Pharmacological prevention of migraine

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People who have migraine experience intermittent attacks of unilateral, pulsating, and moderate to severe headache with associated nausea or photophobia and phonophobia (or all these symptoms). These attacks typically start before the age of 40, often in childhood or teenage years, and occur most commonly from the second to the fourth decade of life. Attacks may be infrequent or frequent. Chronic migraine is diagnosed when attacks regularly occur on more than 15 days a month. Box 1 shows the International Headache Society’s classification criteria for migraine without aura.

Recent population studies have shown the worldwide prevalence of migraine to be greater than 10%. The prevalence of migraine in the United States has been estimated at 18% for women, 6% for men, and 12% overall. Migraine clearly affects women more than men, and its aetiology also seems to have a hereditary component. The World Health Organization ranks migraine 19th on the list of diseases worldwide that cause disability. In spite of recent advances in treatment options for migraine, both acute and preventive, these treatments continue to be underused, which leaves patients with unnecessary suffering and increases the burden on the healthcare system. We review the different types of preventive treatment and discuss how they should be used to treat migraine effectively.

When to consider prevention for migraine

Specific clinical guidelines on when it is clinically appropriate to start preventive treatment vary between different countries and organisations. A high frequency of migraine, inadequate responsiveness to drugs used to treat migraine acutely, and migraines that greatly interfere with activities of daily life are accepted criteria for starting preventive treatment. Box 2 lists the European Federation of Neurological Societies and American Academy of Neurology guidelines for starting preventive treatment. It is important to consider coexisting medical conditions and psychological diagnoses when deciding on a preventive treatment. A single drug may effectively treat the coexisting condition and prevent migraines in some circumstances. The importance of the discussion between practitioner and patient about preventive drugs and the reasons for considering their use is often overlooked. Shared decision making, which ensures that the patient understands the reasons for starting preventive treatment and feels comfortable with the drug chosen, increases the likelihood of adherence to the preventive treatment plan. Because overuse of analgesics and other acute drugs may make preventive drugs less effective, the patient should also be instructed to limit their use. Simple analgesics

Box 1 | International Headache Society’s classification criteria for migraine without aura

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

Box 2 | Criteria for starting preventive treatment

- Quality of life, business duties, or school attendance is severely impaired
- Two or more attacks a month
- Migraine attacks do not respond to acute drug treatment
- Frequent, very long, or uncomfortable auras occur
Drugs for the prevention of migraine

<table>
<thead>
<tr>
<th>Drug</th>
<th>Target dose*</th>
<th>Common adverse drug reactions</th>
<th>Strength of evidence (US)†</th>
<th>Strength of evidence (Europe)‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>β blockers</td>
<td></td>
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<tr>
<td>Propranolol</td>
<td>80-160 mg QD</td>
<td>Hypotension</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Metoprolol</td>
<td>25-100 mg QD-BID</td>
<td>Hypotension</td>
<td>B</td>
<td>A</td>
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<td>Atenolol</td>
<td>25-100 mg QD</td>
<td>Hypotension</td>
<td>B</td>
<td>NA</td>
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<tr>
<td>Calcium channel blockers</td>
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<td></td>
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</tr>
<tr>
<td>Flunarizine</td>
<td>5-15 mg QD</td>
<td>Weight gain, tardive dyskinesia</td>
<td>NA</td>
<td>A</td>
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<tr>
<td>Verapamil</td>
<td>80-120 mg QD-TID</td>
<td>Bradycardia, hypotension</td>
<td>B</td>
<td>NA</td>
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<tr>
<td>Amitriptyline</td>
<td>5-10 mg QD</td>
<td>Oedema</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Other antihypertensives</td>
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<tr>
<td>Lisinopril</td>
<td>20 mg QD</td>
<td>Cough</td>
<td>NA</td>
<td>C</td>
</tr>
<tr>
<td>Canudesartan</td>
<td>16 mg QD</td>
<td></td>
<td>NA</td>
<td>C</td>
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<tr>
<td>Antidepressants</td>
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</tr>
<tr>
<td>Amitriptyline</td>
<td>25-75 mg QD</td>
<td>Anticholinergic side effects</td>
<td>A</td>
<td>B</td>
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<tr>
<td>Nortriptyline</td>
<td>10-100 mg QD</td>
<td>Anticholinergic side effects</td>
<td>C</td>
<td>NA</td>
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<td>Fluoxetine</td>
<td>10-40 mg QD</td>
<td></td>
<td>B</td>
<td>NA</td>
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<tr>
<td>Venlafaxine</td>
<td>75-150 mg QD-BID</td>
<td>Drowsiness, urinary retention</td>
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<td>Anticonvulsants</td>
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<tr>
<td>Valproate</td>
<td>250-500 mg QD-BID</td>
<td>Weight gain, tremor, hair loss</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Topiramate</td>
<td>50-100 mg QD-BID</td>
<td>Nephrolithiasis, acute glaucoma</td>
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<td>Gabapentin</td>
<td>300-1200 mg TID</td>
<td>Drowsiness, dizziness</td>
<td>B</td>
<td>C</td>
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<tr>
<td>Lamotrigine</td>
<td>50-300 mg QD-BID</td>
<td>Stevens-Johnson syndrome</td>
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<tr>
<td>Zonisamide</td>
<td>25-400 mg QD-BID</td>
<td>Nephrolithiasis, sulfonamide allergy</td>
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<td>Supplements and herbs</td>
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<tr>
<td>Riboflavin</td>
<td>200 mg QD</td>
<td></td>
<td>B</td>
<td>C</td>
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<tr>
<td>Coenzyme Q10</td>
<td>100 mg TID</td>
<td>Gastrointestinal upset</td>
<td>NA</td>
<td>C</td>
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<tr>
<td>Magnesium</td>
<td>400-600 mg QD</td>
<td>Diarrhoea</td>
<td>B</td>
<td>C</td>
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<tr>
<td>Others</td>
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<td></td>
</tr>
<tr>
<td>Methysergide</td>
<td>2 mg QD</td>
<td>Retropitoneal fibrosis</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>OnabotulinumtoxinA</td>
<td>155 U</td>
<td></td>
<td>A</td>
<td></td>
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</tbody>
</table>

*QD=once daily; BID=twice daily; TID=three times daily.
†Taken from American Academy of Neurology practice parameter.
‡Taken from European Federation of Neurological Societies guidelines.

What drugs are available for the prevention of migraine?

Although preventive options for migraine may be either pharmacological or non-pharmacological, we will discuss the pharmacological option only. Certain β blockers, calcium channel blockers, tricyclic antidepressants, and antiepileptic drugs are considered first line preventive treatments, and many other drugs are considered second and third line options. Only five drugs are currently approved by the Food and Drug Administration (FDA) for prevention of episodic migraine. These are propranolol, timolol, valproate, topiramate, and methysergide. OnabotulinumtoxinA (Botox) is now FDA approved for the treatment of chronic migraine. European and US treatment recommendations have only a few minor differences (table). The evidence for the recommendations is derived from clinical trials where available.

β blockers

Propranolol and metoprolol have been evaluated in randomised placebo controlled trials for their efficacy in migraine prevention. A Cochrane review of available studies in 2004 concluded that propranolol is effective in preventing migraines in the short term, with insufficient data to make a conclusion regarding long term treatment. Sustained release options offer the benefits of once daily dosing and improved compliance. β blockers are a good choice of preventive drug for patients with coexistent hypertension, but they should not be used for patients with asthma and must be used with caution in patients with depression.

Calcium channel blockers

Flunarizine—a calcium channel blocker not available in all countries—causes a mild reduction in the frequency of migraine attacks. Calcium channel blockers that are more widely available, such as amlodipine and verapamil, are effective options for some patients. As with most other antihypertensive drugs, hypotension and pedal oedema are side effects to watch out for, but otherwise these drugs are well tolerated.

Other antihypertensive drugs

Several drugs belonging to the angiotensin converting enzyme inhibitor class and the angiotensin receptor blocker class have been studied as potential treatments for preventing migraine, although because of a lack of definitive data for migraine prevention, these drugs are second or third tier options. A randomised, placebo controlled, crossover study showed that lisinopril, an angiotensin converting enzyme inhibitor, decreased both the number of days with migraine and headache severity by 20%. One randomised controlled trial found that candesartan, an angiotensin receptor blocker, reduced the number of days of migraine a month by nearly five days compared with placebo. Both these classes of drugs may be alternative choices for patients with or without hypertension who do not tolerate, or do not respond to, β blockers or calcium channel blockers.

Antidepressants

 Amitriptyline, a tricyclic antidepressant, has been shown to be effective in preventing migraine in several randomised controlled trials and is considered a first line option in the

What are the goals of preventive treatment?

The goals of preventive treatment mirror the criteria for starting these drugs. The major targets of preventive treatment are reduced frequency and severity of migraine headaches, and it is helpful to communicate this to the patient. An important point to stress early on is that migraine has no cure, and the goal is to manage and reduce the burden of the disease. The patient’s disability is reduced if these main goals are achieved. Other goals of preventive treatment include reduced use of acute drugs and fewer visits to the emergency room or doctor’s surgery. Patients also need to understand that it may take time for a drug to become effective, most often two to three months at an adequate dose. Asking patients to keep a headache calendar or diary is an effective way to monitor progress.

What do the treatments prevent?

The pathogenesis of migraine is not completely understood. Studies of patients prescribed commonly used drugs for preventing migraine have shown that these drugs suppress cortical spreading depression. However the complex mechanisms of action of migraine preventive drugs are unclear.
Topiramate may be effective in treating chronic migraine and may be useful in patients whose headaches are complicated by overuse of acute drugs. The evidence that gabapentin is effective in preventing migraine is variable, and it is not considered a first line treatment choice. Gabapentin is helpful for patients with other pain conditions, but it has to be taken three times a day. Lamotrigine may be useful for patients who have migraine with aura.

Supplements and herbs

Several vitamins, minerals, and herbal remedies can be used to prevent migraine and may appeal to patients who wish to avoid taking daily prescription drugs. These treatments offer the benefits of few adverse drug reactions and drug interactions. Buttermilk, or Petasites hybridus, is effective but warn patients to use only properly processed plant extracts because the leaves of the plant are potentially carcinogenic. Petasites decreases the frequency of migraine attack, and one study found a statistically significant decrease (≥50%) in the frequency of migraine. Coenzyme Q10 can decrease the frequency of attacks, but it has little effect on the severity of migraine and does not reduce the use of acute drugs. Magnesium oxide and riboflavin (vitamin B-2) have also been shown to reduce the frequency of attacks. A negative Cochrane systematic review and meta-analysis of studies that examined the effectiveness of feverfew, derived from the Tanacetum parthenium plant, has limited its use.

Other drugs

Methysergide, an ergot derivative, is an effective preventive option. Its use is limited to six month periods with recommended drug holidays because of the potential development of retroperitoneal, pleural, and cardiac valve fibrosis. Although it was approved by the FDA for prevention of migraine, methysergide is no longer available in the US. Its major metabolite, methylergonovine, is however used by some practitioners.

Botulinum toxin A

The use of botulinum toxin A has gained a great deal of attention in recent years. The results of trials to date have not proved clear efficacy over placebo in episodic migraine, and it is known to be ineffective for tension-type headache. However, the FDA has approved botulinum toxin A for the treatment of patients with chronic migraine, and it is licensed in the United Kingdom for the same indication. It is administered every three months as 155 units distributed over 31 injection sites, which include the forehead, temporalis muscles, suboccipital areas, upper posterior cervical musculature, and trapezius muscles.

Combination treatment

For patients who fail to respond to single preventive drugs, the use of more than one drug may prove effective—for example, a combination of propranolol and amitriptyline.

When should preventive treatment be discontinued?

The frequency of follow-up visits is tailored to the patient’s individual needs and response to treatment. Guidelines for
Screening for early detection of lung cancer
An editing error occurred in the eighth paragraph of this Observations column by Douglas Kamerow (BMJ 2010;341:c6544, print publication 20 November 2010, p 1080). With reference to the US National Cancer Institute’s termination of its national lung screening trial, we should have retained Kamerow’s original wording: “The study applied only to heavy (30 or more packs a year) smokers [*note* ‘heavy (30 or more packs a year) smokers’] aged 55 or older.”

The rules of retraction
In this Research and Ethics feature article by Melanie Newman (BMJ 2010;341:c6985, print publication 20 November 2010, p 6985) reference should have been included: Jureidini J, McHenry L. Conflicted medical journals and the failure of trust. *BMJ* 2003;327:143-6.

The NHS only a means of delivering healthcare?
In this letter the email address of the author, Gareth Forbes, was missing an important full point (BMJ 2011;342:d983, print publication 19 February, p 397). His correct email address is therefore gareth.forbes@nhs.net (not garethforbes@nhs.net, as published).

CORRECTIONS AND CLARIFICATIONS

Role of brain imaging in early parkinsonism
In this Rational Imaging article by David P Breen and colleagues (BMJ 2011;342:d638, print publication 26 February, pp 695-8) we made a mistake when putting together the images for figure 1. This resulted in the scans being published the wrong way round. The top scan is in fact from the patient with Parkinson’s disease, and the bottom scan is from the patient with drug induced parkinsonism.

Obituary: Carys Margaret Bannister
This.obituary by Jaleel Miyan (BMJ 2010;341:c7238, print publication 1 January 2011, p 51) refers to Carys Bannister as the “first lady neurosurgeon in the UK.” It seems that she almost certainly was not. Diana Beck (1902-56) was appointed consultant neurosurgeon at the Middlesex Hospital in 1947, having previously worked at the Frenchs Hospital in Bristol (see www.ncbi.nlm.nih.gov/pubmed/18425021). Beck was probably the female neurosurgeon alluded to by Bannister in the full, online version of the obituary: “As the first ‘lady brain surgeon’ in the UK (though she herself always said there was one before her who practised during the second world war years but was not fully qualified), Cary received a lot of media attention....” The parenthetical part was cut from the print version to save space.

bmj.com/video
The pain and the pressure: a film about latest research into the causes of this debilitating condition.

bmj.com Previous articles in this series
- The risks of radiation exposure related to diagnostic imaging and how to minimise them (BMJ 2011;342:d947)
- Telehealthcare for long term conditions (BMJ 2011;342:d210)
- Preventing exacerbations in chronic obstructive pulmonary disease (BMJ 2011;342:c7207)
- Islet transplantation in type 1 diabetes (BMJ 2011;342:d217)
- Diagnosis and management of hereditary haemochromatosis (BMJ 2011;342:c7251)

Discontinuing preventive drugs are arbitrary, and treatment decisions should be made on a case by case basis. For example, if coexisting conditions are being treated, the clinician might decide not to discontinue drugs. Drugs might need to be discontinued slowly in patients who react to quick changes in medication. Drugs are usually discontinued in patients who have shown no clear benefit after an adequate trial duration.

Contributors: NF did most of the writing. The article was revised and edited several times before submission by all three authors.

Competing interests: All authors have completed the Unified Competing Interest form at www.cmjs.org/col_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; ML has received honorariums for lectures from NuPathe, Merck, and Allergan and has served as a consultant for NuPathe in the past year. He has been on the Speaker’s Bureau with Merck and Astellas, TW has consulted with NuPath, MAP Pharma, and Pfizer in the past year; he has been on the Speaker’s Bureau with Merck, Zogenix/Astellas, and Allergan, and Valeant, he has received research support from Merck, Allergan, GSK, NMT Medical, and Solstice within the past three years; no other relationships or activities that could appear to have influenced the submitted work.

Provenance and peer review: Commissioned, externally peer reviewed.