

Chronic Pain: Where Medicine and Psychology Meet

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Introduction

The concept of pain has undergone significant changes in clinical settings and the medical profession in general over the years. Pain is now hardly perceived in accordance with the Cartesian principle of nociception, where a lesion in a specific region of the body is interpreted as pain by corresponding functional areas of the brain. This view has been widely abandoned in favor of the Biopsychosocial Model, which describes the pain experience in terms of the interaction between tissue damage, environmental factors as well as psychological conditions. The important relationship between pain and psychology is further emphasized in the definition of pain by IASP as a sensory or emotional experience that is unpleasant and involves actual or possible tissue damage. According to IASP pain is majorly a subjective experience, which cannot be assessed objectively, hence, the dependent on the report of an individual. Mental health issues such as depression and anxiety have often been identified as being among the most important features of the experience of pain (Koenig, 2005). This paper explores the mechanism and common forms of chronic pain and frequently occurring mental health problems, with a particular focus on the relationship between pain and psychological problems. The similarity between the two is evaluated from the perspectives of functional mechanisms, pathophysiology, and therapeutic approaches.

Chronic Pain

Pain, which is described as an unpleasant experience associated with damage to body tissues, is identified as the reason behind the utilization of medical care services by most individuals. In 2008, an estimated one hundred million patients suffering from chronic pain were

admitted to health care facilities in the United States, and the average yearly cost of these services is about six hundred and thirty-five billion US Dollars. Besides the socio-economic burden accompanying situations of chronic pain, treatment of this health problem is characterized by a myriad of side effects, as well as cases where the hoped-for relief fails to be achieved (Woo, 2010).

Understanding the processes involved in the pathophysiology of chronic pain is one of the initial stages in the development of therapies to combat the same. The peripheral nervous system has nociceptors, which are specialized free nerve endings serving as receptors for noxious stimuli. These receptors are activated by inflammatory mediators such as cytokines, chemokines, and mechanical and thermal deformation. In the case of inflammatory pain, the sensation of pain arises from injury to body tissue. There are changes in the responsiveness of the sensory nervous system, which may respond excessively to noxious (hyper-analgesia) as well as innocuous (allodynia) stimuli (Costigan, Scholz & Woolf, 2010). The cell bodies of first order neurons carrying pain stimuli are located in dorsal root ganglia, or in the trigeminal ganglion depending on the part of the body stimulated. As these nerve fibers first synapse with those of the central nervous system, there is release of neurotransmitters, which are pro-nociceptive, including CGRP, glutamate and substance P; an event, which is primarily dependent on voltage-gated channels (Costigan, Scholz & Woolf, 2010). This release activates second order neurons in the ipsilateral dorsal horn, which then control to the contralateral side through the anterior white commissure at the entry level. These neurons ascend as spinothalamic tracts to the ventral posterolateral nucleus of the thalamus, where they synapse with third-order nerve fibers. The latter relay the information through the anterior limb of the internal capsule to the somatosensory cortex, where it is perceived as pain (Wang, 2015).

The neural process in the perception of pain involves transduction, transmission, and modulation. Transduction is the activation of pain receptors by noxious stimuli like a thermal insult and mechanical stimulation. Afferent neurons in the pain pathway are pseudounipolar, and pro-nociceptive neurotransmitters are released at both the peripheral and central terminals on stimulation, resulting in peripheral sensation as well as central perception of pain. The neurons involved in the transmission of pain signals are of two types: C-fiber and A-delta. The former are slow conducting, non-myelinated nerve fibers conducting impulses generated by mechanical, thermal, as well as chemical stimuli (Wang, 2015). The latter conduct impulses at the rate of up to twenty meters each second and are especially sensitive to mechanical stimulation of high intensity. Modulation is the modification of pain transmission to higher centers by selective inhibition from interneurons of the dorsolateral funiculus.

Some of the main forms of chronic pain include osteoarthritis, low back pain, neuropathic pain, and fibromyalgia. Osteoarthritis, which mainly results from the degenerative nature of the cushioning mechanism in body joints and bones, has a significantly high prevalence among geriatric patients in most populations. Fibromyalgia is a condition of chronic pain and fatigue in muscles, which is experienced mostly as an outcome of prolonged maximal loading and static contraction (Bengtsson, 2002). Although the pathophysiology of fibromyalgia is not well understood, neurotransmitters such as serotonin, norepinephrine, and dopamine form a central part of the mechanism at play (Wood & Holman, 2009). Studies using muscle biopsies indicate that the pathophysiology involves muscle fibers, as indicated by ragged red fibers and atrophy of type two muscle fibers. Changes in microcirculation, metabolism, and mitochondrial content of muscle fibers under maximal loading are responsible for the chronic pain. Since central sensitization is present, these changes sensitize intramuscular pain receptors, resulting in pain

and weakness (Bengtsson, 2002; Costigan, Scholz & Woolf, 2010). Neuropathic pain, which may be central or peripheral, arises from lesions to either division of the nervous system.

Peripheral neuropathic may arise from infection, mechanical trauma, and neurotoxic chemicals, among others. Central neuropathic pain is caused by injury to the spinal cord, multiple sclerosis, or stroke. The key feature of neuropathic pain is maladaptive plasticity occurring in the sensory nervous system. The development of this pain state depends on the genetic background of the individual and the balance between reactions that either compensate or decompensate neural damage. The accompanying changes may be adaptive or maladaptive, and result in abnormal plasticity, hyperalgesia, tactile, cold, and mechanical allodynia, disinhibition, ectopic transduction, and ectopic generation of impulses (Costigan, Scholz & Woolf, 2010).

Mental Health Problems

There are many problems associated with mental health, with some of the most commonly occurring being depression, anxiety, and conditions affecting geriatric patients, such as Alzheimer's disease and dementia (Karp, 2009). Depression is the most common of these psychological issues, with an estimated 18.8 million adults in the United States being depressed each year, according to The National Institute of Mental Health. The prevalence of this condition among American women is about twice the rate for men. On average, each individual in the general population in the United States stands a sixteen percent risk of having a major depressive episode at least once in his or her lifetime. According to the criteria put in place in DSM-IV, major depression is a condition in which the patient displays a pervasive low mood for a significantly large proportion of each day, loss of interest or enthusiasm in almost virtually all activities, significant loss or gain of weight over a short period, and frequent cases of insomnia (Costigan, Scholz & Woolf, 2010). Other features of this condition outlined in the diagnostic

manual include fatigue, inappropriate guilt, inability to sustain concentration or think clearly, psychomotor retardation, and recurrent suicidal ideation (Koenig, 2005).

The second most common psychological problem in many patient populations is anxiety. This is a psychological state whereby the cognitive, emotional, somatic, as well as behavioral components of an individual's life, bring about excessive feelings of fear and worry. Main subtypes of this condition identified in DSM-IV include generalized anxiety disorder (most frequently diagnosed), phobia, and panic disorder. In many cases, anxiety is comorbid with other psychological problems, especially depression. While some degree of anxiety may be considered normal in all individuals, clinical anxiety is characterized by a significantly higher intensity and duration of feelings of intense fear. These feelings of dread ultimately impair the normal functioning of the patient. Three cognitive constructs are thought to be mediated by anxiety: catastrophizing, hypervigilance, as well as fear avoidance. Catastrophizing describes the tendency to dwell in and expect the worst possible outcome in any situation, and hypervigilance is an increase in the attention given to pain, and decreased ability to keep one's mind off stimuli related to pain. Fear avoidance refers to the avoidance of situations, which could lead to a given health problem, like avoiding movement or involvement in physical activity due to fear of being injured again (Woo, 2010).

Similarities and Co-Morbidity

There is a close relationship between chronic pain and psychological health problems, and the pathophysiology of these groups of health issues has several closely related features. The biological similarities between pain and common psychological conditions such as depression and anxiety manifest in the neuronal pathways mediating these stimuli and the regions of the

brain involved in their interpretation. The processing of pain takes place through the spinothalamic tracts together with a number of deep brain and cerebral regions. Projections from the thalamus to hypothalamic nuclei as well as the limbic system pass upwards to the dorsolateral parts of the prefrontal cortex, cingulate gyrus, insular, the posterior part of the parietal cortex, somatosensory cortex, and also secondary motor areas. On the other hand, the processing of emotional reactions to the experience of pain occurs through the reticular activation system. Fibers from this system also project to the dorsolateral parts of the prefrontal cortex, hypothalamus, the limbic system, and the cerebellum. Therefore, the anatomical areas of the brain involved in processing of pain are also important areas of psychological problems such as mood and anxiety disorders (Karp, 2009).

Gliosis accompanied by neuronal death is a key feature of the pathophysiology of mild changes occurring in the nervous system with an increase in age and changes brought about by dementia and other mental health problems. These pathological changes usually attack the regions of the brain that function on processing pain, analgesia, and changes in mood and emotion. Functionally, gliosis and death of neurons often result in direct interruption of tracts that important in pain inhibition and control of mood, especially nerve bundles associated with locus coeruleus, periaqueductal region, and the nucleus raphe Magnus (Wood & Holman, 2009). Moreover, evidence indicates that chronic pain patients have less amount of gray matter of the neocortex as compared to normal subjects. In a study involving chronic back pain patients, the difference in the amount of grey matter in the prefrontal cortex and thalamic regions was found to be equivalent to the amount lost in up to twenty years of aging (Karp, 2009). Other research studies have revealed that aged patients with chronic back pain undergo structural changes in the brain, specifically in the corpus callosum, cingulate gyrus, and posterior regions of the parietal

complex. The changes affecting these functional brain regions are relevant in both analgesia and control of mood

The relationship between mental health problems and various forms of chronic pain is indicated by the high level of comorbidity of these health conditions. Sleep disorders are closely associated with chronic pain, and in many clinical cases, these conditions occur together, presenting challenges in the diagnosis and treatment of each other. Deprivation of sleep may result in a decrease in the level of tolerance to pain and; therefore, it is often hard to determine whether aggravation of pain is a result of lack of sleep or the sleep disturbances arise from chronic pain (Karp, 2009). Anxiety is also commonly comorbid with chronic pain, especially among geriatric patients suffering from chronic pain. Such patients frequently experience excessive worry over further exacerbation of pain, onset of disability, dependence on opioids used to relieve pain or death from the condition.

Depression also commonly occurs in patients with chronic pain, and findings from cross-sectional surveys indicate that these two conditions are risk factors for each other, with each condition increasing the risk of developing the other, and the diagnosis and treatment of the conditions become more complex when the two occur simultaneously (Wood & Holman, 2009). Depression-pain syndrome is characterized by the coexistence of the two conditions, exhibiting the same symptoms and exacerbation of each other. This situation may be explained by the sharing of major neurotransmitters, especially norepinephrine, serotonin and also dopamine, in pathways involved in the control of moods and perception of pain (Wood & Holman, 2009). Studies have showed that individuals with chronic pain are more likely to develop anxiety disorders than other people. One of the most prevalent dementing illnesses affecting aged adults is Alzheimer's disease, which has a prevalence of about fifteen percent among adults aged sixty-

five years or more. These patients often display excessive fear avoidance and tend to anticipate the worst outcome in situations where they experience pain (Karp, 2009).

Treatment Strategies and Associated Challenges

Due to the similarity and comorbidity of mental health problems and chronic pain, a number of treatment approaches have been developed to address both conditions simultaneously. These strategies incorporate the simultaneous use of analgesics to relieve pain and also psychotropic agents to alleviate depressive conditions. Over time, clinicians have determined that individual treatment of either chronic pain or accompanying psychological disorders are ineffective, and strategies combining both analgesics and antidepressants are now commonly utilized (Koenig, 2005). There is a wide range of drug classes, which are used in the management of pain, with the choice of analgesics in each case being guided by the nature, location, intensity of the pain, as well as possible side effects. The classes of psychotropic agents in use in the management of depressive symptoms are tricyclic antidepressants and SSRIs. Many of these agents function both to relieve pain and to alleviate symptom of depression.

Tricyclic antidepressants have been the most common pharmacologic agents in the treatment of syndromes of chronic pain as well as neuropathic pain for over two decades. However, due to the myriad of side effects and impacts of overdose associated with tricyclic antidepressants, the use of selective serotonin reuptake inhibitors has recently emerged and increased. There is evidence of higher tolerance to these drugs, and their dosing is much simplified. Both types of antidepressants have been found to be significantly effective in reducing depression symptoms, and both relieve pain to some extent though none of them eradicates pain completely (Smith, 1998). Due to the side effects of drugs used in the

management of pain, novel treatment strategies are being developed to treat chronic pain without the risk of potential addiction and other side effects. One such strategy is the targeting of trafficking of CaV2.2 in ion-gated channels to control pain sensation (Wang, 2015).

Apart from the use of pharmacological agents in responding to psychological health problems and chronic pain, psychotherapeutic techniques are also utilized to effectively manage both health conditions. This approach is being widely adopted owing to its cost-effectiveness and orientation towards specific health goals. The participation of patients in active solution to problems and change in perceptions and general behavior is crucial to the effectiveness of psychotherapeutic techniques. Cognitive behavior therapy is particularly useful in the treatment of depression and improvement in response to recurrent pain (Koenig, 2005).

Treatment of comorbid conditions of psychological illness and chronic pain is faced with many challenges. Drugs such as opioids and tricyclic antidepressants, which are widely utilized in the management of pain and psychological disorders are associated with a spectrum of side effects, including possible addiction, cognitive impairment, and psychomotor deficits. Moreover, due to the close association between pain and sleep, most drugs used for the alleviation of pain have a negative effect on the normal sleep pattern of patients (Bohra et al., 2014). The diagnosis of chronic pain and psychological problems is also significantly difficult in situations where these conditions are comorbid, especially due to the absence of clear guidelines on the same. Therefore, further research on these interactions and development of clear diagnosis and treatment guidelines is necessary for effective response to these health conditions.

Conclusion

The perception of pain has moved from absolute response to damage of body tissues to include the role of emotional and environmental factors in the experience. Chronic pain frequently occurs in comorbidity with psychological health issues such as major depression and anxiety. This may be explained by the similarities and associations existing between the two groups of health problems, especially the neuronal processes and mechanisms controlling perception of pain and control of mood and emotions, and neurotransmitters involved in the different pathways. Due to the existence of overlaps, pain, and psychological illnesses occur together, and several treatment techniques such as use of TCAs, SSRIs, and psychotherapeutic techniques have been utilized to address both types of illnesses.

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