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ESSAY/OPINION PIECE

Interventional pain medicine: retreat from the biopsychosocial model of pain

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ABSTRACT

The field of pain medicine has shifted from multidisciplinary rehabilitation to procedure-focused interventional pain medicine (IPM). Considerable controversy exists regarding the efficacy of IPM and its more narrow focus on nociception as an exclusive target of pain treatment. This topical review aims to examine pain research and treatment outcome studies that support a biopsychosocial model of pain, and to critique the clinical practice of IPM given its departure from the premises of a biopsychosocial model. A modern definition of pain and findings from clinical and basic science studies indicate that pain-related psychological factors are integral to pain perception. The clinical viability of IPM is challenged based upon its biomedical view of peripheral nociception as a primary source of pain and the potential of this viewpoint to foster maladaptive pain attributions and discourage the use of pain coping strategies among chronic pain patients. IPM should adopt a biopsychosocial perspective on pain and operate within a framework of multidisciplinary pain rehabilitation to improve its effectiveness.

KEYWORDS

Biopsychosocial model, Chronic pain, Interventional pain medicine, Multidisciplinary pain rehabilitation, Psychosocial factors in pain

Implication

Practice: To reduce disappointing treatment outcome and enhance patient coping and adjustment to chronic pain, interventional pain medicine should adopt a biopsychosocial model of pain assessment to improve decision-making on the selection of prospective candidates for therapeutic nerve blockade.

Policy: Greater attention by public and private insurance agencies and health-policy institutions should be directed toward an empirically based determination that articulates for whom interventional pain procedures are bested suited in order to reduce health care expenditures and pain morbidity.

Research: Examination of psychosocial factors, with particular attention to pain-related cognitive behavioral variables, appears to be a rich area of experimental investigation for clarifying the mechanisms of therapeutic change and improving clinical outcomes in interventional pain medicine.

INTRODUCTION

The biopsychosocial model (BPSM) serves as a theoretical foundation for the application of multidisciplinary approaches to illness management across many medical conditions. The field of pain management has benefitted greatly from its inclusion within this model [1]. For pain medicine, complementing the more general BPSM was the publication of the Gate Control Theory of Pain [2]. This theory suggested that for pain perception to occur, a tripartite structure existed that required sensory–nociceptive, affective–motivational, and cognitive–evaluative input. The balance of these influences could differ within individuals but all were involved in processing the human experience of pain. Since its original publication, empirical support for the various elements of the gate control theory has emerged from studies of neurobiological pain mechanisms and neuroimaging studies [3–6]. Recognition of the important role played by affect and cognition in pain perception provided a springboard for the development of multidisciplinary pain rehabilitation programs that targeted these non-sensory facets of pain consistent with a biopsychosocial perspective [1, 7].

Growth of multidisciplinary pain rehabilitation programs and interventional pain medicine

Integrative and multidisciplinary pain programs combine a variety of therapeutic modalities including physical and occupational therapies, psychological interventions, and medical services in order to address the many clinical factors that can influence pain. A multidisciplinary approach places primary emphasis on pain management (rather than cure) and improved function (rather than pain relief) [7, 8]. Three decades of research has consistently documented the therapeutic superiority of multidisciplinary pain treatment compared to less comprehensive therapies or single-modality interventions

[9–12]. From early reports of their success [7, 8, 13], the rate of expansion of these programs was impressive; a fourfold increase from the mid-1970s by 1990, with over 200 CARF accredited programs by 1998. Unfortunately, due to a variety of factors, including changes in reimbursement systems and health insurance practices, only about half of such programs still existed 6 years later [7, 8]. Loeser [8] traced this history and argued that financial incentives among academic anesthesiology training programs, along with the need to demonstrate their economic stability, led training programs to increasingly turn to a "needle-based" orientation to pain management. In addition, accrediting bodies overseeing anesthesiology residency and fellowship programs placed a primary focus on interventional procedures for demonstrating competence in pain medicine. Over time, multidisciplinary pain programs were supplanted by less comprehensive pain clinics, many of which are procedure-oriented facilities that utilize nerve blockade as an exclusive or primary modality for pain control [8, 13].

The recent growth of interventional pain medicine (IPM) and costs associated with pain injection therapies has been dramatic [13–15]. Manchikanti et al. [15] observed that for the decade between1997 and 2006, there was a 200% increase in interventional procedures per 100,000 Medicare beneficiaries, with facet blocks increasing 543%. Between 2002 and 2006, there was a 137% increase in the number of Medicare patients receiving various nerve blocks for pain [15], the majority accounted for by the expansion of facet blockade. Between 1994 and 2001, the Medicare population increased only 12%, but billings to Medicare for facet blocks increased 231% and for epidural injections 271% [14]. When one considers adjustment for inflation and the near doubling of the charge for epidural steroid injections during this period, Deyo et al. [16] estimated a 629% increase in Medicare expenditures for epidural injections alone. While some of these procedures were likely administered within a multidisciplinary treatment program, survey data and clinical experience suggest that the majority are performed by pain clinics that provide short-term consultation and rely heavily on IPM as an exclusive therapeutic modality for treating chronic pain [13, 17, 18].

Currently, IPM is suffering a "perfect storm" or crisis of scientific and economic threat [19, 20]. There has been longstanding and continued controversy surrounding the efficacy of IPM for the long-term management of chronic pain [21, 22]. Numerous critical reviews have failed to find evidenced-based support for the routine use of IPM [10, 21–23] as well as for specific procedures such as epidural steroid injections [24–27] and facet blocks [28, 29] for the management of chronic spinal pain. Routine administration of nerve blocks for chronic pain is further challenged by studies of healthy and clinical populations that find little association between abnormalities on magnetic resonance imaging or computerized tomography, upon which much of the decision-making for IPM relies, and pain experience [30–33]. Despite the enormous upward trajectory of IPM, its clinical utility does not appear to be supported empirically by a paralleled improvement in patient outcomes or disability rates for chronic pain [34].

The proliferation of IPM clinics has led to a dramatic change in the nature of pain care, with a shift from a patient-centered approach to a modality-centered one. Associated with this shift has been a disregard for the "suffering" dimension of the chronic pain experience [13, 18, 19, 35]. IPM approaches often fail to address pain-related behavioral and social dysfunction associated with chronic pain [17]. While an IPM clinician may refer a patient for allied pain therapies, the lack of coordination and integration of the aggregate treatment components undermines the potential therapeutic benefits from these allied disciplines [36]. The delimited scope of pain treatment and the highly lucrative nature of an injection-based pain practice have left IPM vulnerable to criticism that it has transformed pain medicine from a "profession" to a "business" [18, 19, 37]. With the current economic climate, and the anticipation of greater scrutiny of escalating health care expenditures in both the public and private sectors, there is general agreement that IPM must pursue controlled empirical investigations to establish its efficacy and, thus, justify its position as a viable pain therapy [19, 20, 38–40].

In this review, we will examine the conceptual and clinical issues that reflect the failure of IPM, in its most general form, as an independent pain practice. We will argue that IPM is out of step with both the modern biopsychosocial view of pain and current understandings of basic mechanisms associated with pain processing. We will devote particular attention to the importance of maladaptive pain beliefs and pain coping strategies as powerful moderators of the pain experience. By excluding these variables when considering candidacy for nerve blockade, IPM treatment outcomes are potentially compromised or subverted. We will also consider the impact of a procedurally oriented pain practice on the physician–patient relationship and discuss how the nature of this relationship can inadvertently reinforce maladaptive pain beliefs or undermine effective pain coping strategies being adopted by the patient.

EARLY UNDERSTANDING OF BASIC PAIN MECHANISMS AND THE BIOMEDICAL MODEL

Prior to 1965, the use of nerve blockade for the treatment of chronic pain was a logical extension of the prevailing biomedical model of pain that presumed peripheral nociceptive activation, transduced by sensory receptors at the locus of a noxious stimulus, to be the primary determinant of pain perception [41]. Nociceptive transmission to the

brain via ascending pathways within the spinal cord was understood to be a unidirectional pathway where a linear relationship existed between the degree of peripheral tissue damage or inflammation and the perception of pain within a supraspinal "pain center". In this model, the brain was conceptualized to be passive in converting incoming ascending nociceptive transmission into a pain percept. Challenging these views, much was written about the failure of the traditional biomedical model to adequately account for important features of clinical pain, including the observed high variability across individuals in their experience of pain despite comparable physical impairment and the presence of pain despite minimal or no evidence for a peripheral lesion [1, 42]. These clinical exigencies called for a new conceptual model by which to understand human pain experience.

Central mechanisms of neural pain processing

Following the publication of the gate control theory, the emphasis shifted from the periphery to central neural mechanisms in understanding pain experience [43]. The brain was now viewed as a central processor, deriving inputs from numerous peripheral and central sources including the influence of affective–motivational and cognitive–evaluative processes relayed from differentiated subsystems of cortical activity contained within the brain itself [4]. Psychophysical studies have confirmed that pain sensation and pain affect (e.g., unpleasantness) represent two distinct dimensions of pain with reliably different relationships to neural pain signaling [44–46]. The sensory and affective dimensions of pain are grounded in separate but overlapping neural circuits and are governed by distinct neural pathways of cortical processing [45]. Evidence suggests that the sensory properties of pain are substantively modulated by the somatosensory cortex while the anterior cingulate cortex (ACC) and prefrontal cortex, brain areas known to be involved in executive cognitive functions [47], are integral to the affective–motivational and cognitive dimensions of pain processing [4, 44, 46–48]. Thus, the "psychological" dimensions of pain are rooted in distinct cortical pathways separate from the intensity characteristics of pain, but no less dependent on neural properties.

With this understanding, the role of the brain was transformed from a passive and relatively minor player of nociceptive registration to the formulator of the pain experience itself [49]. Subsequent data from basic science studies of pain mechanisms established the dynamic and active interplay of both peripheral and central mechanisms, and traced how nociceptive transmission is variably inhibited, enhanced, or modulated by the interplay at multiple levels of the peripheral and central nervous systems. Persistent pain is now as likely to be viewed as an expression of central nervous system dysregulation as it is the result of ascending nociceptive transmission, thus concepts of neuroplasticity [3], convergence [46, 50], central sensitization [4, 51], and central modulation [3, 4, 52] have generally supplanted peripheral nociceptive mechanisms as a central etiology for understanding pain experience.

The importance of the psychological background against which pain is processed

The psychophysiological association between psychological variables and pain processing is evident when considering psychological factors that bear a strong relationship with pain intensity. For example, pain catastrophizing, a cognitive variable robustly related to increased pain intensity [53], is associated with activation in brain regions known to be involved in the processing of the affective and cognitive dimensions of pain such as the prefrontal cortex and anterior cingulate cortex [54]. Perceived control and adaptive attributions about the nature of pain and movement attenuate neural processing of pain in the anterior cingulate and insula [55, 56]. Psychological therapies with established efficacy for the treatment of chronic pain also interact with the cortical mechanisms of pain perception [47] and have a direct impact on brain processing of pain. For example, brief training in simple techniques for psychological control of pain, such as imagery and distraction, enhance endogeneous opioid release during an experimental pain task [57]. Manipulation of attention and the use of distraction to control pain during noxious stimulation are associated with pain-evoked neuromodulation in the pain matrix [6, 58, 59]. A recent and more provocative study [60] utilized a biofeedback paradigm to train normal subjects to control activation of the rostral anterior cingulate cortex, a brain region associated with pain modulation, utilizing real-time *f*MRI sensory feedback during an experimental pain challenge. The investigators found that subjects' ability to increase or decrease ACC activity correlated with less or more pain intensity, respectively, and that, following similar training, chronic pain patients reported reduced pain after demonstrating voluntary control over enhanced ACC activation. Taken together, these findings demonstrate an association between both pain-related cognitive factors and psychological pain control techniques and altered neuromodulation of pain in the brain. These data suggest that psychological factors may reflect neural activity in cortical systems pertinent to the experience of pain, and help to clarify how psychological factors influence pain perception and pain morbidity.

THE CENTRAL ROLE OF COGNITIVE/AFFECTIVE FACTORS IN UNDERSTANDING PAIN

When Melzack and colleagues [2, 61] first articulated the affective–motivational and cognitive–evaluative components of pain, it represented a

paradigmatic shift that equated psychological variables with neurophysiological processes in understanding the constituents that determine pain perception. Fields [62] has suggested a "cognitive–neurobiological model" of pain processing in which affective and cognitive factors alter the behavioral state of the person in pain that, in turn, influence pain modulatory mechanisms within the central nervous system. In his theoretical algorithm, noxious stimulation triggers sensory (nociceptive) transmission that converges with affective–motivational properties, the latter emanating from brain regions following ascending nociceptive signaling from spinal tracts. The conjoint sensory and affective transmission of pain thereafter may be influenced by the effects of mood disturbance and life stressors. Prior to final pain perception and pain-contingent behavioral responding, cognitive–evaluative operations exert modulatory (or facilitative) effects on pain perception. This model places particular emphasis on cognitive factors in the ultimate formation of the pain experience and gives cognition overriding governance in relation to sensory (physiological) sources of nociception.

The association of cognitive factors with pain has emerged as among the most potent and robust research findings in the study of pain perception, and evidence suggests that cognitive factors are stronger predictors of pain-related distress and disability than is medical status [63]. A wide spectrum of cognitive factors has been investigated, including beliefs and appraisals about the meaning and implications of pain and patients' role in pain coping and pain adjustment. Pain beliefs may derive from various sources, including media accounts of pain medicine, one's social network, and information obtained via encounters with pain practitioners. From a biopsychosocial perspective, an emphasis on cognition as a determinant of pain experience recognizes the importance of learning processes as an individual endures a life with pain and its attendant morbidities. As an aversive stimulus, pain can generate escape and avoidance behaviors that are designed to remove or avoid pain. In addition, persistent pain has immediate and delayed expectations for one's functional capabilities and quality of life [45]. While the assessment of mood disturbances such as depression, anxiety, and anger continue to be important dimensions of psychological functioning relevant to the treatment of chronic pain [64–66], the examination of pain-related maladaptive cognitions has become increasingly salient in understanding parameters of pain morbidity.

Pain catastrophizing and pain-related fear

Two important maladaptive pain cognitions are pain catastrophizing [53, 67, 68] and pain-related fear [69]. Pain catastrophizing refers to an exaggerated mental set of appraisals and maladaptive beliefs about pain that are associated with magnification of pain intensity, ruminations about present and future pain, and perceived helplessness to exert control over one's pain experience [53, 68]. Cross-sectional studies have established a consistent relationship between pain catastrophizing and a wide range of pain morbidities including pain severity, pain-related disability and emotional distress, occupational disability, analgesic use, duration of hospitalization for pain, and health care utilization for pain [53, 67, 70–74]. Prospective studies indicate that pain catastrophizing is related to the onset of musculoskeletal pain among healthy individuals [75] and more severe pain and slower recovery after surgery [76]. Reduction in pain catastrophizing is associated with symptomatic improvement following multidisciplinary rehabilitation, physical therapy, and cognitive-behavioral therapy [77, 78]. Moreover, pain catastrophizing may impede neural mechanisms of pain control [79]. Pain catastrophizing is associated with brain activity in regions that are associated with the affective dimension of pain [75] and reduced modulatory influences in the prefrontal cortex [80]. Pain catastrophizing is also important as it is hypothesized to be a precursor to the acquisition of fear of pain that is fundamental to fear-avoidance models of pain disability [69].

Fear of pain entails an acquired emotional response whereby the individual anticipates pain with movement and holds a belief that pain represents increasing physiologic damage (e.g., a signal of harm), thus encouraging avoidance of activity as a means of preventing future pain and advanced physical impairment [69, 81]. Fear-avoidance models of pain disability postulate that individuals who experience an acute onset of pain, typically back pain, will exhibit a catastrophic reaction to their pain, leading to increased fear of pain and movement, progressive deconditioning, depression and distress, heightened fears of the meaning and threat of their pain, and increasing disability. Fear of pain embroils the individual in a cycle of catastrophizing fear and disability that perpetuates the severity and morbidity associated with chronic pain. The validity of the fear-avoidance model of pain disability has been supported by an extensive literature from experimental and chronic pain outcome studies [69, 81, 82]. The clinical significance of pain-related fear lies in its contribution to pain disability beyond that attributable to nociception, and in cases where it exerts prepotent influence on disability, it becomes evident that mere reduction in the peripheral inflow of nociceptive transmission will not offer clinical improvements in functional outcome.

PSYCHOLOGICAL SCREENING AND PAIN INTERVENTIONS: LESSONS FOR IPM

A biopsychosocial approach to the care of patients with chronic pain requires the evaluation of both biomedical and psychological factors that can adversely impact the experience of pain and its

comorbidities [83]. Psychological factors are critically important for understanding all dimensions of pain morbidity including pain severity, pain-related interference with daily activities, emotional adjustment to living with persistent pain, and healthcare utilization for pain complaints [84, 85]. In addition, psychological factors can predict the onset of pain in previously healthy individuals [86, 87], the development of chronic pain following acute injury [88], and the maintenance of chronic pain in patients with a history of persistent pain [89, 90]. Psychological factors are not only important for understanding pain morbidity, they are crucial for identifying negative prognostic risk for patients seeking pain interventions [91]. Pain patients vary in their mood functioning and ability to cope with persistent pain, and these variables can influence a patient's response to intervention [92, 93]. As a result, the use of psychological screening has been a mainstay for optimizing outcomes for pain therapies, particularly for those that utilize invasive procedures, with the goal of identifying those patients at risk for poor outcomes. Psychosocial screening prior to chronic pain treatment can not only aid in improved outcomes but can also lead to reduced patient morbidity, treatment costs, and conflicts between pain physicians and their patients [92].

Psychological predictors of invasive pain treatment outcome

Research studies describing treatment outcome for multidisciplinary pain rehabilitation [94] and less comprehensive physiotherapy programs [95] attest to the predictive value of psychosocial factors in contributing to the outcomes of these interventions. More pertinent to IPM, there is a vast literature on the study and benefit of psychosocial assessment for predicting surgical outcomes and identifying patient risk factors for disappointing surgical results [92, 96, 97]. For example, psychological and demographic risk factors associated with compromised surgical outcomes include mood disorders [98, 99], involvement in litigation or receiving compensation for pain [88, 97, 100], a history of child abuse [101], and maladaptive pain coping or possessing maladaptive pain beliefs [76]. Importantly, by comparison psychosocial variables exert stronger prognostic power when compared to radiographic findings, neurological signs, and other medical indices in predicting surgical outcome [88, 97, 99].

The contribution of psychological factors to understanding surgical outcomes for patients being considered for implantable neuromodulation devices, such as spinal cord or peripheral nerve stimulators, has demonstrated such success [40, 93, 102, 103] that it is clinical convention to obtain a psychological assessment for prospective candidates for these procedures [103]. To illustrate, Heckler et al. [104] found a negative association between pain catastrophizing and therapeutic benefits from implantable neuromodulation devices. Long [105] reported an increased rate of benefit for spinal cord and peripheral nerve stimulation from 33% to 70% after instituting psychological pre-screening for prospective stimulator candidates. In a review of the literature on outcomes for the use of spinal cord stimulators for patients with failed-back surgery syndrome, De la Porte and Van de Kelft [106] found that outcome studies that did not incorporate adequate psychological screening reported 50% of patients experiencing short-term success and only 35% reported long-term positive outcome. In contrast, those investigations that utilized psychological screening reported short-term outcomes that reached 85% improvement with 60% of the patients maintaining positive benefit long term.

Limited attention has been paid to the contribution of psychosocial factors in understanding the efficacy of nerve blocks for chronic pain [107]. IPM practice guidelines are conspicuous for the absence of a meaningful discussion on the relevance of psychosocial screening in the context of interventional procedures [39, 108–111]. Identifying psychological predictors of interventional outcomes makes particular sense given the high variability of IPM outcomes [112] and the lack of prognostic value for radiograph and physical examination findings to predict the results of nerve blockade for chronic pain [34, 113, 114]. A selective review of past studies in this area suggests that psychological factors bear similar relationship to the outcomes of interventional pain procedures as they do for other modalities of pain therapy. For example, Abram et al. [115] reported that poor treatment outcome for an array of interventional procedures for patients suffering chronic spinal and extremity pain was associated with being injured at work, being disabled from work due to pain, receiving financial compensation, and being involved in litigation. Brena et al. [116] reported the results of three studies on the effect of interventional procedures for patients with chronic low back pain and found that higher levels of overt pain behavior was associated with poor outcome. Three studies [29, 117, 118] examined factors that predicted outcomes specifically after epidural steroid injection administration for chronic low back pain, and found that a failed response was associated with pre-procedure higher pain intensity and longer duration of pain, but also more severe depressive symptoms, low educational level, unemployed status, receiving compensation or Social Security Disability benefits, and reporting behavioral withdrawal from leisure activities. More recently, Van Wijk and colleagues [119] found that psychological factors such as lower levels of perceived control and self-efficacy, more disturbed mood, and higher pain catastrophizing demonstrated an inverse relationship with therapeutic response for patients undergoing rhizotomy and other injection therapies for chronic low back pain. Samwel et al. [120] observed that pain catastrophizing held a significant negative relation with patient

response to radiofrequency ablation of the cervical dorsal root ganglion for patients with chronic neck and arm pain. In a prospective cohort study of patients undergoing medial branch blocks for cervical and lumbar spinal pain, Wasan and colleagues [121] stratified subjects based on their reports of levels of depressive and anxiety symptoms and reassessed them for degree of pain relief at one month post-procedure. Forty-five percent of the low distressed group reported at least 30% improvement compared to only 10% of the highly distressed group.

The biopsychosocial model and the clinical setting of IPM

The clinical practice of IPM is based on the presumption that neural blockade of peripheral origins of pain will eradicate or significantly reduce clinical pain and result in global improvement in the patient's mood, physical function and quality of life [98]. IPM relies heavily on findings from imaging studies to identify potential targets of intervention despite evidence for the poor association between radiographic imaging and pain [32, 33, 36]. Moreover, pain relief alone may not facilitate improvements in the suffering and disability common to chronic pain given evidence for the absent relationship between pain severity and both pain-related functional disability and mood [122, 123]. These data raise questions regarding the potential therapeutic benefit of interventional procedures when administered in isolation as a singular modality of pain therapy for patients with chronic pain who suffer clinically significant disorders of mood and psychosocial function.

Interventional pain medicine and pain beliefs

The biomedical model of pain implicit in IPM may also have a deleterious influence on how a patient understands and copes with persistent pain. A common rationale for the consideration of IPM for a patient with intractable and severely disabling pain is the expectation for low risk or harm with its administration. From a strictly biomedical perspective, outcome studies indicate that interventional procedures, while not without some risk [124], are generally safe when conducted by well-trained and skilled practitioners [115, 125]. However, from a broader biopsychosocial view, IPM can impart considerable harm through its influence on beliefs about pain and a diminished emphasis on the patient's role in managing pain. Patients may be drawn to and view IPM as appealing due to the need to have the physical nature of their pain validated and the expectation that technological procedures offer particular efficacy in treating medical disorders. Geisser et al. [35] described the "allure of a cure" to characterize the posture of many chronic pain sufferers who believe that pain relief is a prerequisite for returning to more normal function and who are seduced by the natural appeal of an intervention that will dispense with their pain without the need to accept responsibility for its management. Unfortunately, the unrealistic expectation for pain relief implied by procedural pain therapies, combined with the patient's desperation for relief [126], can lead to unnecessary diagnostic testing, ineffective repeated procedures, doctor shopping, delay in more functionally based pain treatment, greater risk for iatrogenic complications, and a continued spiraling downward in dysfunction, hopelessness, and despair [39, 127]. In this regard, Kerns et al. [128] exhort that any pain intervention that views pain as a solely medical disturbance for which a cure exists runs contrary to current understanding of chronic pain pathophysiology and effective pain management principles.

Many chronic pain patients do not accurately know the source of their pain, and as a result are prone to excessive catastrophizing about their pain and exhibit less adaptive coping [129, 130]. Pain consultations that focus on a peripheral lesion as a primary source of pain may encourage patient beliefs about a linear and fixed relationship between nociception and pain to the exclusion of considering the influence of psychological variables on pain processing. The therapeutic utility of enhancing patient beliefs about the efficacy of psychological strategies for pain control is illustrated by a series of studies by Moseley and colleagues [131–134]. These authors developed a patient education module termed "neuroscience pain education (NPE)" that informs patients regarding the neurophysiology of pain perception, including an emphasis on mechanisms of central modulation of nociception and the influence of non-nociceptive variables in pain experience. Studies of the effect of NPE have shown that neuroscience education alters pain beliefs, including reduction in both pain catastrophizing and the belief that pain connotes tissue damage. Furthermore, changes in pain beliefs following NPE are associated with post-education facilitation of lumbar spine movement and self-reported function and with gains from physiotherapy [131–134]. These studies demonstrate that pain patients can acquire and employ complex information about pain processing that may empower them to accept an active role in acquiring self-management skills for pain control in the pursuit of a functional life.

Interventional pain medicine and pain coping

The emphasis of IPM on nociceptive origins of pain and patients' passive dependence upon the interventionalist for pain reduction may serve to discourage patients from participating in their own pain management and acquiring effective pain coping strategies that can enhance psychological adjustment [77, 136]. A general continuum by which all pain coping strategies can be aligned is the degree to

which they encourage an active or passive patient posture toward pain control [77]. There is consistent evidence that passive coping is associated with poor adjustment to pain, including more severe pain, greater functional impairment, current and future depression, work disability, and lower self-efficacy [138, 139]. The structure of the therapeutic medium of IPM requires little participation from the patient beyond providing consent, and instills the view that eradication of chronic pain can be achieved effortlessly and without patient responsibility or ongoing management. When nerve blocks fail to produce long-term and significant pain relief, the prior promise of pain relief under conditions of passivity and dependency enhances the difficulty to reorient patients to the need for their self-directed involvement in coping with enduring pain.

Conversely, active pain coping is associated with a belief in one's competence to control pain and bears a positive relationship with pain adjustment [137]. Two closely related pain cognitions that have significant relation with active pain coping, and which result from pain therapies that require patient initiative to manage pain [56, 140], are perceived control over pain and self-efficacy for pain [77]. Among chronic pain patients, an individual's belief in his or her perceived ability to control pain is associated with less severe pain and higher levels of functional activity [70, 139] and mediates the relationship between pain intensity and depression [141]. In addition, increased perceived control over pain following multidisciplinary pain treatment predicts reduced pain and disability at follow-up [135, 142]. The exact mechanism by which perceived control influences pain perception remains unclear, but two possible pathways include altering an individual's threat appraisal of the pain stimulus [1] and facilitating cortical modulatory processes in response to pain [54, 143].

The concept of self-efficacy (SE) derives from social learning theory, and is defined as a conviction that an individual can perform a specific task or bring about a desired outcome [144]. Importantly for the notion of SE for pain, the development of SE is based on a history of mastery experience over the relevant task. This suggests that SE for pain will only result from patient participation in a treatment setting that facilitates learned control over a pain stimulus such as is targeted in physical and psychological interventions [85, 145, 146]. In general, studies indicate that higher SE for pain shares a positive relation with functional ability and adjustment to chronic pain [146–148], and mediates the relation between pain and disability [149], pain and depression [150], and life stress and headache [151]. Clinical investigations indicate that SE for pain is associated with lower pain intensity [148, 152], and less severe pain-related distress and disability [95, 153, 154]. In prospective studies, SE predicts outcomes for post-surgical pain rehabilitation [144, 155]. Similar to perceived control, SE may contribute to pain control through the perception of the reduced challenge of pain or effects on neurotransmitter mechanisms associated with increased pain tolerance such as endogenous opioid release [57].

Lastly, another approach to coping with pain that is theoretically in opposition with IPM and that is gaining empirical support for its efficacy is acceptance-based therapy [156–158]. Acceptance therapy attempts to redirect pain patients away from efforts to control pain and to a focus on valued activities and acceptance of the prospect and plausibility that pain does not have to interfere with one's goals or more full participation in life. It is based on clinical observations reflecting the frustration of patients whose repeated attempts to control uncontrollable pain or fixation on unattainable pain relief leads to increasing preoccupation and ruminations about pain, thereby promoting growing feelings of helplessness, defeat, and disillusionment. Clinical outcome studies show that acceptance therapy is associated with decreased levels of pain, disability, depression, and maladaptive pain beliefs such as pain catastrophizing and fear avoidance [156, 158, 159]. From the perspective of assisting chronic pain patients to acquire a realistic appraisal of their prognosis and future functioning, it is clear that when considered in the context of IPM, movement of the patient to an acceptance of chronic pain is undermined by the explicit promise of pain relief that is embraced by the application of pain procedures.

Conclusion

The field of IPM is under growing scrutiny as expenditures for interventional procedures skyrocket in the absence of empirically derived evidence to justify their routine use in the treatment of chronic pain [39, 40]. The expansion of IPM has been marked by a dramatic shift in the disposition of care for patients with chronic pain, from comprehensive rehabilitation that addresses patient suffering and dysfunction in addition to pain intensity to modality-specific clinics that perform needle-based interventions as a primary or exclusive approach to chronic pain care. The underlying clinical practices upon which IPM rests, with an emphasis on the primacy of nociception and the failure to account for psychological factors when evaluating a patient's pain experience, can be traced directly to its reliance on a strictly biomedical orientation to pain treatment and would appear to be critical in explaining the consistently poor outcomes documented in IPM outcome studies. Moreover, the circumscribed nature of interventional procedures and the implicit assumptions they impart to patients may delay or dissuade patients from adopting adaptive pain attributions and coping strategies that are associated with optimal adjustment to chronic pain.

While the outcome data on the efficacy of IPM are, in general, disappointing and fail to meet the quality of empiricism that is required to meet the

standards of evidence-based medicine [10], clinical experience informs that some chronic pain patients can derive clinically meaningful and prolonged benefit from interventional procedures. In addition, interventional procedures appear to have a unique contribution to the effective care of a number of patients with severe, persistent pain. As a result, it is in the interest of pain medicine that IPM sustain a position as a partner in the family of pain therapies. Improving the clinical viability of pain procedures will come first when the practice of IPM, and research efforts to determine clinical efficacy, recognize the need for more careful patient selection in order to determine for whom and under what circumstances interventional procedures are best suited. Fundamental to this endeavor is recognizing that factors that contribute to individual differences across patients can also explain variability in treatment outcome observed for pain interventions [160]. The routine assessment of psychosocial variables in both outcomes research and clinical practice can provide the empirical foundation for identifying those patients at risk for disappointing or harmful results.

The assessment of psychosocial factors may not only improve the efficacy of interventional procedures but they can also enhance our understanding of how pain procedures produce therapeutic benefit. Psychosocial factors are known to serve as moderating and mediating variables in the explaining of how pain therapies work [161], and this is likely to be similarly true for IPM. Furthermore, unveiling mechanisms of therapeutic action can be critical to enhancing treatment outcome. To illustrate, consider the potential finding that the cognitive attribution of pain-related fear mediates the relation between facet blockade and clinical response for low back pain, in which patients with high fear and activity avoidance evidence poor outcomes. As a result, those patients with high pain-related fear could be targeted for education regarding the safety of movement in preparation for the procedure, with the hope of facilitating improved functional outcome following nerve blockade. Given the potential adverse influence of interventional pain procedures on pain beliefs and pain coping, the study of interactional effects between pain cognitions and response to nerve blockade would appear to be a rich area of inquiry.

Finally, several authors have argued that IPM needs to endorse a BPSM of pain and integrate its practice within a multidisciplinary framework [22, 26, 38, 41]. The clinical advantages of the application of pain procedures within a larger clinical context of multidisciplinary care would seem obvious, including the opportunity for interventional pain practitioners to have direct consultation with pain psychologists when evaluating candidates for pain procedures as well as rendering pain services within a therapeutic context that concurrently addresses comorbidities of suffering and disability. In addition, interventional procedures in tandem with other pain treatment strategies, such as physical therapy, can boost a patient's response to movement-oriented therapy by effecting short-term but significant pain relief from nerve blockade that allows acceleration of progress with therapeutic exercises and functional restoration. Integrating IPM within multidisciplinary programs would also facilitate coordination and consistency across practitioners in educating patients to acquire adaptive attributions about their pain. Despite the intuitive inference for the increased efficacy of IPM under the umbrella of multidisciplinary rehabilitation, random controlled trials will be needed to verify if interventional procedures are more efficacious and cost-effective within this context when compared to its current model of independent practice.

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