Curr Pain Headache Rep (2016) 20: 29
DOI 10.1007/s11916-016-0562-z

Role of Alternative Therapies for Chronic Pain Syndromes

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Published online: 2 April 2016

Abstract There is increasing interest in the use of complimentary and alternative medicine (CAM) for the treatment of chronic pain. This review examines alternative and complimentary therapies, which can be incorporated as part of a biopsychosocial approach in the treatment of chronic pain syndromes. In the present investigation, literature from articles indexed on PubMed was evaluated including topics of alternative therapies, complimentary therapies, pain psychology, biofeedback therapy, physical exercise therapies, acupuncture, natural and herbal supplements, whole-body cryotherapy, and smartphone technologies in the treatment of chronic pain syndromes. This review highlights the key role of psychology in the treatment of chronic pain. Cognitive behavior therapy appears to be the most impactful while biofeedback therapy has also been shown to be effective for chronic pain. Exercise therapy has been shown to be effective in short-, intermediate-, and long-term pain states. When compared to that in sham controls, acupuncture has shown some benefit for neck pain immediately after the procedure and in the short term and improvement has also been demonstrated in the treatment of headaches. The role of smartphones and whole-body cryotherapy are new modalities and further studies are needed. Recent literature suggests that several alternate therapies could play a role in the treatment of chronic pain, supporting the biopsychosocial model in the treatment of pain states.

Keywords Chronic pain · Alternative medicine · Complimentary and alternative medicine · Biofeedback · Cryotherapy

This article is part of the Topical Collection on *Other Pain*

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Introduction

The treatment of chronic pain has traditionally been understood in a disease model with treatment limited to medications and to interventions. This understanding has gradually shifted to a biopsychosocial approach with three main components: biological, psychological, and social [1]. The biological, or neurophysiological, component of pain previously based on peripheral, or nociceptive, stimuli recently transitioned to a central model of pain based on active brain processes. The main involved cortical areas of the brain are the prefrontal cortex, the anterior cingulated cortex, and the insula, which are responsible for processing the meaning of pain, the emotional response to pain, and the personal understanding of pain, respectively [2]. This central neurophysiological model suggests that the brain is not passive, but rather active, in processing of painful stimuli and is, therefore, receptive to psychological interventions. In addition to this evolving understanding of the sensory experience, pain is always a subjective condition based on emotions, personality, and

environmental factors [3]. Pain is only understood by observation, inference, and verbal description, rather than objective information, and requires multimodal interventions.

Pharmacological agents and invasive procedures can temporarily reduce symptoms but fail to target the emotional and cognitive components of chronic pain. Thus, effective treatment relies on complementary and alternative therapies, including pain counseling, physical therapy, behavioral management, hypnosis, biofeedback, and cognitive behavioral therapy [3]. Other alternative therapies include acupuncture and herbal supplement. We review some of the most recent studies regarding alternative therapies in the treatment of chronic pain, which can be utilized in a biopsychosocial approach to supplement traditional therapies and ultimately improve care.

Pain Psychology

Whereas acute pain serves as a warning signal, chronic pain serves no adaptive purpose. Acute pain often has a clear cause, such as trauma or surgery, and a clear healing end point [4]. If treated effectively with a short course of pharmacological agents, in addition to physical therapy, acute pain is mostly typically a finite condition. However, if not treated properly, acute pain can develop into chronic pain, which does not have a clear etiology or progression. Acute pain results from characteristic nociceptive afferent inputs, unlike chronic pain, which usually involves the disassociation of nociception, and pain [5]. Chronic pain is a complex condition without a well-defined onset that persists beyond predicted healing times and does not respond to traditional biomedical interventions [6]. Poorly understood without a clear definition, chronic pain is different for each individual with unique experiences and values and, therefore, has a strong psychological component that requires specific treatment.

A portion of the stress and anxiety experienced by chronic pain patients is related to providers who do not adequately listen and imply that the patient's symptoms are all in their head [7]. Providers can minimize these psychopathologic thoughts by being compassionate and listening to the patient and by providing the patient with thorough counseling and referrals to physical and cognitive therapists. Of all the behavioral treatments, cognitive behavioral therapy, which replaces maladaptive thoughts with healthy thoughts, is the most effective therapy for patients with chronic pain [8••]. Newer therapies, such as acceptance and commitment therapy, which promotes acceptance, rather than change of thoughts, are also increasing in popularity but lack supportive evidence. Biofeedback therapy, a self-regulatory technique which allows patients to visualize physical changes during pain and to take control of changes in their body with relaxation skills, however, is effective treatment for patients with chronic pain [9]. Used primarily for adult patients, biofeedback is now gaining support for use in pediatric and adolescent patients [10]. Early implementation of psychosocial treatments with an interdisciplinary approach minimizes debilitating depression often associated with chronic pain.

Physical Exercises and Therapies

Physical therapy (PT) is a frequently utilized modality for chronic pain; however, its prevalence is highly variable. For example, only 2 % of the French with chronic pain utilize it, whereas in neighboring Holland, the use is 52 % [11]. One American study of 588 subjects with chronic lower back pain (CLBP) who had sought care in the year previous to the study found that less than one third of the individuals saw a physical therapist [12]. There are many reasons why patients may not elect to undergo or continue with PT as a modality, but common barriers include low levels of physical activity at baseline, depression, anxiety, and increased pain levels during exercise [13].

Traditional or land-based PT relies on various exercises and stretches to increase strength, flexibility, balance, and coordination. The vast majority of research regarding PT as it relates to chronic pain is performed with this type of PT. Aquatic exercise, or aquatherapy, utilizes similar techniques in an aquatic environment. Water immersion decreases loading of the spine and joints through the effects of buoyancy, and is credited with allowing the performance of movements that are impossible on land. Despite the perceived benefits, a meta-analysis found "sound evidence that there are no differences in pain-relieving effects between aquatic and land exercise" [14].

Of all types of chronic pain, the most frequently researched in regard to PT is CLBP; however, the quality of the studies varies widely. A review of 61 randomized controlled trials found exercise therapy to be effective in chronic back pain relative to comparisons in short-, intermediate-, and long-term follow-ups [15•]. Another review looking at 83 studies demonstrated low-quality evidence for the effectiveness of exercise therapy compared to usual care for lower back pain [16]. The most recent review stated no firm conclusions regarding efficacy could be drawn from the existing RCTs [17]. This conclusion was made given the inadequate reports of descriptive statistics and heterogeneity across included studies which made a statistical meta-analysis impossible. Despite the mounting data, the most recent clinical practice guidelines from the American Physical Therapy Association recommend manual therapy, trunk coordination, and endurance exercises with an "A"-grade recommendation for patients with CLBP [18]. For patients who do utilize the modality, supervised exercise was still significantly better than chiropractic spinal

manipulation and home exercise in terms of satisfaction with treatment [19].

Other types of pain are less well studied, though preliminary work with promising results has shown some benefit with diverse targets such as chronic pelvic pain [20, 21], complex regional pain syndrome, myofascial masticatory pain [22], and patellofemoral pain [23, 24].

Acupuncture

Acupuncture therapy encompasses a group of procedures which stimulate precise anatomical locations by a variety of techniques to produce clinical effects [25]. Current practices of acupuncture in the USA incorporate elements of therapy originally developed in China, Japan, Korea, and other countries [26]. There are a variety of methods of stimulating anatomic points in acupuncture, including needle insertion with and without manipulation, the application of surface pressure, and electrical stimulation of inserted needles, among others, and each approach may be employed to produce a different therapeutic and clinical effect, such as pain management [25]. The acupuncture technique which has been studied most extensively involves needle penetration of the skin through the use of thin, solid, metallic needles which are manipulated by the hands and may or may not incorporate electrical stimulation as well [26].

An estimated 3.5 million American adults receive acupuncture treatment each year, a number that has been increasing in a linear trend between 2002 and 2012 [27]. One study found that the major reason reported for acupuncture use is the perceived ineffectiveness of conventional medical treatment [28]. Chronic pain is the most common reason for seeking acupuncture therapy [29]. Females are more likely to seek acupuncture treatment than males, and having a higher level of education is associated with a higher utilization, as is having a higher income [28]. This trend may well be related to the economic cost of obtaining acupuncture therapy, which may average to about $93 ± 39 per visit [30]. In addition, the economic cost is compounded by the frequency of therapy that may be necessary to achieve clinical effects. For example, chronic pain acupuncture treatments may require ten to 12 sessions for optimal clinical outcomes [25].

Large meta-analyses have often found positive data when comparing acupuncture to the control and to other established modalities. For neck pain, one meta-analysis of ten studies found moderate evidence that acupuncture was more effective than inactive sham treatments both immediately after treatment and when observed at short-term follow-up [31]. However, there is limited evidence that acupuncture is more effective than massage at short-term follow-up. For chronic radicular neck pain, there is moderate evidence that acupuncture therapy is more effective than a wait-list control as observed in the short-term period. Another large meta-analysis found pain scores improved through acupuncture by 0.23 standard deviation (SD) for neck pain and back pain [32].

With regard to chronic lower back pain, a meta-analysis of 33 studies found that acupuncture is significantly more effective than sham treatment (standardized mean difference, 0.54 [95 % CI, 0.35 to 0.73]; seven trials) and no additional treatment (standardized mean difference, 0.69 [CI, 0.40 to 0.98]; eight trials). However, for patients with acute low back pain, data are sparse and inconclusive [33].

For chronic headaches, a large meta-analysis found an improvement of 0.15 SD in pain scores with acupuncture when compared with sham acupuncture and 0.42 SD in patients receiving no acupuncture [34].

The safety profile of acupuncture is well studied. A German study involved 229,230 patients receiving acupuncture from physicians with postgraduate acupuncture training for an average of about ten acupuncture treatments. In the analysis, 8.6 % of the patients were found to have experienced at least one adverse effect, with 2.2 % requiring treatment. These adverse effects in order of occurrence in the study included bleedings or hematoma (6.1 %), pain (1.7 %), and vegetative symptoms (0.7 %). Two patients in the study were noted to have developed a pneumothorax requiring medical attention. The longest-lasting side effect was noted to be a nerve lesion of the lower limb, persisting for 180 days [35]. These rates of adverse events show an acceptable level of complication compared with other frequently used modalities (e.g., GI bleed with NSAIDs or overdoses with opiates).

Studying the effects of acupuncture in a controlled trial is challenging due to difficulties in blinding. Although non-penetrating needles have been developed, they can be expensive and difficult to implement. Penetrating needles have been shown to have important physiologic activity even when placed as the sham controls and have thus been recommended to be avoided in future research requiring blinding [36].

Natural and Herbal Supplements

At present, there are thousands of herbal products available which are taken daily for a wide variety of ailments. They are easy to access and inexpensive, do not require a prescription, and are self-administered by consumers daily throughout the world for pain-related states typically without scientific investigation determining efficacy. While dietary supplements are generally considered safe related to their natural origins, some components within these products are pharmacologically active and may adversely affect patients unaware of their effects. In this regard, therapeutic efficacy can be seen, and this may be related to the product itself or be seen through the placebo effect.

Over the past 50 years, the biopsychosocial model replaced the disease model of chronic pain. Where the disease model focused on treatment with pharmacological agents and invasive procedures, the biopsychosocial model recognizes a need for complementary and alternative medicine in addition to traditional therapies. These complements to standard medicine often include physical and cognitive therapy but also include the use of natural and herbal supplements. The US Dietary Supplement Health and Education Act of 1994 defines a supplement as "a product that is intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by man to supplement the diet by increasing the total daily intake, or a concentrate, metabolite, constituent, extract, or combinations of these ingredients" [37]. Although limited, there is low-to-moderate-quality evidence for specific herbal supplements for short-term treatment of patients with chronic low back pain [38].

There are four herbal medicines which have been shown to provide temporary relief of chronic low back pain. These are herbs with an active plant ingredient which is either ingested, injected, or topically applied [39]; *Harpagophytum procumbens* (devil's claw) in doses of 50 and 100 mg can provide pain relief when compared to a placebo [45]. Similarly, *Salix* (willow bark extract) in doses of 120 and 240 mg reduces pain more than a placebo [46]. Both devil's claw and willow bark extract, however, did not provide additional pain relief when compared to rofecoxib alone [38]. *Capsicum frutescens* with its 11 mg of capsaicinoids has been shown to reduce pain and improve function when applied topically [47]. In the same way, lavender oil applied topically with acupressure reduced pain and improved flexibility in chronic low back pain patients [48]. Despite these promising results, the patients in these studies underwent additional interventions, which contributed to their reduced pain. Future studies in patients with many chronic pain conditions would help support the benefits of herbal supplements.

Patients who take herbal supplements for chronic pain conditions need to weigh the potential benefits versus the potential risks of treatment. Devil's claw can increase stomach acid, decrease blood glucose levels, decrease blood pressure, and interfere with the p450 cytochrome [39]. Willow bark extract contains salicin similar to aspirin and can cause gastrointestinal side effects, including ulcers, nausea, and vomiting. Both capsicum and lavender can cause skin irritation when applied topically, causing some patients to discontinue use during the studies mentioned above [38]. Due to both the potential risks and the questionable benefits, the majority of providers will not include herbal or natural supplements in their initial treatment plan for chronic pain patients. Furthermore, clinicians should consider the placebo effect, in particular as it relates to pain states.

Whole-Body Cryotherapy

Cryotherapy is a literal combination of *cryo*, which stems from the Greek term *kruos* translating to frost and *therapy* that also lends back to the Greek word *therapeia* for healing. The use of ice and cold compresses for the treatment of localized pain symptoms and inflammation spans many decades, and has often transcended into whole-body ice baths where athletes would immerse themselves in tubs filled with ice and frigid water to shorten recovery time between strenuous workouts. The evolution of cold therapy led to a particular process that was proposed about 30 years ago, in Japan, for the treatment of rheumatic diseases with exposure to cold air in cryochambers for a brief period of time [40]. Polish scientists then took the idea and used it for rehabilitation of athletes after intense training periods, and established a cryochamber in the Olympic training grounds where it gained wide popularity around Europe and the USA to help reduce inflammation and speed up recovery between workouts. This up-and-coming modality is gaining wide momentum particularly among elite athletes and has garnered tremendous attention in the media by touting benefits for treating muscle soreness, inflammation, various skin conditions, anxiety, depression, and chronic pain.

The cryotherapy procedure consists of brief exposure to extremely cold air in specially designed chambers. The temperature of the ambient air is maintained at −110 to −140 °C. The treatment was named whole-body cryotherapy (WBC), and the timeline of the exposure varies between 2 and 3 min. Prior to entry into the cryochamber, the participant is acclimated to the upcoming temperature change by first experiencing 30 s of −60 °C air in a special vestibule before entering the cryochamber. During the exposure period, the participant will have minimal clothing (shorts or bathing suit) to ensure maximal skin exposure. However, extremities and sensitive areas are covered with gloves, socks, and a surgical mask and a headband to cover the ears is used to avoid frostbite. Prior to entry into the chamber, any sweat is also wiped away for this reason. Within the chamber, the subjects are instructed to continually move their fingers and legs and avoid holding their breath for the duration.

The application of WBC is believed to help relieve pain and inflammatory symptoms caused by conditions like rheumatoid arthritis, fibromyalgia, and ankylosing spondylitis. According to available literature, WBC has not been shown to be harmful to healthy individuals. Studies have shown that WBC is associated with an increase in anti-inflammatory cytokines like interleukin-10 (IL-10) with concurrent decreases in pro-inflammatory cytokines such as IL-2 and IL-8, lending to the theory that such treatment could lead to decreased inflammatory response. Banfi and colleagues go on to show that a week of cryotherapy on rugby players resulted in a significant decrease in creatinine kinase and lactate dehydrogenase,

which lends to the theory that this could facilitate muscle recovery after injury [41]. Cardiac markers like troponin-I and C-reactive peptide were not changed, and cryotherapy did not seem to affect the pituitary-adrenal cortex axis [42].

The benefits of cryotherapy can be extrapolated by such published data to explain its effects on chronic pain produced by conditions fueled by inflammation such as fibromyalgia and rheumatoid diseases. Bettoni and colleagues published a paper showing the effects of 15 cryotherapy sessions resulting in marked improvement in quality of life [43] while Guillot and colleagues did a systematic review of the use of cryotherapy on rheumatic diseases and published results evident for significantly decreased visual analog pain scores in these patients [44]. Other studies validate similar findings; however, the studies are limited, and many of the publications are not in English.

Much of the studies done on effects of cryotherapy in regard to shortening recovery time post strenuous workouts have been done on athletes who are physically at their peak. This was the patient population used in studying inflammatory markers and their response to the cold therapy. This data may therefore not be translatable to the general population where other confounding medical conditions are present. In addition, the studies on cryotherapy and chronic pain are incredibly limited and do not have a standardized regimen of cryotherapy nor do they include any long-term benefits or detriments. Much of the therapeutic value being advertised is anecdotal and based on observational studies. Cryotherapy remains a novel modality and appears to have much potential in the treatment of chronic pain. However, more clinical studies following patients over a longer period of time are needed to examine the safety and effectiveness of this therapy before such treatments would be officially approved.

Smartphone Technologies

The growing use of smartphones among patients in the USA has promoted the integration of such technologies in the healthcare setting. The use of such technologies has been studied extensively in mental health research, as methods to deliver interventions and psychoeducation supplement treatment and enhance therapeutic reach [49]. More recently, this area of clinical investigation has included research on the feasibility, safety, and efficacy of smartphone technologies in pain management. Smartphone applications provide multiple features conducive to its integration into outpatient pain management, including familiarity of patients with mobile phones, portability, easy accessibility, and the potential of continued product advancements based on patient feedback. The use of such technologies is an area of active clinical investigation, and results of previous studies have demonstrated a growing role of smartphone applications as an emerging tool in pain management.

A recent study assessed the effectiveness of a short message service (SMS) text message-based social support intervention in not only reducing daily pain levels and pain interference but also improving perceptions of social support in patients with chronic non-cancer pain [50•]. The study involved 68 patients randomized to either standard care or to standard care along with receipt of twice-daily supportive SMS text messages over the 4-week study period. The study demonstrated reduced perceptions of pain and improved positive affect among chronic patients utilizing this novel mobile application.

Another avenue of research involves the application of smartphone technology as a means of employing virtual reality pain distraction methods. Previous studies have demonstrated that virtual reality can change how the brain physically registers pain with some studies reporting a reduction of 30 % in reports of "worse pain" and 44 % in "time spent thinking about pain," as well as a significant reduction in pain-related brain activity in relevant neuroanatomical areas of interest in the brain [51]. In a recent small-scale study, the efficacy of mobile phone displays delivering pain distraction virtual reality in which patients were instructed to interact with the simulation graphics and explore virtual worlds was tested [52]. This novel study examining the role of smartphone technology to deliver virtual reality pain distraction demonstrated that use of the application was easy and not associated with any adverse effects, such as cybersickness, and that the intervention reduced pain and anxiety in participants. The results of this study are promising, and future larger-scale studies are warranted to further establish the efficacy of integrating smartphone technology and virtual reality pain distraction methods.

The Personalized Research for Monitoring Pain Treatment (PREEMPT) study is an active randomized controlled trial that is investigating the role of a smartphone application called Trialist in improving healthcare outcomes in chronic pain patients [53]. The Trialist application provides treatment reminders and collects data entered daily by the patient on pain levels and treatment side effects. The goal of the study is to assess the feasibility and efficacy of this application in promoting individualized therapy for chronic pain patients, and the results of this study may help further establish the role of smartphone technology in clinical pain medicine. Another active clinical trial is assessing the effectiveness of a mobile phone application providing instructions for relaxation techniques in patients with chronic low back and neck pain [54]. The participants will be randomized to either standard care or the use of this novel mobile phone application providing instruction for three relaxation techniques, including autogenic training, mindfulness meditation, or guided imagery. The results of both of these active clinical trials may provide useful clinical information about the role of novel mobile phone applications that promote active, individualized care for patients with chronic pain.

The role of novel smartphone applications in the management of chronic pain is an area of active investigation at present. The published data suggest ease of use and feasibility in addition to efficacy in reducing pain levels among patients. The current clinical trials may not only broaden the scope of applicability of smartphone technology but also promote more patient involvement in self-pain management in an individualized manner. More studies are warranted to help elucidate the role of such technology in the management of a wide range of chronic pain conditions.

Conclusion

There definitely appears to be a role for alternative therapies and complimentary medicine in the treatment of chronic pain syndromes. This review showed that biofeedback therapies and cognitive behavior therapies that constitute the most studies of the psychological therapies appear to be effective in the treatment of chronic pain. Clearly, more studies are needed to validate any role that newer therapies such as acceptance and commitment therapy could have on these patients. The evidence for the use of physical therapy in the treatment of chronic pain has been variable, at best. Continued research on the alternative therapies of acupuncture, chiropractic manipulation, herbal medications, and massage is also needed to determine their safety and efficacy as more patients turn to these therapies in addition to being treated with conventional therapies for relief of chronic pain.

Compliance with Ethical Standards

Conflict of Interest Donna-Ann Thomas, Benjamin Maslin, Aron Legler, Erin Springer, Abbas Asgerally, and Nalini Vadivelu declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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- •• Of major importance

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