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A review of migraine treatment methods: a comparative analysis of therapeutic approaches

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Abstract

Migraine, a complex neurological disorder, affects a significant portion of the population and presents both medical and societal challenges. The aim of this paper is to provide a detailed review and analysis of available therapeutic methods for patients suffering from migraines, considering both pharmacological and non-pharmacological therapies. The approaches presented include acute treatment with triptans and nonsteroidal anti-inflammatory drugs (NSAIDs), as well as preventive therapies, such as beta-blockers and antiepileptic drugs. The section on non-pharmacological therapies focuses on cognitive-behavioral therapy (CBT), biofeedback, and lifestyle recommendations, including diet and sleep hygiene. A review of the literature indicates that integrating pharmacological and non-pharmacological approaches can significantly improve treatment effectiveness and the quality of life for patients with migraines.

KEYWORDS: Migraine, migraine treatment, migraine pharmacotherapy, chronic migraine, migraine prophylaxis, headache, anti-migraine therapy, neuromodulation in migraine, serotonin receptors, triptan medications, CGRP inhibitors, CGRP and migraine, non-pharmacological migraine treatment,

Introduction

Migraine is a chronic and recurrent neurological disorder that affects a significant portion of the global population. It is characterized by episodes of intense headache, often accompanied by symptoms such as nausea, and sensitivity to light and sound. Due to its prevalence and impact on daily life, migraine represents a serious public health issue, particularly in highly developed countries. This condition significantly lowers the quality of life for those affected, causing not only physical discomfort but also numerous psychological and social consequences. Economically, migraine incurs substantial costs for healthcare systems and the economy, as individuals suffering from migraines are more likely to require medical care and take work absences, leading to reduced productivity. Effective migraine treatment is therefore essential, both to improve patients' quality of life and to reduce the financial burdens associated with this disorder. (1) The purpose of this review article is to analyze the available

therapeutic methods used in migraine treatment. This work includes both conventional pharmacological approaches and modern alternative therapies, with particular focus on the effectiveness and mechanisms of action of each method. This review aims to provide comprehensive knowledge of available therapies and highlight the most effective approaches that can improve the health and quality of life for patients with migraine.

Types of migraine therapies

1. Pharmacological Therapies

Migraine, as a chronic neurological condition, requires a varied therapeutic approach. Pharmacological therapies can be divided into two main types: acute treatment, used during a migraine attack, and preventive treatment, which aims to reduce the frequency and intensity of attacks. This section discusses the differences between these approaches, the mechanisms of action of the medications used, their effectiveness, and potential side effects.

Acute and preventive treatment

Acute treatment focuses on the rapid relief of migraine symptoms, primarily headache and associated ailments. Medications such as triptans and nonsteroidal anti-inflammatory drugs (NSAIDs) are among the primary agents used in acute migraine treatment. Triptans, acting as 5-HT1 serotonin receptor agonists, cause blood vessel constriction and inhibit the release of neuropeptides associated with inflammation, providing relief from pain and other migraine symptoms (2, 3). Preventive treatment aims to reduce the frequency and severity of migraine attacks and improve the overall quality of life for patients. Medications used in prevention include beta-blockers, antidepressants, antiepileptics, and botulinum toxin. Beta-blockers, such as propranolol, lower sympathetic nervous system activity, which stabilizes vascular tone and reduces the likelihood of migraine occurrence (4, 5).

Mechanisms of action

At the physiological level, both acute and preventive medications act through different mechanisms, which include the modulation of neurotransmitters and effects on the central nervous system. Triptans, being serotonin receptor agonists, inhibit the release of neuropeptides such as substance P and CGRP (Calcitonin Gene-Related Peptide), which contributes to the reduction of migraine pain (6). NSAIDs, such as diclofenac, block the

cyclooxygenase enzymes (COX-1 and COX-2), which limits the synthesis of prostaglandins and reduces the inflammatory process and pain, making them effective in alleviating migraine attacks (7). Preventive medications primarily act by stabilizing neuronal activity. Antidepressants, such as amitriptyline, affect the serotonergic and noradrenergic systems, which helps reduce migraine symptoms. Antiepileptic drugs, such as topiramate, stabilize neuronal membranes and limit excessive excitation, which reduces the risk of attacks (4, 5).

Effectiveness and side effects

Studies show that triptans effectively relieve migraine pain in most patients within two hours of administration; however, they may cause side effects such as fatigue, nausea, and in rare cases, coronary vasospasm (2). NSAIDs are also effective in treating moderate migraine symptoms, but their long-term use is associated with the risk of gastrointestinal irritation (7).

In migraine prevention, propranolol demonstrates effectiveness in reducing the number of migraine days, although it may cause fatigue, low blood pressure, and bradycardia (4). Antiepileptic drugs, such as topiramate, and antidepressants, such as amitriptyline, also show positive effects in migraine prevention, but they can cause side effects such as drowsiness, weight gain, and cognitive issues (4, 5).

2. Non-pharmacological therapies

Non-pharmacological methods of treating migraines serve as an alternative or complement to traditional pharmacological therapies. They focus on lifestyle changes, stress management techniques, and other approaches that support the mental and physical health of patients.

- **Behavioral therapy**

Behavioral therapy, particularly cognitive-behavioral therapy (CBT), has a wide application in the non-pharmacological treatment of migraines. CBT is based on identifying and modifying negative thoughts and behaviors that may exacerbate pain. Patients learn stress management techniques, which often result in a reduction in the frequency and intensity of migraine attacks. This approach aims to improve patients' ability to manage pain while decreasing their dependence on medication (6).

- **Lifestyle and dietary changes**

An important element of non-pharmacological therapy is recommendations regarding lifestyle, such as maintaining regular sleep habits, avoiding migraine triggers, and ensuring a healthy diet. Sleep hygiene involves establishing habits that promote recovery and rest, which may include consistent sleep hours and avoiding caffeine and electronics before bedtime (5). Diet also plays a significant role, and patients are advised to avoid foods that may trigger migraines, such as chocolate, wine, tyramine-containing products, and processed foods (6). Regular physical activity of moderate intensity, such as walking, yoga, or aerobic exercises, supports blood circulation and reduces stress levels, which may help alleviate migraine symptoms (3, 5).

- **Green light therapy**

Green light therapy is an effective, non-pharmacological method for alleviating the symptoms of chronic migraines. This procedure involves regular exposure to green light for a specified period and under strictly controlled conditions. Patients are exposed to green light of a specific intensity, which reduces their sensitivity to pain and decreases the frequency of migraines. This therapy is conducted in specialized sessions, allowing for the alleviation of migraine symptoms without the side effects associated with exposure to other colors of light. Exposure to green light decreases the frequency and intensity of headaches, improves sleep quality, and reduces anxiety levels. Unlike other colors of light, green does not exacerbate photophobia. This effect is due to its calming influence on the nervous system and the reduction of sensitivity to pain stimuli. This therapy has the potential to be an effective and safe alternative for migraine treatment (8).

- **Acupuncture**

Acupuncture is an effective non-pharmacological method for treating migraines, which can significantly reduce the frequency and intensity of attacks. This technique works by stimulating acupuncture points, affecting the modulation of the nervous system and pain perception. Studies have shown that acupuncture provides long-lasting effects, making it a valuable option for patients with chronic migraines. Furthermore, acupuncture has a low incidence of side effects, which enhances its appeal as a treatment method. In addition, acupuncture may improve patients' quality of life by providing relief not only from

headaches but also from associated symptoms such as anxiety and depression. This method is well tolerated by most patients, making it a safe alternative to traditional medications (9).

- **Biofeedback**

Biofeedback is a non-pharmacological method for treating migraines, involving the provision of feedback to patients about their physiological responses. There are various types of biofeedback, including thermal biofeedback, which monitors body temperature, and electromyographic biofeedback, which tracks electrical activity in muscles. This method allows patients to learn to control their body's reactions, which can lead to a reduction in muscle tension and stress, often triggers for migraines. Through regular biofeedback sessions, patients can develop self-regulation skills, which may provide relief from headaches (10).

3. Innovative and Alternative Therapies

- **Neuromodulation Devices**

Neuromodulation devices are playing an increasingly important role in the treatment of migraines, offering an alternative to traditional pharmacological methods, especially for patients who do not tolerate medications or have contraindications to their use. Various types of devices are currently available, including vagus nerve stimulators (VNS), transcranial magnetic stimulation (TMS), supraorbital nerve stimulation (Cefaly), and spinal cord stimulation (SCS). Each of these devices operates on different principles, but their goal is to modify the activity of neurons responsible for triggering migraine pain (11). Neuromodulation involves the direct influence on the nervous system using electrical or magnetic impulses that reduce the transmission of pain signals. For example, supraorbital nerve stimulation (Cefaly) may decrease the frequency of migraine attacks by affecting the endings of the trigeminal nerve. Transcranial magnetic stimulation (TMS) impacts the cortex, inhibiting neuronal responses associated with the onset of migraines (12). Studies indicate that neuromodulation devices can significantly reduce the number of days with migraine pain, the intensity of pain,

and the demand for medication. Compared to pharmacotherapy, neuromodulation is generally safe and characterized by a low risk of serious side effects. However, the effectiveness of the therapy varies among patients and depends on individual characteristics and the type of migraine (13). These sources demonstrate that neuromodulation devices are a promising method for treating migraines, offering both a reduction in pain intensity and an improvement in patients' quality of life, particularly for those who do not respond to conventional therapies.

- **Alternative Medicine**

Alternative medicine, including the use of supplements and herbs, is commonly used as a complementary method for treating migraines, especially for patients seeking natural therapeutic options. Below is a discussion of selected ingredients such as magnesium, riboflavin, butterbur, and feverfew, based on scientific research findings.

1. Magnesium: Magnesium is one of the most frequently used supplements for migraine prevention, mainly due to its role in regulating neurotransmitters and nerve conduction. Studies indicate that magnesium deficiency may be linked to more frequent migraine attacks, and supplementation of this element can reduce the number of headache days and their intensity. Magnesium is particularly effective for patients with menstrual migraines (14).

2. Riboflavin (Vitamin B2): Riboflavin is used as a natural method for migraine prevention as it supports energy production in cellular mitochondria. Several studies have shown that riboflavin supplementation can reduce the frequency and intensity of migraine headaches, with recommended doses ranging from 200 to 400 mg daily (15).

3. Butterbur: Butterbur is an herb that has anti-inflammatory properties and may alleviate migraine pain. Systematic reviews indicate its effectiveness in reducing the frequency of migraine attacks, although caution is required due to the risk of toxic effects on the liver (16).

4. Feverfew (Tanacetum parthenium): Feverfew has been traditionally used for migraine prevention. The active ingredient parthenolide acts on serotonin receptors, which may help in preventing migraines. Meta-analyses suggest moderate

effectiveness of feverfew in reducing the frequency of migraine attacks, but its effects can vary from person to person (17).

In summary, supplements and herbs such as magnesium, riboflavin, butterbur, and feverfew may be helpful as adjuncts to migraine treatment. While their effectiveness varies individually, research results suggest potential improvement in patients' quality of life, with monitoring of their use being crucial, especially for herbs with hepatotoxic effects.

- **Botulinum Toxin Injections**

Botulinum toxin therapy (Botox) is used as a treatment method for chronic migraines, which involve at least 15 headache days per month, with at least 8 of those being migraine days. The procedure involves injecting botulinum toxin into specific areas of the head and neck, aimed at reducing the frequency and intensity of migraine attacks. Botulinum toxin works by blocking the release of neurotransmitters responsible for pain transmission, such as glutamate and substance P. This reduces the transmission of pain impulses in the peripheral nervous system. Additionally, blocking nerve endings can diminish inflammatory processes and neuronal hypersensitivity, which is crucial in reducing migraine headaches (18). Clinical studies have confirmed the effectiveness of botulinum toxin therapy in reducing the number of migraine days in patients with chronic migraines. In the PREEMPT study (Phase III Research Evaluating Migraine Prophylaxis Therapy), it was shown that patients treated with Botox experienced a significant reduction in the number of migraine days and an improvement in quality of life after several cycles of therapy (19). Botulinum toxin therapy is relatively safe, and its side effects are usually mild, including local effects such as pain at the injection site, eyelid droop, or neck stiffness. However, side effects are generally transient and resolve after a few days (20). Botulinum toxin therapy has become the standard for treating chronic migraines, offering effectiveness and safety for patients struggling with intense, frequent headaches.

- **Comparison of Effectiveness**

Analyzing the effectiveness of modern migraine treatment therapies, such as neuromodulation, supplements and herbs, and botulinum toxin, compared to traditional methods (NSAIDs, triptans, lifestyle changes, and behavioral therapy) provides significant insights into various approaches depending on the type of migraine and patient needs. Modern therapies, such as

neuromodulation and botulinum toxin, are promising, particularly for patients with chronic migraines or those who do not tolerate traditional medications. Supplements and herbs represent a safe alternative for prevention, but they require longer use and may have less predictable effects. Traditional methods, such as NSAIDs and triptans, remain the most effective for treating acute attacks, but their long-term use may be problematic (16, 19, 21-23).

4. Discussion

A comparative analysis of various migraine therapies, including modern and traditional approaches, reveals significant differences in terms of costs, availability, side effects, and patient adherence to recommendations. Neuromodulation, as a modern form of therapy, is one of the most expensive methods, primarily due to the costs of devices and the need for regular sessions. It also requires specialized care, which may limit accessibility for patients in less developed regions. On the other hand, neuromodulation is valued for its minimal side effects, which promotes greater adherence to recommendations, especially among patients who have experienced side effects from traditional migraine medications such as NSAIDs and triptans (21, 24). Botulinum toxin therapy is effective, especially for patients with chronic migraines, and results from the PREEMPT program suggest that regular Botox injections can significantly reduce the number of migraine days (19). Unfortunately, Botox also incurs high costs and is less accessible, which restricts its use primarily to more developed countries. In contrast to some pharmacological methods, Botox has a relatively low side effect profile, and patient adherence is generally high due to perceived clinical benefits. Alternative therapies, such as supplements (magnesium, riboflavin) and herbs (butterbur, feverfew), offer patients more economical and accessible solutions. The costs of supplements are significantly lower than those of other modern methods, making them more accessible to a broader group of patients. However, their effectiveness can be variable, and long-term use may result in lower adherence to recommendations. They also require regular use over an extended period before effects are noticed, which can impact patients' motivation to follow therapeutic guidelines, subsequently affecting the effectiveness of the therapy (16, 21). Traditional therapies, such as NSAIDs and triptans, remain popular due to their rapid action and availability. NSAIDs are inexpensive, but their use is associated with the risk of side effects, such as gastrointestinal issues and the risk of medication-overuse headaches, which may limit their use by patients. Conversely, triptans are more expensive than NSAIDs but are effective for acute migraine

attacks. Both methods have good availability, although patients may encounter adherence issues, especially when migraine requires long-term therapy (22). Finally, behavioral therapies and lifestyle modification are foundational in migraine prevention and treatment, particularly in combination with other methods. However, they require significant patient commitment, which can decrease adherence. These therapies are inexpensive and accessible to most patients, but their effectiveness depends on individual discipline and therapeutic support (22). For clarity, the above considerations are presented in the form of a table comparing different types of migraine therapies, including modern and traditional methods along with their strengths and weaknesses.

Type of Therapy	Strengths	Weaknesses	Cost	Availability	Patient Adherence
Neuromodulation	Minimal side effects, well tolerated by patients.	High cost of devices, requires regular sessions, limited availability in less developed regions.	High	Limited	High, due to minimal side effects
Botulinum Toxin Therapy	Effective for chronic migraine patients, relatively low risk of side effects.	High treatment cost, lower availability, primarily used in more developed countries.	High	Limited	High, with regular injections
Supplements and Herbs	Low cost, wide availability, natural alternatives, limited side effects.	Variable efficacy, requires long-term use, which may affect adherence.	Low	Wide	Variable, depends on regular use
NSAIDs and Triptans	Fast-acting, widely available, effective for acute migraine attacks.	Risk of side effects such as gastrointestinal issues; risk of medication-overuse headaches.	Low - Medium	Very Wide	Moderate, for long-term use
Behavioral Therapy and Lifestyle Modification	Low cost, no side effects, widely available, can support long-term migraine management.	Requires high patient commitment, therapist support and discipline, effectiveness depends on individual engagement.	Low	Very Wide	Variable, depends on patient discipline

In migraine treatment research, there are several challenges and significant gaps that impact the effectiveness of available therapies and the understanding of their long-term effects. One of the main limitations is the lack of long-term data regarding new therapies, such as neuromodulation, botulinum toxin, and biological drug therapy. Although short-term studies indicate the effectiveness of these methods, it is still unclear how they may affect patient health after years of use. Long-term studies are costly, and some patients withdraw before completion, further limiting their reliability and data completeness. Additionally, data on new therapies are often collected under strictly controlled clinical conditions, which may not reflect the real-life circumstances of patients. Another issue is the limited representation of different demographic groups. For example, studies on botulinum toxin therapy or neuromodulation still lack sufficient data involving younger patient groups, which poses a problem in the context of the widespread application of these therapies in clinical practice. Another limitation is the issue of patient adherence to recommendations. Many migraine treatment methods require consistency and commitment, which can be difficult to maintain, especially with behavioral therapies or supplements whose effects are only visible after a longer period. Therefore, further research is needed on methods to support patients in adhering to recommendations, which could enhance their effectiveness. In migraine treatment research, there is often a lack of consistent results comparing the effectiveness of different therapies, especially between modern and traditional methods. Differences in study designs, inclusion criteria, and assessment tools for effectiveness complicate the development of universal clinical recommendations (24-28). Personalization of therapeutic approaches in migraine treatment is a key element of effective management of this condition. Given the diversity of symptoms, causes, and responses to treatment, individual therapeutic plans should consider patient preferences, comorbidities, and the severity of migraines. Personalization of migraine therapy allows for the adjustment of treatment methods to individual patient preferences. Studies show that patients who are actively engaged in the decision-making process have better therapeutic outcomes. Involving the patient in treatment planning increases their satisfaction and adherence to recommendations (29). Individuals suffering from migraines often have other conditions, such as depression, anxiety, or cardiovascular issues. Adjusting treatment to these conditions can help reduce the severity of migraines and improve the patient's overall quality of life. For instance, patients with depression may require a more complex therapeutic approach that combines pharmacotherapy with psychotherapy (30). Assessing the severity of migraines and the frequency of attacks is crucial for personalizing therapy. The application of various treatment methods, including

pharmacotherapy, behavioral therapy, and relaxation techniques, may be justified depending on the severity of the migraines. For example, in cases of patients with severe migraines, it may be necessary to include more intensive pharmacological treatment, while patients with milder symptoms may benefit from non-pharmacological therapies (31, 32). Personalization of therapeutic approaches in migraine treatment, taking into account individual patient preferences, comorbidities, and the severity of migraines, is a crucial aspect of effective therapy. Properly matching treatment methods to patient needs can significantly improve quality of life and therapy effectiveness (2).

5. Conclusions

As a result of the analysis of various methods for treating migraines, several key conclusions can be drawn regarding the effectiveness, safety, and potential integration of different therapeutic approaches. In the context of the increasing number of individuals suffering from migraines, understanding and implementing effective treatment methods becomes extremely important.

1. Effectiveness of pharmacological therapies

Pharmacological therapies, such as triptans and non-steroidal anti-inflammatory drugs (NSAIDs), have demonstrated high effectiveness in alleviating acute migraine symptoms. Triptans, which act on serotonin receptors, effectively terminate migraine attacks; however, their use is associated with the risk of side effects, such as rebound headaches, dizziness, and feelings of weakness. Therefore, it is important for patients to be aware of these potential side effects and to be monitored by specialists to optimize dosing. In the case of preventive treatment, beta-blockers, such as metoprolol and propranolol, as well as anticonvulsants like topiramate, provide significant relief. However, they may cause undesirable effects, such as fatigue and memory problems. A key aspect of effective treatment is understanding individual patient responses to these medications and regularly adjusting them based on the symptoms reported by the patients.

2. The increasing importance of non-pharmacological therapies

Non-pharmacological approaches, such as cognitive-behavioral therapy (CBT), biofeedback, acupuncture, and lifestyle changes, are increasingly recognized as important components of a

comprehensive treatment for migraines. Cognitive-behavioral therapy, which involves identifying and modifying negative thought patterns, helps patients better cope with symptoms and stress, which often triggers migraines. Biofeedback, on the other hand, allows patients to learn control over their physiological responses, potentially leading to a reduction in the frequency of attacks. Acupuncture, although its mechanisms of action are still under investigation, shows promising results in reducing the number of attacks and the intensity of pain. Lifestyle changes, such as regular physical activity, a healthy diet, and relaxation techniques, also play a significant role in migraine prevention. Reducing stress and improving sleep quality can contribute to a decrease in the frequency of migraine attacks.

3. Innovative therapies

The development of modern treatment methods, such as neuromodulation and botulinum toxin therapy, opens new possibilities for patients who do not respond to traditional medications. Neuromodulation, which includes techniques such as trigeminal nerve stimulation and spinal cord stimulation, shows potential in treating migraines by modifying neuronal activity, leading to a reduction in the frequency and intensity of attacks. Studies indicate that these therapies may be particularly beneficial for patients suffering from chronic migraines. Botulinum toxin therapy, which involves injecting small doses of the substance into specific areas of the head, has been approved as a preventive treatment for patients with chronic migraine attacks. Reviews of clinical studies have shown that it can significantly reduce the number of migraine days and improve patients' quality of life, offering a favorable safety profile compared to traditional pharmacological therapies.

4. Holistic approach to treatment

A key element of effective migraine management is a holistic approach that combines various treatment methods, both pharmacological and non-pharmacological. This approach not only helps in controlling symptoms but also enables a better quality of life for patients. Educating patients about the available therapeutic options, their effectiveness, and potential side effects is essential for achieving optimal treatment outcomes. An individualized approach to the patient, considering their treatment preferences and responses to therapy, is crucial for the effectiveness of migraine treatment. Collaboration among specialists in neurology, psychology, and alternative medicine is necessary to develop a comprehensive therapeutic plan.

5. Recommendations for clinical practice

Based on the conducted review, physicians should tailor therapeutic approaches to the individual needs of patients, considering both the type of migraine and preferences regarding treatment methods. It is essential for physicians to focus not only on alleviating symptoms but also on educating patients about self-management of their health. A long-term approach to migraine treatment that incorporates both pharmacological and non-pharmacological methods can contribute to achieving better therapeutic outcomes. Regular monitoring of treatment progress and adjusting therapeutic strategies as needed is also crucial to ensure that patients receive the best possible quality of life and symptom reduction.

SUMMARY

In summary, there are many effective methods for treating migraines, and their application should be individualized based on the characteristics of the patient and their response to therapy. The aim of each of these methods should not only be to alleviate symptoms but also to improve the quality of life for patients. In the context of the growing number of individuals suffering from migraines, effective management of this condition requires continuous expansion of knowledge, research, and the implementation of new therapeutic methods in clinical practice.

DISLOCURE

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