

Chapter 14

Nonpharmacologic Modalities for Chronic Pain



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Introduction

Hellen Keller once said, “*Although the world is full of suffering, it is full also of the overcoming of it.*” Chronic pain (CP) with or without neuropathic features is considered a major public health problem and among the most common chief complaints encountered in primary care [1, 2]. CP exists beyond the usual tissue healing time for a certain underlying illness [3], and may persist for more than 3–6 months or present intermittently as a recurring symptom [4–7]. Its vast and lingering impact on the physical, neuropsychological, and social aspects of the life of a patient may contribute not just to his/her reduced health-related quality of life, which is among the lowest found for any medical condition [8], but also to the community’s economic burden from loss of productivity and increased demand for disability-related compensations [9, 10]. Although there is no universally acceptable standardized or fixed protocol for CP care [11, 12], a lot of treatment options are available, ranging from pharmacologic to nonpharmacologic, and unimodal (a single therapeutic intervention targeting a specific pain mechanism or diagnosis) to multimodal (concurrent use of two or more therapeutic interventions within the realm of one discipline targeting different pain mechanisms), multidisciplinary (multimodal approach by a team composed of different disciplines working separately towards a common

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goal), and interdisciplinary (multidisciplinary team working in collaboration with the patient and/or family) treatments, which can all be contextualized according to the patient's overall condition, needs, goals, and resources [13].

Treatment Rationale

Previously viewed as being outside the scope of mainstream pain management [14], nonpharmacologic modalities, which are interventions that do not rely on medications to effect analgesia, are now part of the fundamental and holistic care for patients even from the outset of pain to prevent it from “chronification” (progression into persistent pain due to imbalance between pain amplification and inhibition) [11, 15]. While acute pain may be considered a normal, expected, and physiologic response to an underlying tissue injury, CP does not seem to serve a protective function or apparent biological value [15].

In line with Engel's biopsychosocial model [16], CP can result from a complex and dynamic interaction of biological, cognitive, psychological, social, and cultural contexts that may shape the clinical symptoms, severity, duration, functional impact, perceptions, and response to illness experienced by a patient [17]. Given the multifaceted nature of CP, providing at least a multimodal approach to treatment may, therefore, seem rational [17, 18]. Nonetheless, an interdisciplinary approach maximizing the coordinated efforts of healthcare providers from different disciplines (e.g., physicians from relevant specialties and subspecialties, physical therapists, occupational therapists, psychologists, nurses, nutritionists, social workers, and other health professionals) can more comprehensively address the individualized needs of a patient [19], but similar to any other intervention/s its cost-effectiveness has to be considered [17].

The evolution of pain models began with the World Health Organization's three-step ladder (depicting the linear up or down approach to medication use) [20], which eventually gave rise to the four-step ladder (incorporating interventional procedures) [21], and platform model (highlighting both pharmacologic and nonpharmacologic treatments) [22]. The latest model comes in the image of a trolley that advocates dynamic, tailored, and multimodal pain management [12]. The simple and intuitive “analgesic trolley” model consists of several drawers containing pharmacologic options with different mechanisms of action, and nonpharmacologic options whether nonoperative (e.g., therapeutic, educational, or psychological services; complementary and alternative medicine) or operative (e.g., neurolysis; other interventional procedures). It guides a healthcare provider in selecting the most appropriate treatment modalities for his/her patient depending on the following: (1) pain intensity; (2) underlying pathophysiology; (3) complex clinical presentation; (4) comorbid condition/s; and (5) socioenvironmental factors [12].

Nonpharmacologic Modalities

Nonpharmacologic modalities can be used either as stand-alone or in combination with analgesic medications. Their advantages over pharmacologic treatments may include, but are not limited to, their overall safety, tolerability, patient compliance, and potentially long-term benefits [23–25]. Nonpharmacologic modalities may also minimize the dosage of analgesic medications (e.g., opioids) and subsequently their possible side effects [26]. The selection of individual modalities comprising a comprehensive and tailored treatment should consider various clinical factors, such as patient’s age, medical history and evaluation, prior interventions, current pain status, safety, preferences, and treatment goals [26]. Nonpharmacologic modalities generally aim to control, rather than eliminate, the pain and its negative impact on the person (e.g., limitations in functional activities and societal roles; anxiety; reduced quality of life) [24, 26]. However, the success of patient-centered nonpharmacologic approach may entail consistent and active participation from the patient and family, who ultimately direct and adhere to the treatment options offered by the healthcare team based on their needs and available resources. Incorporating nonpharmacologic modalities in the treatment armamentarium for a patient suffering from CP encourages “patient self-efficacy, active problem-solving, realistic goal setting, and a functional/rehabilitative outlook” [27].

Turk and Monarch describe a medical condition or “disease” as an objective alteration of the normal or physiological body structure and function, while an “illness” as a subjective experience arising from a “unique interaction among biological, psychological, and social factors” [28]. CP, albeit emerging from underlying peripheral sensory and central sensitization mechanisms [29], can be viewed as an illness that may benefit from rehabilitation and disability management, rather than mere curative approach [30]. In the same way, the biopsychosocial perspective may target the illness more than the disease, taking into account the diverse differences in the pain journey of individual patients [31].

For an organized discussion, this section presents some of the nonpharmacologic modalities according to their intuitively primary or direct benefits as follows: (1) biological or physical; (2) psychological or behavioral; and (3) social or cultural. However, it must be noted that most, if not all, of the nonpharmacologic modalities presented herein may have one or more of these interrelated benefits.

Biological or Physical Treatment Options

Nociception pertains to pain perception as a result of underlying biological or physiological pain mechanisms (e.g., through nerve receptors, specifically free nerve endings for pain; nerve fibers, such as types A-delta or C for acute or chronic pain, respectively) associated with sensory input [31]. The multitude of pain conditions can be categorized into inflammatory, neuropathic, or cancer pain [30]. The

mechanism of acute inflammatory pain states involves “stimulation or potentiation of nociceptive transduction at peripheral terminals and central changes contributing to hypersensitivity” [30, 32], which if managed inadequately may lead to CP characterized by central sensitization, an abnormal heightened state of pain perception disproportionate to usual sensory inputs and mechanisms [33]. Neuropathic pain arises from “a lesion or disease of the somatosensory system” [34], spanning from the peripheral nerves to the spinal cord and other areas in the central nervous system. Meanwhile, cancer-related pain can result from tumor infiltration or mechanical compression of adjacent neurologic structures, neuroendocrine substances released by tumors, or effects of treatment [30]. CP can typically accompany neuropathic and cancer-related types of pain [35, 36].

Given the biological mechanisms of CP, various nonpharmacologic modalities have been developed to alleviate primarily the physical aspect of this pain condition.

Thermotherapy

Thermotherapy refers to any therapeutic modality that can either increase (heat therapy) or decrease (cryotherapy) the cutaneous, intraarticular, and/or core temperature of soft tissues with the goal of relieving pain and spasm [37, 38]. Thermoreceptors, localized in the dermal ends of primary somatosensory nerve fibers [39], may alter the neurotransmission of nociceptive or pain impulses [38]. Aside from ‘shutting the pain gate,’ heat therapy works by vasodilation resulting in enhanced local blood flow, metabolic rate, and tissue extensibility of the treatment area, while cryotherapy facilitates vasoconstriction that initially decreases and then increases local blood flow with the net result of reduction in tissue metabolism, neuronal excitability and conduction, and inflammation [37, 40]. In general, cryotherapy is used during the inflammatory phase of healing to help control swelling [41], whereas heat therapy can be instituted either alone or alternately with cryotherapy (i.e., contrast bath) during the proliferative and remodeling phases. The choice between cryotherapy and heat therapy depends on the patient’s medical history, treatment goals, and preference, along with the healthcare provider’s experience and judgment [42].

Topical modalities that employ heat therapy can be categorized into superficial and deep heating agents. Superficial heating agents (e.g., hot packs; heating pads; infrared radiation; dry heat in the form of fluidotherapy; paraffin wax bath) achieve a maximum tissue temperature in the skin and subcutaneous tissue and allow heat dissipation to deeper tissues through vasodilation and the insulating properties of fat [43]. Deep heating agents (e.g., therapeutic ultrasound; shortwave diathermy; microwave diathermy) penetrate the skin and subcutaneous tissue and produce a maximum temperature increase (up to therapeutic levels of 40–45° C or 104–113° F) in the underlying tissues, without heating up or damaging the more superficial ones [43, 44]. Therapeutic heat can benefit various painful conditions, such as sprains, strains, fibrositis, muscle injury, arthritis, contractures, chronic pelvic inflammatory disease, etc [44].

The modalities that provide cryotherapy are all superficial cooling agents. Examples include cold packs, ice massage, cold water immersion, and cryotherapy-compression units that employ conduction as their main form of energy transfer. On the other hand, vapocoolant sprays and whirlpool baths transfer energy through evaporation and convection, respectively [43]. A recent systematic review found supportive evidence for the use of either local or nonlocal (whole body) cryotherapy for CP of degenerative or rheumatic origins [40]. Promising results were observed for adhesive capsulitis, myofascial pain syndrome, chronic low back pain, fibromyalgia, rheumatoid arthritis, ankylosing spondylitis, and osteoarthritis. However, insufficient evidence was found for chronic venous disease and multiple sclerosis.

Thermotherapy is a generally safe nonpharmacologic modality, but it is not without known adverse effects inherent to either heat or cold application. Hence, a thorough review of the patient's medical contraindications and precautions, along with adequate knowledge of the mechanism and risks of any available specific modality, should be considered before incorporating thermotherapy in the treatment regimen.

Electrotherapy

Electrotherapy in the form of transcutaneous electrical nerve stimulation (TENS), which can come in a small, low-cost, battery-powered device delivering alternating current through electrodes applied on or near the painful area, is used widely for CP [45]. TENS works at both peripheral and central levels. It activates large diameter afferent fibers and subsequently the descending inhibitory systems to reduce pain perception [45, 46]. The high-frequency TENS (25–50 Hertz) in particular reduces neuronal excitation and sensitization in the spinal cord through the reduction of glutamate [45, 47]. The effectiveness of TENS is associated with its pulse frequency and intensity that can be increased until levels perceived by the patient as pain-free, although tolerance may develop especially with frequent application using the same parameters [45].

Earlier systematic reviews suggested emerging evidence of TENS for CP such as in osteoarthritis and fibromyalgia, and neuropathic pain such as in diabetes mellitus and spinal cord injury [45]. However, a recent review of prior Cochrane reviews was unable to reach a solid conclusion regarding the effectiveness of TENS for adults with CP due to the very low-quality evidence found in the literature [48]. For the same reason, the 2019 guideline of the American College of Rheumatology/Arthritis Foundation does not recommend TENS for knee and/or hip osteoarthritis [49].

Manual Therapy

Manual therapy refers to passive techniques applied by trained practitioners (e.g., physicians, physiotherapists, chiropractors, osteopaths) to joint, muscle, connective, and/or neurovascular tissues [50]. It comes in different forms, such as oscillatory techniques, high-velocity, low-amplitude thrust techniques, sustained

stretching, muscle energy techniques, and massage, depending on the patient's needs, clinician's expertise, treatment goals, and even cultural beliefs [51, 52]. It can provide several physiological, biomechanical or physical, and psychological therapeutic benefits. It reduces pain by activating the gate control theory and descending inhibitory tracts, and inhibits muscles spasm by reducing the pressure or tension of intraarticular or periarticular structures [53]. To improve joint range of motion and quality, 'mobilization' or 'manipulation' can be performed within or beyond an available active range of motion, respectively [54]. Through repetitive movements, manual therapy can produce alterations in tissue extensibility and joint fluid dynamics to facilitate repair and remodeling of injured structures [54, 55]. Employing direct physical contact, it can foster patient-clinician interaction via the "laying of hands," possibly alleviating stress or anxiety [50, 54, 56].

The incidence of major adverse events with manual therapy in general is low, and no catastrophic event like death or stroke has been reported [57]. It may, however, present with minor adverse events like short-term muscle soreness, stiffness, and headache in about 50% of patients [58, 59]. Especially for spinal manipulation, several contraindications should be considered such as the following: joint hypermobility (e.g., syndromes presenting with ligamentous laxity) or instability (e.g., spondylolisthesis); bone disease (e.g., malignancy, infection, fracture, osteoporosis); neurovascular compromise (e.g., spinal cord compression, moderate to severe nerve root compression); rheumatologic disease (e.g., rheumatoid arthritis, ankylosing spondylitis, polymyalgia rheumatica); and vascular disorders (e.g., aortic aneurysm, severe blood dyscrasias, vertebrobasilar insufficiency, spinal ischemia) [60].

Prior systematic reviews, including a Cochrane review, showed that spinal manipulative therapy may be as effective and safe as other common interventions like standard medical treatment, physiotherapy, or exercises, in reducing pain and improving function among patients with chronic low back pain [61, 62]. However, due to a high risk of bias found in the included studies, further research, including economic evaluations to determine cost-effectiveness, was recommended. Meanwhile, a more recent randomized controlled trial (RCT) compared the effects of manual therapy (3 sessions at one per week employing high thoracic manipulation, cervical articular mobilization, and suboccipital muscle inhibition), therapeutic exercises for cervical flexors and extensors daily for 3 weeks, and placebo on non-specific chronic neck pain [63]. The two experimental groups showed statistically significant improvements in pain and disability in the short and medium terms. Nonetheless, the authors recognized the need for further studies particularly on the effects of multimodal treatment (e.g., combined manual therapy, therapeutic exercise, and pain education), which might provide more optimal outcomes.

Therapeutic Exercises

Therapeutic exercise refers to a planned, structured, and repetitive "performance of bodily movements, postures, or physical activities" aimed towards the prevention or rehabilitation of impairments, control of health-related risk factors, and

maintenance or improvement of function, fitness, and overall well-being [64, 65]. It refers to a wide range of exercise modalities (e.g., land- or water-based range-of-motion, resistance, and/or aerobic exercises; tai chi; balance training; motor control exercise; Pilates method) that can target one or more of the following interrelated components of function: mobility/flexibility, muscle performance (strength, power, muscular endurance), posture, stability, balance, neuromuscular control/coordination, and cardiopulmonary fitness/endurance [64, 65]. It is a fundamental component of any rehabilitation program that can benefit a variety of conditions, including those presenting with CP. Studies show that exercise, especially when done repeatedly, can increase one's level of endogenous opioids resulting in anti-nociception, promote self-efficacy and ability to self-manage pain, and improve health-related quality of life [64, 66].

Different guidelines such as from the National Institute for Health & Care Excellence (NICE) and the American College of Sports Medicine (ACSM) recommend physical activity to help manage chronic primary pain (e.g., fibromyalgia; chronic neck pain; others in which no underlying condition can adequately account for the pain or its impact) [67, 68]. There is evidence of various short- and long-term benefits across different exercise modalities, depending on the type of pain [64, 69]. In general, therapeutic exercises are found to be cost-effective and free from negative outcomes, except for potential problems with patient adherence, which seems to improve when exercise programs are sustainable and suited to one's lifestyle, preferences, abilities, needs, and resources [67].

Psychological or Behavioral Treatment Options

CP can negatively impact sleep, mood, interpersonal relationships, functional and work-related activities, and quality of life [19, 30]. It may result in the development of maladaptive behaviors and ineffective coping strategies, which logically can be managed by incorporating psychological interventions as part of a comprehensive treatment plan [19]. A careful psychological assessment and management can control the vicious cycle of nociception, distress, and disability perpetuated by the emotional and cognitive components of the CP experience [30].

A holistic assessment of the person should look beyond objective physical and ancillary findings in order to address even the unseen, possibly neglected, consequences of CP [29]. The essential psychosocial elements that the healthcare provider needs to evaluate include, but are not limited to, the following: patient's perception of and attitude towards CP; positive and negative coping strategies, including drug dependence and substance use (if any); past medical and family history of psychiatric conditions; and social support [29, 70, 71]. In general, psychological or behavioral interventions aim to reduce the suffering caused by the entire pain experience through patient education, empowerment, and self-efficacy techniques [29].

Cognitive-Behavioral Therapy

Cognitive-behavioral therapy (CBT) is the first-line psychosocial treatment for a wide range of CP conditions, such as headache, low back pain, arthritis, fibromyalgia, orofacial pain, and cancer or its treatment [72]. There is no single standardized protocol for conducting CBT, varying in content (specific techniques), format (group versus one-on-one; in-person versus online), and dose (duration; number of sessions; frequency). Examples of CBT techniques include relaxation training (which can be combined with physiologic techniques like slow diaphragmatic breathing and progressive muscle relaxation exercises), activity pacing, problem solving, cognitive restructuring, behavioral activation, and mindfulness meditation [72–74]. Regardless of the technique, whether administered alone or as adjunct to pharmacologic or other nonpharmacologic interventions, CBT targets negative appraisals, fear avoidance, catastrophizing, and other maladaptive cognitions [75, 76]. A recently updated Cochrane review of psychological therapies for CP, excluding headache, found sufficient evidence supporting the efficacy of CBT, albeit small or very small benefits, on pain, disability, and distress based on 59 studies with over 5000 participants [77]. The review, however, found insufficient evidence to evaluate the adverse events associated with CBT. Nonetheless, the efficacy of CBT is relatively well-established in the literature compared with other psychological interventions that need more research like the following: Acceptance and Commitment Therapy (ACT) (promoting psychological flexibility as alternative to experiential avoidance); guided imagery (incorporating words and music to bring to mind calming images and positive scenarios); hypnosis and suggestion (inducing a state of balance between relaxation and focus), and biofeedback (learning to self-regulate bodily processes through physiologic feedback information, such as from electromyography, heart rate variability, and respiratory, mirror visual, or postural biofeedback) [72, 74, 77–79].

Social or Cultural Treatment Options

Waddell (1987) emphasized that in order to have a complete understanding of a patient's pain experience, his/her sociocultural context needs to be evaluated and considered in the treatment planning and implementation [80]. Missing any of the components of the biopsychosocial approach may result in an inadequate intervention [30]. In Gatchel's conceptual model depicting the biopsychosocial interactive processes involved in health and illness, the social component involves consideration of the following: activities of daily living, environmental stressors, interpersonal relationships, family environment, social support/isolation, social expectations, cultural factors, medicolegal/insurance issues, previous treatment experiences, and work history [30, 81]. Recognized among the important contributors to the multidimensional pain experience, social factors can help individualize patient care by also

considering job security, financial status, access to preventative care, past history of physical or sexual abuse, ethnocultural background, external locus of control, and family events like loss of a family member and marital conflicts [29, 82].

The psychological and social aspects of treatment for CP are generally intertwined and ideally involve working with an interdisciplinary team of healthcare professionals (e.g., primary care provider, pain clinician, psychiatrist, psychologist, rehabilitation specialist, physical or occupational therapist, counselor, social worker) [83]. A meta-analysis of 25 interventions (e.g., coping skills training; cognitive restructuring; coaching; patient education about analgesic use; one-on-one counselling; support groups) emphasized the potential utility of various psychosocial modalities as adjunct to medical treatment for cancer-related pain [84]. Few of its included studies, however, were limited by their small sample size, inadequate subject description, and/or lack of randomization among others. Nevertheless, healthcare professionals can select from a variety of psychosocial treatment options based on sound clinical judgment, existing body of knowledge, and patient acceptance [84].

Since social isolation is commonly associated with CP, gradual reintegration to premorbid functioning at home, work/school, and/or community is necessary, wherever and whenever applicable [74]. Lifestyle modifications (e.g., changes in diet and eating behavior; avoidance of vices like smoking or substance use; regular physical activity; stress management; sleep hygiene) may help improve one's self-esteem associated with improvements in pain perception and social participation [74, 82]. In addition, vocational rehabilitation involving strategies initiated towards the later stages of a comprehensive rehabilitation program aims to facilitate early and successful return to work [85]. Examples of components unique to vocational rehabilitation include career exploration, job matching, job-seeking skills training, work placement, supported employment, and social development [86]. These can be accompanied by occupational medicine and rehabilitation components like functional capacity evaluation, job demands analysis, on-the-job support, assistive technology and accommodations, and ergonomics [86].

Future Directions

The potential benefits of various nonpharmacologic modalities for CP may be maximized through shared decision-making involving the patient and healthcare provider/s working collaboratively to ensure that all aspects of the treatment program are acceptable to all parties [87]. Unlike the traditional and often authoritative clinical decision-making process wherein the healthcare provider dictates and the patient is expected to agree with the prescribed intervention, shared decision-making is consistent with the patient-centered approach [88]. However, its effectiveness has yet to be studied [88].

The current body of literature regarding the combination of individual treatment approaches for CP generally remains inconclusive, emphasizing the need for

healthcare providers to conduct more methodologically sound research [29, 74]. Nonetheless, it remains prudent to incorporate multimodal interventions for patients based on clinical experience, sound judgment, and practice-based evidence [29].

In certain healthcare settings, in-person access to nonpharmacologic modalities for CP may not be available [74]. In addition, there may be challenges to the coordination of specialized care across disciplines, treatment facilities, and geographic locations of patients and healthcare providers [74, 89]. Hence, if applicable, telehealth using information and communication technologies to remotely deliver healthcare services and overcome the barriers of distance, time, and costs among others can be leveraged either as an adjunct or alternative to in-person pain management [90]. Further research is recommended to determine the characteristics of patients who can significantly benefit from telehealth versus those who need to be seen in person. Amid the ongoing and future technological advancements in healthcare, telehealth for CP may have to explore the cost-effectiveness of various frontiers (e.g., virtual reality, contactless ultrasonic haptic technology) for screening, monitoring, and treatment processes [90].

With the shift from being mere passive recipients of care to taking a more active role in the pain journey, patients can potentially engage in long-term preventive and restorative strategies. A call to action, however, is imperative to ensure adequate knowledge dissemination regarding available treatment options, professional and public education, and proper and inclusive reimbursement schemes [74].

Summary

Nonpharmacologic modalities comprise a fundamental component of the treatment armamentarium to combat the chronic pain epidemic. Patients and healthcare providers alike need to recognize the multidimensional nature of chronic pain in order to arrive at a mutually acceptable treatment program, which results from a careful selection of nonpharmacologic modalities as standalone or adjunct to pharmacologic therapy. Although the body of evidence is still evolving, there are undeniably a lot of generally safe and low-cost physiologic, psychological, and social treatment options available for chronic pain. Keeping in mind the biopsychosocial model in evaluation and treatment of chronic pain, the interventions can be optimized by employing an individualized, patient-centered, interdisciplinary approach. Proper selection and implementation of therapeutic modalities based on sound clinical reasoning are important drivers of a successful outcome. The cost-effectiveness of individual or combined nonpharmacologic modalities, however, can be derived from relevant methodologically sound studies in the future.

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