausea and/or vomiting
 2. Photophobia and phonophobia
- E. Not attributed to another disorder

Methods

We reviewed the electronic medical records (EMRs) of eligible visits of an urban, university-associated, tertiary care pediatric emergency department between January 2003 and December 2006. Inclusion criteria were patient age 3-16 years, a presenting chief complaint of headache consistent with migraine, and a final diagnosis of migraine made by either the ED attending

physician or a consulting pediatric neurologist. Exclusion criteria were a final diagnosis other than migraine (including non-migrainous headache), presence of fever, transfer from another facility where therapy had already been initiated, and more than one visit by the same patient within one week or more than three visits within one year. Case identification was accomplished using a two-tiered system: All EMRs were first queried electronically using a novel regular-expression methodology [9]; thereafter, a manual review was performed (by H.C.) to assure that the visit was for acute migraine headache. The technique of regular expression provides a more comprehensive search than key words, because it also detects misspelled and abbreviated versions of an index word, for example capturing headache that is recorded as "HA" [9]. The data abstracted from each chart included demographic variables (age, sex), headache characteristics, and past medical, social and family history. Detailed data on ED management, response to therapy, and disposition were also recorded. Over the entire study period, our ED utilized the Wong-Baker visual analog scale for pain assessment.

The medications used for management and patient outcome were compared between the period before publication of the guidelines (January 2003 to end-August 2005; first period) and after (September 2005 to December 2006; second period). All statistical modeling was based on logistic models fit with the GENMOD procedure of SAS 9.1 (SAS Institute, Cary, NC). Two-sided tests were carried out at the 5% level. For the pre-post test of the unadjusted effect of the guidelines, we used a logistic model with a single binary predictor for guidelines. To analyze the added effect of time, we used a logistic model with predictors for guidelines, time, and age. This study was approved by our Institutional Review Board.

Results

Using the text search tool, 105,751 age-eligible patient records were screened, yielding 1732 records for second-tier review. The final sample included 324 eligible visits (Figure 2): 192 occurred before September 2005 (first period) and 132 later (second period). Median age of the patients was 13.8 years [IQR 12-15.2]; 199 (61%) were female. Prior migraine was reported in 38% of study visits. Other baseline

characteristics are shown in Table 1. Common migraine was the most prevalent type. Only 9.4% of patients reported an antecedent aura. Nearly half the patients presented to the ED within 24 hours of the onset of pain. The pain characteristics were diverse; the most common complaints were throbbing or pounding (24.8%). Frontal pain was more common than pain in other locations (32.4%). Photophobia was reported in 31.4% of cases. The most consistent associated complaints were gastrointestinal; 50.6% of children reported nausea or vomiting. A neurology consult was obtained in 40.7% of visits, usually because the patient was under active follow-up in the hospital neurology department.

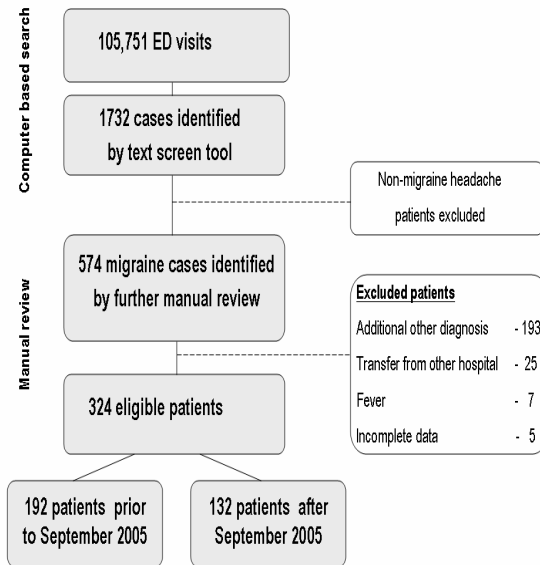


Figure 2. Case identification

The most common medications used as the first treatment in the ED were the nonsteroidal anti-inflammatory drugs (NSAIDs) acetaminophen, ibuprofen, and ketorolac (n=185), followed by phenothiazines (n=61), metoclopramide (n=55),

and ondansetron (n=34). As shown in Table 2, the use of ketorolac and/or prochlorperazine increased significantly over time (p=0.03). There was a strong effect of time over the study period on continuous improvement in adherence to consensus guidelines (p=0.01) (Figure 3). The use of triptans for acute management was uniformly low both before and after September 2005: 3% of visits in the first period and 3.7% in the second (p=0.74).

Pain score and the response to medication were recorded in 73% of the visits. The rate of pain persistence dropped significantly, from 14% in the first period to 6% in the second (OR 0.39; 95% CI 0.14-0.97). Throughout the study period, hospital admission rates for treatment failure (persistent pain) were low: 6% in the first period and 5% in the second (OR 0.71; CI 0.24-1.89). In the first period, one round of medications was administered in 133/192 visits (68.3%), and in the second period, in 89/132 visits (67.4%). There was no significant difference in the need for additional courses of medication in the ED between the two periods (12% vs. 8%; OR 0.67; CI 0.3-1.39).

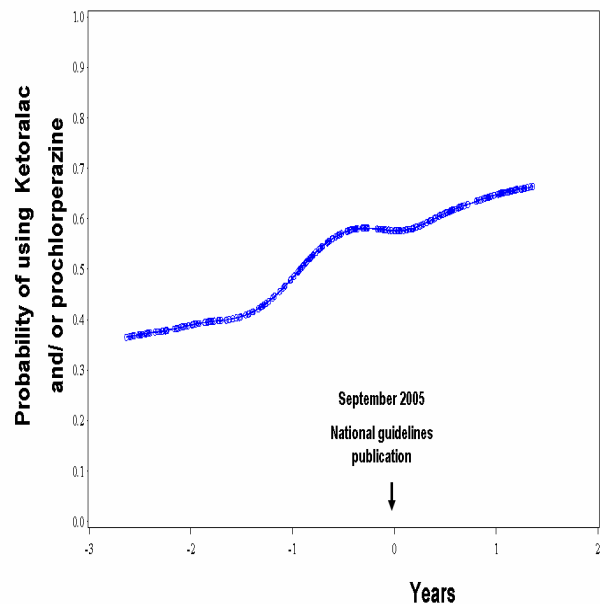


Figure 3. Probability of using ketorolac and/or prochlorperazine over the study period.

Table 1. Patient demographics

ED visits (ages 3-16 years)		
N	105,751	
Median age (years)	13.81 IQR(11.93, 15.28)	
Female (%)	61.4(%)	
Cases Identified by text search tool		
1,732		
Migraine study population		
N	324	
	<i>Pre -guideline</i>	<i>Post -guideline</i>
N	192	132
Median age (years)	13.67 IQR (11.65,15.35)	13.7 IQR (12.6, 14.77)
Female (%)	63.5%	58.3%
Headache <24 hours (%)	44.8%	50.0 %
Migraine history recorded (%)	65.1%	65.1%
Family migraine history recorded (%)	24.0 %	33.3%
Migraine medications at home	117 (60.9%)	77 (58.3%)

Table 2. First round of medication administered

Medication	Pre- guideline	Post-guideline
No medications	47	33
Ketorolac	87	71
Metoclopramide	35	21
Ondansetron	25	11
Prochlorperazine	20	41
Ibuprofen	17	8
IV narcotic	12	3
Acetaminophen	8	3
Triptan	7	3
Butalbital	5	0
Promethazine	5	1
Benzodiazepine	2	1
Oral narcotic	1	1
Periactin	1	0

Discussion

As part of the study of changes in clinical practice, it is particularly difficult to determine if a discrete change in approach leads to global shifts in management. The typical pharmacologic management of pediatric migraine varies among providers and among EDs. In a recent study, Richer et al. [10] reported that 44.2% of pediatric patients presenting to the ED with a diagnosis of migraine did not receive any treatment. Oral

analgesics were given in 23.3% of cases, whereas opiates, ketorolac, and dihydroergotamine were each given much less frequently (5.5%, 4.7%, and 1% of the time, respectively). Although this study was performed in Canada and may not completely mimic US practice parameters, it serves to illustrate the great variation in pediatric migraine treatment and the lack of a uniform approach. Similarly, Bailey and McManus [11], in a comprehensive review of the highest quality

studies on ED management of pediatric migraine, concluded that “there is a lack of studies addressing the question of treatment in the ED for children experiencing migraine.”

Our data, collected in a single large pediatric ED, demonstrate an increase in the use of prochlorperazine and ketorolac over a small window of time, consistent with published, systematically derived recommendations. Given that the change was continuous over the 4 years of the study, trending upward both prior to and after publication of the guidelines, we assume it was the result of diffusion of knowledge as well as diffusion of practice. In terms of *diffusion of knowledge*, our practitioners were exposed to the same evidence that led to publication of the guidelines, which may account for the steady increase in the administration of NSAIDs and prochlorperazine prior to September 2005. In terms of *diffusion of practice*, even when knowledge is absorbed, the effect on practice is not immediate, but rather diffuses via teaching, quoting the guidelines to colleagues, etc. This may account for the continued steady increase in use of NSAIDs and prochlorperazine after September 2005.

Various success rates of abortive pharmacotherapy for migraine have been reported. Hamalainen et al. [12] found that the percent alleviation at 2 hours was 68% with ibuprofen and 54% with acetaminophen. Placebo alone had a success rate of 37%. The percentage of escape medication required was low: 10% in the ibuprofen group, 16% in the acetaminophen group, and 23% in the placebo group. In the present study, there was a correlation between the increasing use of prochlorperazine and ketorolac and treatment success, as evidenced by decreased pain persistence and a lower proportion of visits in which a second course of medications was administered. Furthermore, despite the wide variation in the types of medications used to treat migraine both before and after the recommendations, we noted a trend toward the use of ketorolac and prochlorperazine and away from narcotics and other drugs that had not been recommended (Table 2). These findings are consistent with the study of Brousseau et al. [13] comparing the effectiveness of two commonly used intravenous drugs, ketorolac and prochlorperazine. It is also noteworthy that the consensus guidelines specifically discourage the use of triptans. In our

ED, triptans were not largely used either before or after the recommendations. The bulk of the change in migraine care involved the decreased use of narcotics.

Our study had a number of limitations. First, the sample was small and may have been underpowered to demonstrate significance in secondary measures such as hospitalization rates and need for additional courses of medications. These beneficial effects have been described by others and helped to form the basis of the consensus guidelines; larger studies are required for their further validation. Another main limitation is the study's retrospective design. For example, precise analysis of the pain response to medications was difficult because this must be clearly indicated in the medical record. Nevertheless, methods of physician documentation did not change over the study interval, making it unlikely that the observed changes between the periods were the result of shortcomings in chart documentation. The study was based on a chart review of typed physician notes, such that pain assessments recorded by nurses were not accessible. However, here again, there were no changes in documentation over the study period, suggesting that the changes observed in practice were not the result of data gaps.

In summary, the recommendations published in the 2005 consensus guidelines on pediatric migraine management appear to have significantly affected the treatment of acute migraine in our ED, leading to a secular increase in the use of prochlorperazine and ketorolac and a decrease in the use of narcotics. The observed practice change likely resulted from the combination of diffusion of knowledge of the data underlying the consensus statement as well as diffusion of practice in the months following its publication.

References

1. Lewis D, Ashwal S, Hershey A, Hirtz D, Yonker M, Silberstein S. Practice parameter: pharmacological treatment of migraine headache in children and adolescents: report of the American Academy of Neurology Quality Standards Subcommittee and the Practice Committee of the Child Neurology Society. *Neurology* 2004; 63(12):2215-2224.

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2. Pakalnis A. Pediatric migraine: new diagnostic strategies and treatment options. *Expert Rev Neurother* 2006; 6(3):291-296.
 3. Stewart WF, Linet MS, Celentano DD, Van Natta M, Ziegler D. Age- and sex-specific incidence rates of migraine with and without visual aura. *Am J Epidemiol* 1991; 134(10):1111-1120.
 4. Lewis DW, Ashwal S, Dahl G, Dorbad D, Hirtz D, Prenskey A, et al. Practice parameter: evaluation of children and adolescents with recurrent headaches: report of the Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society. *Neurology* 2002; 59(4):490-498.
 5. Damen L, Buijn JK, Verhagen AP, Berger MY, Passchier J, Koes BW. Symptomatic treatment of migraine in children: a systematic review of medication trials. *Pediatrics* 2005; 116(2):e295-e302.
 6. 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation* 2005; 112(24 Suppl):IV1-203.
 7. Baraff LJ, Bass JW, Fleisher GR, Klein JO, McCracken GH Jr, Powell KR, et al. Practice guideline for the management of infants and children 0 to 36 months of age with fever without source. Agency for Health Care Policy and Research. *Ann Emerg Med* 1993; 22(7):1198-1210.
 8. Schutzman SA, Barnes P, Duhaime AC, Greenes D, Homer C, Jaffe D, et al. Evaluation and management of children younger than two years old with apparently minor head trauma: proposed guidelines. *Pediatrics* 2001; 107(5):983-993.
 9. Watt A. *Beginning Regular Expressions*. Indianapolis, Ind.: Wiley, 2005.
 10. Richer L, Graham L, Klassen T, Rowe B. Emergency department management of acute migraine in children in Canada: a practice variation study. *Headache* 2007;47(5):703-10.
 11. Bailey B, McManus BC. Treatment of children with migraine in the emergency department: a qualitative systematic review. *Pediatr Emerg Care* 2008;24(5):321-30.
 12. Hamalainen ML, Hoppu K, Valkeila E, Santavuori P. Ibuprofen or acetaminophen for the acute treatment of migraine in children: a double-blind, randomized, placebo-controlled, crossover study. *Neurology* 1997; 48(1):103-107.
 13. Brousseau DC, Duffy SJ, Anderson AC, Linakis JG. Treatment of pediatric migraine headaches: a randomized, double-blind trial of prochlorperazine versus ketorolac. *Ann Emerg Med* 2004; 43(2):256-262.
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