Evidence-based guideline update: Pharmacologic treatment for episodic migraine prevention in adults

Report of the Quality Standards Subcommittee of the American Academy of Neurology and the American Headache Society

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ABSTRACT

Objective: To provide updated evidence-based recommendations for the preventive treatment of migraine headache. The clinical question addressed was: What pharmacologic therapies are proven effective for migraine prevention?

Methods: The authors analyzed published studies from June 1999 to May 2009 using a structured review process to classify the evidence relative to the efficacy of various medications available in the United States for migraine prevention.

Results and Recommendations: The author panel reviewed 284 abstracts, which ultimately yielded 29 Class I or Class II articles that are reviewed herein. Divalproex sodium, sodium valproate, topiramate, metoprolol, propranolol, and timolol are effective for migraine prevention and should be offered to patients with migraine to reduce migraine attack frequency and severity (Level A). Frovatriptan is effective for prevention of menstrual migraine (Level A). Lamotrigine is ineffective for migraine prevention (Level A). Neurology® 2012;78:1337–1345

GLOSSARY

AAN = American Academy of Neurology; AE = adverse event; CI = confidence interval; ER = extended-release; MAM = menstrually associated migraine; PMP = perimenstrual period; RCT = randomized controlled trial.

Epidemiologic studies suggest approximately 38% of migraineurs need preventive therapy, but only 3%–13% currently use it.¹ In 2000, the American Academy of Neurology (AAN) published guidelines for migraine prevention.²,³ Since then, new clinical studies have been published on the efficacy and safety of migraine preventive therapies. This guideline seeks to assess this new evidence to answer the following clinical question: For patients with migraine, which pharmacologic therapies are proven effective for prevention, as measured by reduced migraine attack frequency, reduced number of migraine days, or reduced attack severity? This article addresses the safety and efficacy of pharmacologic therapies for migraine prevention.

Separate guidelines are available for botulinum toxin.¹ The 2008 guideline included a Level B recommendation that botulinum toxin was probably ineffective for treatment of episodic migraine. A new guideline is in development. An updated guideline on nonsteroidal anti-inflammatory drugs⁵ and complementary alternative treatments has been approved for publication as a companion to this guideline.⁵

DESCRIPTION OF THE ANALYTIC PROCESS

The AAN and the American Headache Society participated in the development process. An author panel of headache and methodologic experts was assembled to review the evidence. Computerized searches of the MEDLINE, PsycINFO, and CINAHL databases identified new studies (published in English). The search strategy used the MeSH term “headache” (exploded) and a published search strategy for identifying randomized controlled trials (RCTs) published between June 1999 and May 2007. Additional MEDLINE searches revealed studies published through May
2009, which were reviewed and included as supplemental articles.

Studies of pharmacologic agents available in the United States were included in the analysis if they randomized adult patients with migraine to the agent under study or a comparator drug (including placebo) and utilized masked outcome assessment. At least 2 panelists independently reviewed each study and rated it according to the AAN therapeutic classification of evidence scheme (appendix e-3 on the Neurology® website at www.neurology.org). Differences in ratings were resolved by author panel discussion.

**ANALYSIS OF EVIDENCE** The original search identified 179 articles. A supplemental search (2007–2009) yielded 105 additional articles. Of the total 284 articles, 29 were classified as Class I or Class II and are reviewed herein. Studies were excluded if they:

- Assessed the efficacy of therapeutic agents for headache other than episodic migraine in adults
- Assessed acute migraine treatment, migraine aura treatment/prevention, or nonpharmacologic treatments (e.g., behavioral approaches)
- Used quality of life measures, disability assessment, or nonstandardized outcomes as primary efficacy endpoints
- Tested the efficacy of drugs not available in the United States

Since the 2000 guideline publication, the AAN revised its evidence classification criteria to include study completion rates. Studies with completion rates below 80% were downgraded; several studies in the original guideline have thus been downgraded.

We found no new Class I or II studies published for acebutolol, atenolol, bisoprolol, carbamazepine,
clonazepam, clonidine, clomipramine, fluvoxamine, guanfacine, nabumetone, nadolol, nicardipine, ni-
cedipine, or protriptyline. Recommendations for
these agents are based on the evidence reviewed in
the original guideline (see table 1). Currently, no
Class I or Class II studies exist for anticoagulants
(limited Class III and IV studies were identified; ta-
ble 1 includes anticoagulants).

Angiotensin receptor blockers and angiotensin-
converting-enzyme inhibitors. In the 2000 guide-
line, there were no studies testing the efficacy of
angiotensin receptor blockers or angiotensin-
converting-enzyme (ACE) inhibitors for migraine
prevention. Since that publication, 3 reports have
been published.

Candesartan. In a Class II crossover study (12-week
treatment separated by 4-week washout), the mean
number of headache days was 18.5 with placebo
(26.3% reduction from baseline) vs 13.6 with candes-
artan (45.6% reduction from baseline; \( p = 0.001 \)).
Selected secondary endpoints also favored candesar-
tan: headache hours (139 vs 95; \( p < 0.001 \)), mi-
graine days (12.6 vs 9.0; \( p < 0.001 \)), migraine hours
(92.2 vs 59.4; \( p < 0.001 \)), and headache severity
index (293 vs 191; \( p < 0.001 \)). No serious adverse
events (AEs) occurred. The most common AEs were
dizziness (31%), “symptoms of the musculoskeletal
system” (21%), and fatigue (14%); none occurred
significantly more often than with placebo.

Lisinopril. One Class II study reported significant
reduction in all 3 primary endpoints with lisinopril
vs placebo (headache hours: 129 vs 162 [mean change
in hours 20, confidence interval (CI) 5–36];
headache days: 19.7 vs 23.7 [20, CI 5–30]; migraine
days: 14.5 vs 18.5 [21, CI 9–34]).\(^7\) AEs included
cough (26%; 10% discontinued treatment due to
cough), dizziness (23%), and “tendency to faint”
(10%). No serious AEs were reported.

Telmisartan. In a single Class II placebo-
controlled trial, telmisartan 80 mg did not show a
significant difference from placebo for reduction in
migraine days (\( -1.65 \) vs \( -1.14 \)).\(^8\)

Conclusions. Lisinopril and candesartan are possibly
effective for migraine prevention (1 Class II study
each). Telmisartan is possibly ineffective for reducing
the number of migraine days (1 negative Class II
study).

Antiepileptic drugs. Divalproex. The original guideline
found strong, consistent support (5 studies) for the effi-
cacy of divalproex sodium and its corresponding com-
 pound, sodium valproate, for migraine prevention.

Since the 2000 publication, 1 double-blind, ran-
domized, Class I placebo-controlled 12-week trial
showed extended-release (ER) divalproex sodium
500–1,000 mg/day had a mean reduction in 4-week
migraine headache rate from 4.4/week (baseline) to
3.2/week (\( -1.2 \) attacks/week) in the ER divalproex so-
dium group and from 4.2/week to 3.6/week (\( -0.6 \)
attacks/week) in the placebo group (CI 0.2–1.2;
\( p = 0.006 \)). No significant differences were de-
tected between groups in the number of treat-
ment-emergent AEs.

Clinical context. In most headache trials, patients
taking divalproex sodium or sodium valproate re-
ported no more AEs than those on placebo. How-
ever, weight gain has been clinically observed with
divalproex sodium long-term use.\(^9\)\(^,\)\(^10\) Treatment with
these agents requires careful follow-up and testing
because of pancreatitis, liver failure, and teratogenic-
ity risks.\(^11\)

Gabapentin. Since the 2000 publication, a Class III
study\(^12\) reported that a stable gabapentin dose (4-
week titration phase to 2,400 mg/day; 8-week main-
tenance phase) significantly reduced the median
monthly migraine rate vs placebo on the basis of a
modified intention-to-treat analysis.

Lamotrigine. The original guideline reported a sin-
gle Class I lamotrigine study\(^13\) that failed to show a
significant effect for migraine prevention. A second,
new Class I study comparing lamotrigine 50 mg/day
with placebo or topiramate 50 mg/day reported lam-
otrigine was not more effective than placebo (for
both primary endpoints) and was less effective than
topiramate in reducing migraine frequency and in-
tensity.\(^14\) The primary outcome measure (responder
rate: \( \geq 50\% \) monthly migraine frequency reduction)
was 46% for lamotrigine vs 34% for placebo (\( p =
0.093, \) CI 0.02–0.26) and 63% for topiramate vs
46% for lamotrigine (\( p = 0.019, \) CI 0.03–0.31).
Treatment-related AEs (rash, giddiness, sleepiness,
and gastrointestinal intolerance) occurred in 10% of
patients on lamotrigine.

Oxcarbazepine. One Class II trial evaluated the effi-
cacy of oxcarbazepine (1,200 mg/day) vs placebo.\(^15\)
There was no difference between oxcarbazepine
(\( -1.30 \) [SE 0.282]) and placebo for mean change in
number of migraine attacks from baseline during the
last 28 days of the double-blind 15-week treatment
phase (\( -1.74 \) [SE 0.283]; \( p = 0.2274 \)).

Topiramate. Four Class I studies\(^14,16,18\) and 7 Class
II studies\(^19\)\()-\(^22\) report topiramate (50–200 mg/day)
is effective in migraine prevention.

In a Class I placebo-controlled study (mean topi-	ramate dose 125 mg/day [range 25–200 mg/day]),
patients given topiramate experienced a significantly
lower 28-day migraine frequency vs with placebo
(\( 3.31 \pm 1.7 \) vs \( 3.83 \pm 2.1; \ p = 0.002 \)).\(^18\) In a second
placebo-controlled Class I double-crossover study
(reviewed above), topiramate was more effective than
placebo and lamotrigine for primary efficacy measures. In the topiramate groups, 15% of patients experienced AEs, most commonly paresthesias, sleepiness, and gastrointestinal intolerance. The placebo group reported gastrointestinal intolerance (3%) and anorexia (3%).

Two additional Class I studies reported topiramate is as effective as propranolol or sodium valproate, drugs previously established as effective for migraine prevention. In the first study, subjects given topiramate 50 mg/day had reduced mean migraine frequency (episodes/month) from baseline (6.07 ± 1.89 to 1.83 ± 1.39; \( p < 0.001 \)) at 8 weeks, decreased headache intensity VAS score from 7.1 ± 1.45 to 3.67 ± 2.1 (\( p < 0.001 \)), and decreased headache duration from 16.37 ± 7.26 hours to 6.23 ± 5.22 hours (\( p < 0.001 \)). Subjects given topiramate reported paresthesias (23%), weight loss (16%), and somnolence (13%). In patients treated with propranolol 80 mg/day, mean headache frequency (episodes/month) decreased from 5.83 ± 1.98 to 2.2 ± 1.67 (\( p < 0.001 \)) at 8 weeks, headache intensity VAS score decreased from 6.43 ± 1.6 to 4.13 ± 1.94 (\( p < 0.001 \)), and headache duration decreased from 15.10 ± 6.84 hours to 7.27 ± 6.46 hours (\( p < 0.001 \)). Although monthly headache frequency, intensity, and duration decreased in both groups, the topiramate group reported significantly greater mean reduction (topiramate frequency decrease 4.23 ± 1.2 vs propranolol 3.63 ± 0.96 [\( p = 0.036; \) CI 0.39–1.16]; topiramate intensity decrease 3.43 ± 1.38 vs propranolol 2.3 ± 1.2 [\( p = 0.001; \) CI 0.46–1.8]; topiramate duration decrease 10.1 ± 4.3 vs propranolol 7.83 ± 4.5 [\( p = 0.048; \) CI 0.17–4.6]).

In a crossover Class I trial (2-month washout between therapies) comparing topiramate 50 mg/day with sodium valproate 400 mg/day, both groups showed improvement from baseline in headache frequency, intensity, and duration. Average monthly migraine frequency decreased by 1.8 times with sodium valproate (baseline 5.4 ± 2.5; posttreatment 3.6 ± 2.1; CI 1.0–2.6; \( p < 0.001 \)), as compared with a 3-time reduction with topiramate (baseline 5.4 ± 2.0; posttreatment 2.4 ± 2.4; CI 2.1–3.9; \( p < 0.001 \)). Headache intensity decreased by 3.7 with sodium valproate (baseline 7.7 ± 1.2; treatment 4.0 ± 2.1; CI 2.9–4.6; \( p < 0.001 \)), as compared with a reduction of 3.6 with topiramate (baseline 6.9 ± 1.2, treatment phase 3.3 ± 1.5; CI 2.9–4.3; \( p < 0.001 \)). The average headache episode duration decreased by 13.4 hours from baseline with sodium valproate (baseline 21.3 ± 14.6; treatment 7.9 ± 7.7; CI 7.5–19.3; \( p < 0.001 \)) as compared with an 11.9-hour reduction with topiramate (baseline 17.3 ± 8.4; treatment 5.4 ± 6.4; CI 8.2–15.6; \( p < 0.001 \)). The overall analysis of repeated-measures analysis of variance demonstrated no differences in monthly headache frequency, intensity, or duration after the first or second treatment rounds. Topiramate AEs were weight loss (18.8%), paresthesias (9.4%), or both (25%). Sodium valproate AEs were weight gain (34.5%), hair loss (3.1%), and somnolence (3.1%).

Results of 5 Class II studies support those of the Class I studies showing topiramate as effective for migraine prevention. Four studies demonstrated significant improvement over placebo as compared with an active comparator arm, suggesting equivalence of topiramate (100, 200 mg/day) and propranolol (160 mg/day). Two studies comparing topiramate and amitriptyline (25–150 mg/day) reported no difference in efficacy for primary endpoints; however, amitriptyline was associated with a significant AE increase, and the amitriptyline-topiramate combination suggested improvement in depression scores vs monotherapy. In one of these studies, the most common AEs were similar to those previously reported. One Class II placebo-controlled 24-week pilot study failed to show a difference in efficacy between topiramate 200 mg and placebo.

Conclusions. Divalproex sodium and sodium valproate are established as effective in migraine prevention (multiple Class I studies). Data are insufficient to determine the effectiveness of gabapentin (1 Class III study). Lamotrigine is established as ineffective for migraine prevention (2 Class I studies). Oxcarbazepine is possibly ineffective for migraine prevention (1 Class II study). Topiramate is established as effective for migraine prevention (4 Class I studies, multiple Class II studies; 1 negative Class II study). Topiramate is probably as effective for migraine prevention as propranolol (1 Class I study), sodium valproate (1 Class I study), and amitriptyline (2 Class II studies).

Antidepressants. Fluoxetine. In the original guideline, 1 Class II study showed fluoxetine (racemic) was significantly better than placebo for migraine prevention, but the results were not duplicated in a second study.

Since the original guideline, a Class II study has shown fluoxetine 20 mg/day was more effective than placebo in reducing total pain index scores (calculated as \( [D1 \times 1] + [D2 \times 2] + [D3 \times 3] \), where D1, D2, and D3 represent headache hours calculated in a month, with pain intensity shown by 1, 2, 3) at 6 months. After the 6 months, pain index scores for the fluoxetine group decreased from 135 (baseline) to 41.3 (SD ± 63.8; \( p = 0.001 \)). The placebo group pain index was 98 at baseline and 61.1 at 6 months (SD ± 57.7; \( p = 0.07 \)). However, differences were noted between treatment groups for baseline measures.
Venlafaxine. In a Class I study, venlafaxine XR 150 mg significantly reduced the number of headache days (median reduction in days: venlafaxine 150 mg –4 days; venlafaxine 75 mg –2 days; placebo –1 day; Kruskal-Wallis = 10.306, df = 2; p < 0.006). All 3 groups showed decreased headache severity and duration from baseline; no differences were observed between treatment groups for these endpoints. The most common AEs were nausea (41%), vomiting (27%), and drowsiness (27%). Fourteen percent of patients receiving venlafaxine withdrew because of AEs.

A Class II trial assessed the efficacy of venlafaxine vs amitriptyline; both were effective in reducing attack frequency (venlafaxine: baseline = 4.15 [SD ± 2.24] vs 12 weeks = 1.77 [SD ± 1.39; p < 0.001]; amitriptyline: baseline = 3.27 [SD ± 1.61] vs 12 weeks 1.54 [SD ± 1.54; p < 0.001]). Patients taking venlafaxine experienced nausea/vomiting (23%) and tachycardia (15%); 1 patient withdrew because of AEs. Patients taking amitriptyline reported hypersomnolence (80%), dry mouth (69%), and concentration difficulties (54%).

Tricyclic antidepressants. The original guideline concluded amitriptyline was established as effective for migraine prevention; that evidence has since been downgraded to Class II (all 3 studies had >20% drop-out rates). Comparative studies of amitriptyline with topiramate21,22 and venlafaxine31 (reviewed above) report similar efficacy at the doses tested.

Conclusions. There is conflicting Class II evidence for use of fluoxetine. Venlafaxine is probably effective for migraine prevention (1 Class I study) and is possibly as effective as amitriptyline in migraine prevention (1 Class II study). Amitriptyline is probably effective for migraine prevention (multiple Class II studies); it is probably as effective as topiramate (2 Class II studies) and possibly as effective as venlafaxine (1 Class II study) for migraine prevention.

β-Blockers. Metoprolol. The original guideline concluded metoprolol was probably effective in migraine prevention. We reclassified these studies as Class I using the revised AAN criteria.

One new Class II study reported metoprolol (200 mg/day) was more effective than aspirin (300 mg/day) in achieving 50% migraine frequency reduction (responder rate metoprolol = 45.2%; aspirin = 29.6%; mean difference 15.65; CI 4.43–26.88).32 Attack frequencies (attacks/month) at placebo run-in and week 20 are 3.36 to 2.37, respectively, for aspirin and 3.55 to 1.82, respectively, for metoprolol. No significant AEs were reported.

A small Class II study reported metoprolol (47.5–142.5 mg/day) had similar efficacy to nebivolol 5 mg/day for migraine prevention (assessed by a decrease in mean migraine attacks).33

Propranolol. The original guideline concluded propranolol was established as effective for migraine prevention.

In a Class II study, propranolol (80 mg/day) was more effective than placebo and as effective as cyproheptadine (4 mg/day) in reducing migraine frequency, duration, and attack severity.34 The difference in attack frequency reduction was significant between treatments: propranolol −2.85 ± 0.2 (SEM) vs cyproheptadine −3.09 ± 0.31 vs combination 3.12 ± 0.1 vs placebo −1.77 ± 0.44 (all p < 0.05 vs placebo). For attack frequency reduction, combination therapy was more effective than monotherapy (p < 0.05). AEs were drowsiness, sleep disturbance, weight gain, fatigue, and dry mouth; percentages of patients affected were not reported.

Conclusions. Metoprolol is established as effective for migraine prevention (2 Class I studies) and is possibly as effective as nebivolol or aspirin for migraine prevention (1 Class II study each). Propranolol is established as effective for migraine prevention (multiple Class I studies) and is possibly as effective as cyproheptadine for migraine prevention (1 Class II study).

Calcium-channel blockers. The original guideline concluded that verapamil and nimodipine were probably effective for migraine prevention. The original studies on verapamil and nimodipine were found to have conflicting Class III evidence on the basis of current classification criteria and were downgraded accordingly, yielding Level U recommendations.

Conclusions. Data from older studies regarding verapamil and nimodipine are insufficient when current AAN classification criteria are applied.

Direct vascular smooth muscle relaxants. The original guideline concluded cyclandelate was probably effective for migraine prevention.

Cyclandelate. Two new Class II studies reported conflicting results. The first study showed cyclandelate to be no more effective than placebo in reducing migraine days, attacks, or duration.35 The second study (smaller, underpowered; n = 25) found cyclandelate significantly reduced the number of migraine days and duration (assessed using a contingent negative variation measure).36

Conclusions. The efficacy of cyclandelate is unknown (conflicting Class II studies).

Triptans. Since the original guideline, new Class I studies have assessed the efficacy of frovatriptan,37,38 naratriptan,39 and zolmitriptan40 for short-term prevention of menstrually associated migraine (MAM).

Frovatriptan. Frovatriptan 2.5 mg BID/qd was more effective than placebo in reducing migraine fre-
The mean number of headache-free perimenstrual periods (PMPs) per patient (primary endpoint) was higher in the 2 frovatriptan groups (2.5 mg qd = 0.69 [SD ± 0.92; CI 1.14–2.73; \( p = 0.0091 \)) vs 2.5 mg BID = 0.92 [SD 1.03; CI 1.84–4.28; \( p < 0.0001 \)) vs placebo = 0.42 [SD ± 0.78]), representing 64% (2.5 mg/day) and 119% (5 mg/day) increases in the mean number of headache-free PMPs per patient over placebo. A second Class I study also reports the MAM headache incidence and type for both regimens were similar to those for placebo. The overall AE incidence for frovatriptan was 4.1% (2.5 mg BID) and 2.7% (2.5 mg qd) higher than during placebo treatment.

Naratriptan. In a Class I study, 1 mg BID (given for 5 days, starting 2 days before menses onset) reduced the number of perimenstrual migraine attacks and migraine days. Patients treated with naratriptan 1 mg experienced more headache-free PMPs than those on placebo (50% vs 25%, \( p = 0.003 \)). Naratriptan 1 mg reduced the number of MAMs (2.0 vs 4.0, \( p < 0.05 \)) and MAM days (4.2 vs 7.0, \( p < 0.01 \)) vs placebo. The AE incidence and severity were similar to those of placebo; <10% of patients experienced dizziness, chest pain, or malaise.

Zolmitriptan. One Class I study reported the efficacy of zolmitriptan 2.5 BID/TID vs placebo. Both zolmitriptan regimens demonstrated superior efficacy vs placebo: the proportion of patients with a ≥50% MAM attack frequency reduction (zolmitriptan 2.5 mg TID [58.6%], \( p = 0.0007 \)) vs placebo; zolmitriptan 2.5 mg BID [54.7%], \( p = 0.002 \) vs placebo; placebo 37.8%). AEs were considered possibly treatment-related in 28 patients (33.3%) in the zolmitriptan 2.5 mg TID group, 29 (36.3%) in the zolmitriptan 2.5 mg BID group, and 18 (22.0%) in the placebo group. The most common AEs were asthenia, headache, dizziness, and nausea.

Conclusions. Frovatriptan is established as effective for the short-term prevention of MAMs (2 Class I studies). Zolmitriptan and naratriptan are probably effective for the short-term prevention of MAMs (1 Class I study each). The utility of these agents in receiving a separate indication for pure menstrual migraine is currently being deliberated by US regulatory authorities.

Other agents. Since the original guideline, additional studies have been identified that assess the efficacy of a carbonic anhydrase inhibitor and a neurokinin inhibitor for migraine prevention.

Carbonic anhydrase inhibitor. In a single Class II study, acetazolamide 250 mg BID was no more effective than placebo in reducing migraine frequency, duration, and severity. This trial (\( n = 53 \)) was stopped prematurely due to a high number of withdrawals (34%), primarily due to acetazolamide-associated AEs, including paresthesias and asthenia.

Conclusions. The efficacy of acetazolamide is unknown at this time (1 Class II study terminated early).

RECOMMENDATIONS Level A. The following medications are established as effective and should be offered for migraine prevention:

- Antiepileptic drugs (AEDs): divalproex sodium, sodium valproate, topiramate
- \( \beta \)-Blockers: metoprolol, propranolol, timolol
- Triptans: frovatriptan for short-term MAMs prevention

Level B. The following medications are probably effective and should be considered for migraine prevention:

- Antidepressants: amitriptyline, venlafaxine
- \( \beta \)-Blockers: atenolol, nadolol
- Triptans: naratriptan, zolmitriptan for short-term MAMs prevention

Level C. The following medications are possibly effective and may be considered for migraine prevention:

- ACE inhibitors: lisinopril
- Angiotensin receptor blockers: candesartan
- \( \alpha \)-Agonists: clonidine, guanfacine
- AEDs: carbamazepine
- \( \beta \)-Blockers: nebivolol, pindolol

Level U. Evidence is conflicting or inadequate to support or refute the use of the following medications for migraine prevention:

- AEDs: gabapentin
- Antidepressants
  - Selective serotonin reuptake inhibitor/selective serotonin-norepinephrine reuptake inhibitors: fluoxetine, fluvoxamine
  - Tricyclics: protriptyline
  - Antithrombotics: acenocoumarol, Coumadin, picotamide
  - \( \beta \)-Blockers: bisoprolol
  - Calcium-channel blockers: nicardipine, nifedipine, nimodipine, verapamil
  - Acetazolamide
  - Cyclandelate

Level A negative. The following medication is established as ineffective and should not be offered for migraine prevention:

- Lamotrigine
**Level B negative.** The following medication is probably ineffective and should not be considered for migraine prevention:

- Clomipramine

**Level C negative.** The following medications are possibly ineffective and may not be considered for migraine prevention:

- Acebutolol
- Clonazepam
- Nabumetone
- Oxcarbazepine
- Telmisartan

**CLINICAL CONTEXT** Evidence to support pharmacologic treatment strategies for migraine prevention indicates which treatments might be effective but is insufficient to establish how to choose an optimal therapy. Consequently, although Level A recommendations can be made for pharmacologic migraine prevention, similar evidence is unavailable to help the practitioner choose one therapy over another. Treatment regimens, therefore, need to be designed case by case, which may include complex or even nontraditional approaches. Moreover, decision-making must remain with the physician and the patient to determine the optimal therapy, accounting for efficacy, AEs, coexisting/comorbid conditions, and personal considerations. Often trial and error is needed.

Evidence is also unavailable for making broad-range comparisons among multiple agents within a single class; such evidence would provide a more comprehensive understanding of relative efficacy and tolerability profiles across a broader range of therapeutic agents. Studies are needed that specifically evaluate when preventive therapy is warranted and how medications should be titrated. Table e-2 lists some specific consensus-based clinical circumstances wherein considering preventive therapy would be reasonable. A shortcoming of migraine prevention clinical studies is the relatively brief treatment duration (often only 12–16 weeks). Long-term assessment of the efficacy and safety of migraine preventive treatments is needed. Additionally, overall cost is a consideration when prescribing medications; cost may influence compliance, especially long-term.

It seems reasonable that a clinician be mindful of comorbid and coexistent conditions in patients with migraine, to maximize potential treatment efficacy and minimize AE risk. Table e-2 identifies which therapies to consider or avoid when common migraine coexisting conditions are present. Because migraine is frequent in women of childbearing age, the potential for adverse fetal effects related to migraine prevention strategies is particularly concerning.

Evidence from the 2 Class I frovatriptan studies meets the AAN threshold for a Level A recommendation for short-term use to prevent menstrual migraine (reduction in MAM headache incidence by 26% on 2.5 mg BID). However, the Food and Drug Administration questions whether the benefit demonstrated is clinically meaningful and has not approved frovatriptan for this indication.

**RECOMMENDATIONS FOR FUTURE RESEARCH** Although many preventive therapies reviewed herein are rated as Level C or U on the basis of the quality of evidence available, for some treatments extensive clinical experience supports a possible role in migraine prevention. Many of the older approaches to treating episodic migraine lack the financial justification for high-quality clinical study because they are not currently patentable drugs or otherwise do not promise a financial return for the cost of a major study. Until such treatments can be accurately studied, practitioners are cautioned not to discount these agents because Class I prospective clinical studies are lacking. A case-by-case evaluation of these agents as treatment options is prudent. Future directions should include validating these initial clinical observations in scientifically sound RCTs.

**AUTHOR CONTRIBUTIONS**

Dr. Silberstein: manuscript preparation, drafting/revising the manuscript, study concept or design, analysis or interpretation of data, acquisition of data, study supervision. Dr. Holland: drafting/revising the manuscript, study concept or design, analysis or interpretation of data. Dr. Freitag: drafting/revising the manuscript, analysis or interpretation of data, acquisition of data. Dr. Dodick: drafting/revising the manuscript, study concept or design, analysis or interpretation of data. Dr. Argoff: drafting/revising the manuscript, study concept or design, analysis or interpretation of data. Dr. Ashman: drafting/revising the manuscript, analysis or interpretation of data.

**DISCLOSURE**

Dr. Silberstein is on the advisory panel of and receives honoraria from AGA, Allergan, Amgen, Capnia, Coherex, Colcuic, Cydx, GlaxoSmithKline, Lilly, MAP, Medtronic, Merck, Minster, Neuralive, NINDS, NuParthe, Pfizer, Sr. Jade Medical, and Valeant. He is on the speakers’ bureau of and receives honoraria from Endo Pharmaceuticals, GlaxoSmithKline, and Merck. He serves as a consultant for and receives honoraria from Amgen and Novartis. His employer receives research support from AGA, Allergan, Boston Scientific, Capnia, Coherex, Endo Pharmaceuticals, GlaxoSmithKline, Lilly, MAP, Medtronic, Merck, NINDS, NuParthe, St. Jude Medical, and Valeant Pharmaceuticals. Dr. Holland (formerly Dr. Pearlman) receives consulting income from Map Pharmaceuticals and the American Headache Society and research support from Albert Einstein College of Medicine. Dr. Freitag has served on the scientific advisory boards of Zogenix Pharmaceuticals, Allergan Pharmaceuticals, Nautilus, MAP Pharmaceuticals, and NuParthe; has received travel expenses and or honoraria from GlaxoSmithKline, Zogenix, Merck, Nautilus, Allergan, Diamond Headache Clinic Research and Educational Foundation (not for profit), and the American Headache Society (travel). Dr. Freitag is a member of the Board of Directors of the National Headache Foundation. Dr. Dodick, within the past 3 years, serves on advisory boards and has consulted for Allergan, Alder, Pfizer, Merck, Coherex, Ferring, Neurocore, Neuralive, Neuraxon, NuParthe Inc., MAP, SmithKline Beecham, Boston Scientific, Medtronic, Inc., Nautilus, Eli Lilly & Company, No...
CONFLICT OF INTEREST

The American Academy of Neurology and the American Headache Society are committed to producing independent, critical and truthful clinical practice guidelines (CPGs). Significant efforts are made to minimize the potential for conflicts of interest to influence the recommendations of this CPG. To the extent possible, the AAN and AHS keep separate those who have a financial stake in the success or failure of the products appraised in the CPGs and the developers of the guidelines. Conflict of interest forms were obtained from all authors and reviewed by an oversight committee prior to project initiation. AAN and AHS limit the participation of authors with substantial conflicts of interest. The AAN and AHS forbid commercial participation in, or funding of, guideline projects. Drafts of the guidelines have been reviewed by at least three AAN and AHS peer reviewers, and representatives from related fields. The AAN Guideline Author Conflict of Interest Policy can be viewed at www.aan.com.

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REFERENCES


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CORRECTION


In the special article “Evidence-based guideline update: Pharmacologic treatment for episodic migraine prevention in adults: Report of the Quality Standards Subcommittee of the American Academy of Neurology and the American Headache Society” by S.D. Silberstein et al. (Neurology 2012;78:1337–1345), there are errors in table 1 and the text on page 1342. Due to changes in the AAN’s LOE classification criteria, pindolol and clonidine should have been labeled as having Level U recommendations and nicardipine should have been listed as having a Level C recommendation. These changes are based on studies cited in the original 2001 guideline; no new studies were found in the literature search for the 2012 update. Please see the corrected table below. The authors regret the errors.

Table 1  Classification of migraine preventive therapies (available in the United States)

<table>
<thead>
<tr>
<th>Level A: Medications with established efficacy (≥2 Class I trials)</th>
<th>Level B: Medications are probably effective (1 Class I or 2 Class II studies)</th>
<th>Level C: Medications are possibly effective (1 Class II study)</th>
<th>Level U: Inadequate or conflicting data to support or refute medication use</th>
<th>Other: Medications that are established as ineffective, probably ineffective, or possibly ineffective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiepileptic drugs</td>
<td>Antidepressants/SSRI/SSNRI/TCA</td>
<td>ACE inhibitors</td>
<td>α2-Agonists</td>
<td>Established as ineffective</td>
</tr>
<tr>
<td>Divalproex sodium</td>
<td>Amitriptyline</td>
<td>Lisinopril</td>
<td>Clonidinea</td>
<td>Lamotrigine</td>
</tr>
<tr>
<td>Sodium valproate</td>
<td>Venlafaxine</td>
<td>α2-Agonists</td>
<td>Antidepressants/SSRI/SSNRI</td>
<td>Probably ineffective</td>
</tr>
<tr>
<td>Topiramate</td>
<td>β-Blockers</td>
<td>Guanfacinea</td>
<td>Fluoxetine</td>
<td>Clonipraminea</td>
</tr>
<tr>
<td>β-Blockers</td>
<td>Atenolola</td>
<td>Angiotensin receptor blockers</td>
<td>Fluvoxaminea</td>
<td>Possibly ineffective</td>
</tr>
<tr>
<td>Metoprolol</td>
<td>Nadolola</td>
<td>Candesartan</td>
<td>Antiepileptic drugs</td>
<td>Acebutolola</td>
</tr>
<tr>
<td>Propranolol</td>
<td>Triptans (MRM)b</td>
<td>Antiepileptic drugs</td>
<td>Gabapentin</td>
<td>Clonazepama</td>
</tr>
<tr>
<td>Timololb</td>
<td>Naratriptanb</td>
<td>Carbamazepinea</td>
<td>Antithrombotics</td>
<td>Nabumetonea</td>
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<tr>
<td>Triptans (MRM)b</td>
<td>Zolmitriptanb</td>
<td>Antihistamines</td>
<td>Acenocoumarol</td>
<td>Oxcarbazepine</td>
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<tr>
<td>Frovatriptanb</td>
<td>Cyproheptadine</td>
<td>Coumadin</td>
<td>Telmisartan</td>
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<tr>
<td>β-Blockers</td>
<td>Picotamide</td>
<td>Nebivolol</td>
<td>β-Blockers</td>
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<tr>
<td>Ca++ blockers</td>
<td>Bisoprolola</td>
<td>Candesartan</td>
<td>Nifedipinea</td>
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<td>Nicardipinea</td>
<td></td>
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<td>Nimodipine</td>
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<td>Verapamil</td>
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<td>Ca++ blockers</td>
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<td>Protriptylinea</td>
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Abbreviations: ACE = angiotensin-converting-enzyme; Ca++ blockers = calcium channel blockers; MRM = menstrually related migraine; SSNRI = selective serotonin-norepinephrine reuptake inhibitor; SSRI = selective serotonin reuptake inhibitor; TCA = tricyclic antidepressant.

a Classification based on original guideline and new evidence not found for this report.

b For short-term prophylaxis of MRM.