

Marco A. Arruda
Carlos A. Bordini
Marcelo C. Ciciarelli
José G. Speciali

Decreasing the minimal duration of the attack to 1 hour: is this sufficient to increase the sensitivity of the ICHD-II diagnostic criteria for migraine in childhood?

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M.A. Arruda (✉) • C.A. Bordini
M.C. Ciciarelli • J.G. Speciali
Department of Neurology,
Ribeirão Preto Medical School,
São Paulo, Brazil,
e-mail: brheadache@netsite.com.br

Abstract We applied the second edition of the International Classification of Headache Disorders (ICHD-II) in 417 children (age range, 2–12 years) with chronic headaches attending a pediatric headache clinic. The initial diagnosis was made according to the ICHD-II while the final diagnosis was, based on the longitudinal intuitive clinical diagnosis (LICD), deemed to be the gold standard. The diagnosis of migraine without aura had a sensitivity of 52%, a specificity of 100% and a positive predictive value of 100%; for the diagnosis of migraine (at the one-

digit level) these values were 87%, 100% and 100%, respectively. The ICHD-II criteria for migraine without aura have high specificity but low sensitivity in childhood, even considering the minimal duration of the attacks to be 1 hour. Other factors, such as the existence of subgroup 2.4 (probable tension-type headache), are responsible for the low sensitivity of ICHD-II criteria for the diagnosis of migraine without aura in patients of this age group.

Key words Headache classification • Migraine • Childhood • Diagnosis

Introduction

The first edition of the International classification of Headache Disorders (ICHD-I) [1] was published in 1988 and henceforth it has been widely applied and validated [2]. However, since 1992, many studies have shown the high specificity but low sensitivity of the ICHD-I diagnostic criteria for migraine without aura when applied in children [3–15]. In spite of the different methodologies, the intuitive clinical diagnosis was considered the gold standard by these authors and the diagnosis was made in cohorts, not longitudinally. The two most important proposals for the modification of ICHD-I for migraine without aura were to decrease the minimal duration of the

attacks to 1 hour [3, 6–14, 16, 17] and to exclude the criteria related to the duration of attacks [15].

In 2003, after 15 years, the second edition of the International Classification of Headache Disorders (ICHD-II) was presented in Rome during the congress of the International Headache Society (IHS) [18]. Concerning migraine and tension-type headache, the pivotal changes were the following:

1. Concerning the diagnosis of migraine without aura, the minimal duration of attacks in children was decreased from 2 to 1 hour.
2. The migraine with aura group was reclassified as follows: typical aura with migraine headache (1.2.1), typical aura with non-migraine headache (1.2.2), typical aura without headache (1.2.3), familial hemiplegic

- migraine (1.2.4), sporadic hemiplegic migraine (1.2.5) and basilar-type migraine (1.2.6).
3. Chronic migraine, persistent aura without infarction and migraine triggered seizure are new entrants in the group of complications of migraine.
 4. Ophthalmoplegic migraine was transferred from the migraine group to the cranial neuralgias group (group 13).
 5. Alternating hemiplegia of childhood was removed and abdominal migraine and cyclical vomiting were included in the group of childhood periodic syndromes that are commonly precursors of migraine;
 6. The following terminological changes were made:
 - (a) Migrainous disorders not fulfilling migraine criteria are now called probable migraine (group 1.6);
 - (b) Headache of the tension-type not fulfilling the tension-type headache criteria are called probable tension-type headache (group 2.4);
 - (c) Basilar migraine how are termed basilar-type migraine (1.2.6);
 - (d) Childhood periodic syndromes that may be precursors to or associated with migraine are classified under childhood periodic syndromes that are commonly precursors of migraine.
 7. A new subdivision of the episodic tension-type headache was proposed: infrequent and frequent episodic tension-type headache.

To determine if the reduction in the minimal duration of the migraine attack to 1 hour and the other previously mentioned changes are able to improve the sensitivity of the ICHD-II criteria in childhood, we performed a historical cohort study in a group of children with chronic headache.

Materials and methods

We selected 489 consecutive children with recurrent and chronic headache who attended for the first time the Childhood Headache Clinic of the Clinical Hospital of Ribeirão Preto (São Paulo University, Brazil).

A semi-structured, standardized and validated questionnaire designed to provide the information required in ICHD-II was administered to the children and their mothers.

The initial diagnosis was retrospectively made according to the ICHD-II. The final diagnosis was prospectively based on the longitudinal headache history, any given information in the headache diary, the family history, the complementary investigations and the effects of prophylactic drugs, as advised in ICHD-II. This method of diagnosis was called longitudinal intuitive clinical diagnosis (LICD) and was deemed to be the gold standard.

Some conventions concerning migraine with aura criteria of the ICHD-II were adopted in order to make possible its application in this study group. The length of time of aura development

and the duration of aura were not considered. All the other criteria for migraine with aura were fully respected.

In some children, the characteristics of the headache attack fulfilled the criteria for both types of headaches simultaneously: probable migraine (1.6) and probable tension-type headache (2.4). According to rule number 5 of the ICHD-II: "Fulfillment of the diagnostic criteria for *1 migraine, 2 tension-type headache or 3 cluster headache and other trigeminal autonomic cephalalgias*, or any of their subtypes, always trumps fulfillment of criteria for the *probable* diagnostic categories of each, which are last-described in the respective groups. In other words, a patient whose headache fulfils criteria for both *1.6 probable migraine* and *2.1 infrequent episodic tension-type headache* should be coded to the latter." Nevertheless, which categories must prevail when both are probable diagnoses? Although the ICHD-II does not establish the solution for this condition, these children were here classified as a distinct group in order to ascertain the evolution of their diagnoses (group 1.6+2.4).

The comparison of the initial (ICHD-II) and final (LICD, gold standard) diagnoses allowed us to calculate the following parameters: sensitivity, specificity and positive predictive value (PPV) of the ICHD-II, and subsequently, to identify false-positive and false-negative cases.

Results

Of 489 children initially selected, 72 (14.7%) were excluded from the study for not attending the follow-up visits (48 children) or because the charts were not properly fulfilled during the initial interview (24 children).

The final sample was composed of 417 children, 205 boys and 212 girls, with ages ranging from 2 to 12 years (mean age, 8.8 years; SD=2.3 years). The mean length of follow-up was 16 months (SD=12.9 months).

According to ICHD-II criteria, migraine without aura was the most frequent headache diagnosed in this group (122 children, 29.3%), followed by migraine with aura (114 children, 27.3%). Other frequent diagnoses were probable migraine without aura, probable migraine plus probable tension-type headache, frequent episodic tension-type headache, probable frequent episodic tension-type headache, probable migraine with aura and chronic tension-type headache (Table 1). In 42 children (10.1%) the characteristics of the headache attacks fulfilled the explicit criteria for two types of headaches simultaneously: probable migraine and probable tension-type headache (group 1.6 + 2.4, Table 1). Other headache disorders were less frequently diagnosed: primary stabbing headache, chronic post-traumatic headache, headache attributed to increased intracranial pressure or hydrocephalus caused by neoplasm, exogenous hormone-induced headache and headache unspecified (Table 1).

Compared to the diagnoses made with ICHD-II, with LICD (Table 1) there was a higher frequency of migraine

Table 1 Diagnoses of 417 children with recurrent chronic headache, according to the International Classification of Headache Disorders, 2nd edition (ICHD-II) and the longitudinal intuitive clinical diagnosis (LICD) deemed to be the gold standard. Values are number (percentage) of children

Diagnosis	ICHD-II	LICD
Migraine without aura (1.1)	122 (29.3)	236 (56.6)
Migraine with aura (1.2)	114 (27.3)	151 (36.2)
Probable migraine without aura (1.6.1)	44 (10.5)	– (0)
Probable migraine with aura (1.6.2)	18 (4.3)	– (0)
Frequent episodic tension-type headache (2.2)	33 (7.9)	15 (3.6)
Chronic tension-type headache (2.3)	7 (1.7)	5 (1.2)
Probable frequent episodic tension-type headache (2.4.2)	31 (7.4)	0 (0)
Probable migraine plus probable tension-type headache ^a (1.6+2.4)	42 (10.1)	0 (0)
Primary stabbing headache (4.1)	1 (0.2)	1 (0.2)
Chronic post-traumatic headache (5.2)	1 (0.2)	1 (0.2)
Headache attributed to increased intracranial pressure or hydrocephalus caused by neoplasm (7.4.1)	1 (0.2)	1 (0.2)
Exogenous hormone-induced headache (8.3.1)	2 (0.5)	2 (0.5)
Headache unspecified (14.2)	1 (0.2)	5 (1.2)
Total	417 (100)	417 (100)

^a Children whose headache fulfills the diagnostic criteria for probable migraine (1.6) and probable tension-type headache (2.4) simultaneously. They were here classified as a distinct group in order to ascertain the evolution of their diagnoses

without aura (236 children, 56.6%) and migraine with aura (151 children, 36.2%), and a lower frequency of frequent episodic tension-type headache (15 children, 3.6%) and chronic tension-type headache (5 children, 1.2%).

The migration of diagnoses from ICHD-II to LICD is shown in Table 2.

Of 236 cases of migraine without aura according to LICD, 122 were initially diagnosed as migraine without aura by the ICHD-II, 44 as probable migraine without aura, 14 as frequent episodic tension-type headache, 1 as chronic tension type-headache, 25 as probable frequent episodic tension-type headache and the remaining 30 cases as fulfilling the criteria for probable migraine and probable tension-type headache simultaneously. Of 151 cases of migraine with aura according to LICD, 114 were initially diagnosed as migraine with aura by the ICHD-II, 18 as probable migraine without aura, 1 as frequent episodic tension-type headache, 1 as chronic tension type-headache, 5 as probable frequent episodic tension-type headache and the remaining 12 cases fulfilling the criteria for probable migraine and probable tension-type headache simultaneously. Of 5 cases of headache unspecified according to LICD, only 1 case had the same diagnosis by ICHD-II, 3 were initially diagnosed as frequent episodic

tension-type headache and 1 case fulfilled the criteria for probable migraine and probable tension-type headache simultaneously. All the remaining cases had the same diagnosis according to LICD and ICHD-II (Table 2).

According to LICD (gold standard), a total of 114 false-negative cases of migraine without aura and 37 false-negative cases of migraine with aura were identified in the ICHD-II groups. Of 114 false-negative cases of migraine without aura 44, were initially diagnosed by ICHD-II as probable migraine without aura, 14 as frequent episodic tension-type headache, 1 as chronic tension-type headache, 25 as probable frequent episodic tension-type headache and 30 cases fulfilled the criteria for probable migraine and probable tension-type headache simultaneously (Table 2). Of 37 false-negative cases of migraine with aura, 18 were initially diagnosed by ICHD-II as probable migraine with aura, 1 as frequent episodic tension-type headache, 1 as chronic tension-type headache, 5 as probable frequent episodic tension-type headache and 12 cases fulfilling the criteria for probable migraine and probable tension-type headache simultaneously (Table 2).

There were no false-positive cases of migraine nor false-negative cases of tension-type headache according

Table 2 Change in headache diagnosis from ICHD-II (initial diagnosis) to LICD (final diagnosis), for 417 children. Headache codes are defined in table 1.

	ICHD-II													Total
	1.1	1.2	1.6.1	1.6.2	2.2	2.3	2.4.2	1.6+ 2.4 ^c	4.1	5.2	7.4.1	8.3.1	14.2	
LICD														
1.1	122	–	44 ^a	–	14 ^a	1 ^a	25 ^a	30 ^a	–	–	–	–	–	236
1.2	–	114	–	18 ^b	1 ^b	1 ^b	5 ^b	12 ^b	–	–	–	–	–	151
2.2	–	–	–	–	15	–	–	–	–	–	–	–	–	15
2.3	–	–	–	–	–	5	–	–	–	–	–	–	–	5
4.1	–	–	–	–	–	–	–	–	1	–	–	–	–	1
5.2	–	–	–	–	–	–	–	–	–	1	–	–	–	1
7.4.1	–	–	–	–	–	–	–	–	–	–	1	–	–	1
8.3.1	–	–	–	–	–	–	–	–	–	–	–	2	–	2
14.2	–	–	–	–	3	–	1	–	–	–	–	–	1	5
Total	122	114	44	18	33	7	31	42	1	1	1	2	1	417

ICHD-II International Classification of Headache Disorders, 2nd edition

LICD longitudinal intuitive clinical diagnosis.

^a False-negative cases of migraine without aura according to ICHD-II

^b False-negative cases of migraine with aura according to ICHD-II

^c Children whose headache fulfills the diagnostic criteria for probable migraine (1.6) and probable tension-type headache (2.4) simultaneously. They were here classified as a distinct group in order to ascertain the evolution of their diagnoses

to ICHD-II. According to LICD (gold standard), a total of 93 false-positive cases of tension-type headache were identified in the ICHD-II groups: 18 were initially diagnosed as frequent episodic tension-type headache, 2 as chronic tension-type headache, 31 as probable frequent episodic tension-type headache and 42 cases fulfilled the criteria for probable migraine and probable tension-type headache simultaneously (Table 2). Excepted the 4 cases that were later diagnosed as unspecified headache, all of the remaining cases were later diagnosed as migraine with or without aura by the LICD.

Of the 62 cases of probable migraine (1.6.1 and 1.6.2), 61 were classified in this group because of the short duration of the headache attacks (less than 1 hour). All of them were later diagnosed as having migraine without aura (44 cases) or migraine with aura (18 cases) by the LICD (Table 2).

According to ICHD-II, 30 of 31 cases of probable frequent episodic tension-type headache were classified in this group because of not fulfilling the criteria C (pain characteristics, 25 cases) or D (accompanying symptoms, 5 cases). All of them were later diagnosed as having migraine without aura (25 cases) or migraine with aura (5

cases) by LICD, except 1 case that was later classified as unspecified headache (Table 2).

Concerning those 42 cases that fulfilled the criteria for probable migraine and probable tension-type headache simultaneously, all were later diagnosed as having migraine (Table 2). Six of these cases did not fulfill criteria B (duration of the attacks), 2 did not fulfill criteria C (pain characteristics) and 34 did not fulfill the criteria D (accompanying symptoms) for migraine without aura. Thirty-four cases did not fulfill criteria C (pain characteristics) and 8 did not fulfill criteria D (accompanying symptoms) for episodic tension-type headache.

The sensitivity, the specificity and positive predictive value (PPV) of the major groups of headaches diagnosed in this study are shown in Table 3. At the one-digit level of diagnosis, the ICHD-II criteria for migraine v.s. tension-type headache showed the following respective scores: sensitivity, 87% v.s. 100%; specificity, 100% v.s. 81%; and PPV, 100% v.s. 18%. The 42 children whose the headache fulfilled the diagnostic criteria for probable migraine and probable tension-type headache simultaneously were considered to be correctly diagnosed for migraine and tension-type

Table 3 Sensitivity, specificity and positive predictive value (PPV) of the International Classification of Headache Disorders (ICHD), 2nd edition [18], when used to diagnose headache in 417 children

Diagnosis	Sensitivity, %	Specificity, %	PPV, %
Migraine (1)	87	100	100
Migraine without aura (1.1)	52	100	100
Migraine with aura (1.2)	75	100	100
Tension-type headache (2)	100	81	18
Frequent episodic tension-type headache (2.2)	100	95	45
Chronic tension-type headache (2.3)	100	99	71

headache at the one-digit level of diagnosis. Concerning the two-digit level of diagnosis, ICHD-II criteria for migraine with v.s. without aura showed the following scores: sensitivity, 75% v.s. 52%; specificity, 100% v.s. 100%; and PPV, 100% v.s. 100%. On the other hand, for frequent episodic v.s. chronic tension-type headache, the following scores were obtained: sensitivity, 100% v.s. 100%; specificity, 95% v.s. 99%; and PPV, 45% v.s. 71%.

Discussion

Since 1992, many papers have shown the high specificity but low sensitivity of ICHD-I diagnostic criteria for migraine without aura in childhood [3–15]. Several published series have shown that the percentage of children in which the attack duration is less than 2 hours ranged from 11% to 32% [3, 5, 7, 8, 11]. This fact has been seen as main reason for the low sensitivity of the aforementioned criteria. Moreover it has possibly been the reason for the reduction in the minimal duration of the attacks to 1 hour in ICHD-II.

The present study shows that out of 298 children fulfilling diagnostic criteria for migraine, in 61 (20.4%) of them the attack durations were shorter than 1 hour and accordingly these children should receive the diagnosis of “probable migraine”. In fact, these children have been properly diagnosed with migraine at the one-digit level; LICD clearly showed that all of them will evolve in full-blown migraine. Accordingly, the ICHD-II one-digit level of diagnosis for migraine reached higher figures of sensitivity (87%) than the two-digit level ones (c.f. 52% for migraine without aura).

It is noteworthy that no false-positive cases of migraine were found in our series; this observation may explain the absolute specificity and positive predictive value of ICHD-II diagnostic criteria for migraine.

On the other hand, considering the high number of false-negative cases of migraine without aura (at the two-digit level of diagnosis), we may realize that besides the attack duration, other features may play a role in the low sensitivity of the ICHD-II considering this diagnosis. Out of 114 false-negative cases of migraine without aura:

1. 44 had been classified as probable migraine without aura because of the short duration of the attacks (less than 1 hour).
2. 30 had been classified as probable migraine plus probable tension-type headache mostly because they did not fulfill criteria D (accompanying symptoms) for migraine without aura.
3. 25 had been classified as probable frequent episodic tension-type headache, 14 as frequent episodic tension-type headache and 1 as chronic tension-type headache.

Herein, it is shown that false-negative cases of migraine without aura would receive other diagnoses at two-digit level mostly because the duration of the attacks lasting less than 1 hour (44 cases) and the existence of the subgroup 2.4, probable tension-type headache (55 cases).

Summarizing, we answer the question proposed by the title as follows: decreasing the minimal duration of the attack to 1 hour is sufficient to increase the sensitivity of the ICHD-II diagnostic criteria for migraine in childhood only at the one-digit level of diagnosis. This study shows that aspects concerning the pain characteristics and accompanying symptoms of migraine in childhood and the existence of “probable tension-type headache” subgroup play an important role in the low sensitivity of ICHD-II criteria for migraine at the two-digit level of diagnosis at this age.

There are no biological markers for primary headaches so far. The longitudinal intuitive clinical diagnosis (LICD) may be seen not only as the gold standard in studies like

the present one, but also as a tool for the proper diagnosis in dubious cases, actually, as is already recommended by ICHD-II. Some peculiar aspects concerning the clinical polymorphism of primary headaches in children deserve

further studies, since they may represent an age-related neurobiological phenomena and even a clinically distinct endophenotype that may shed some light on understanding this kaleidoscope called migraine.

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