Drug and Alcohol Dependence 173 (2017) S11–S21

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Review

Providing chronic pain management in the "Fifth Vital Sign" Era: Historical and treatment perspectives on a modern-day medical dilemma

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ARTICLE INFO

Article history:
Received 13 June 2016
Received in revised form
29 December 2016
Accepted 31 December 2016

Keywords:
Opioids
Chronic pain
Chronic pain management
Multidisciplinary pain treatment
John J. Bonica

ABSTRACT

Background: Over 100 million Americans are living with chronic pain, and pain is the most common reason that patients seek medical attention. Despite the prevalence of pain, the practice of pain management and the scientific discipline of pain research are relatively new fields compared to the rest of medicine – contributing to a twenty-first century dilemma for health care providers asked to relieve suffering in the "Fifth Vital Sign" era.

Methods: This manuscript provides a narrative review of the basic mechanisms of chronic pain and history of chronic pain management in the United States – including the various regulatory, health system and provider factors that contributed to the decline of multidisciplinary pain treatment in favor of the predominant opioid treatment strategy seen today. Multiple non-opioid pain treatment strategies are then outlined. The manuscript concludes with three key questions to help guide future research at the intersection of pain and addiction.

Conclusions: The assessment and treatment of chronic pain will continue to be one of the most common functions of a health care provider. To move beyond an over reliance on opioid medications, the addiction and pain research communities must unite with chronic pain patients to increase the evidence base supporting non-opioid analgesic strategies.

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1. Introduction

Although pain is one of the most common human experiences, the scientific discipline of pain research and the medical subspecialty of pain management are relatively new fields. Prior to the 1800s, pain was largely viewed as an existential experience and accepted as a consequence of aging (Meldrum, 2003), but the twentieth century saw the medicalization of pain management with a growth in the knowledge of pain pathophysiology and in the variety of pain treatment strategies. This paper will focus on chronic pain, as this is an emerging field with high public health importance, and will provide (1) a review of the etiology of chronic pain, (2) an overview of the history of chronic pain management – including reasons behind the dramatic rise in opioids for the treatment of most chronic pain disorders, (3) an overview of non-opioid analgesic treatment strategies, and (4) guidance for future pain research needs.

To ensure consistency throughout this paper, it is important to first define chronic pain. Pain is "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (International Association for the Study of Pain, 1986). In this definition, pain is understood not just as a function of neuronal activity, but highlights the importance of higher-level cognitive processes that help interpret and define the pain experience for individuals. Pain is understood as an inherently subjective experience that does not require identifiable tissue damage to be clinically significant. Chronic pain is defined as pain that has lasted beyond the normal healing time for a given injury, operationalized as pain lasting >3 months (International Association for the Study of Pain, 1986). For treatment purposes, chronic pain is further divided as associated with or not associated with a terminal illness (usually cancer).

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http://dx.doi.org/10.1016/j.drugalcdep.2016.12.002
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2. The epidemic of chronic pain in the United States

2.1. Differences between acute and chronic pain

A comprehensive review of the pain signaling pathway is beyond the scope of this review, but readers can reference reviews by Clark and Treisman (2004) and Leknes and Tracey (2008) for more information. Acute pain has a clear evolutionary and life-sustaining purpose – to bring attention to the occurrence of actual or potential tissue damage and to motivate the organism to remove itself from the cause of pain. Nociceptors are peripheral neurons whose main purpose is to detect painful stimuli, and can be stimulated by extremes in temperature (heat or cold), pressure, and/or chemicals most often released in the inflammatory response (Clark and Treisman, 2004). For example, only when a temperature stimulus reaches a physiologically determined point (usually 43 °C in healthy individuals) does a cutaneous heat nociceptor fire an action potential to indicate pain (Walk and Poliak-Tunis, 2016). Nociceptors transmit action potentials to the spinal cord or brainstem, and then to the cerebral cortex and thalamus. Direct injury to nerves through trauma, surgery, or chronic illnesses like diabetes mellitus or alcohol use disorder can also result in pain through spontaneous nociceptor transmission without painful stimuli, enhanced pain facilitation or pathologic neuroplasticity (Costigan et al., 2009).

The rate of nociceptor firing (interpreted as pain intensity) can be influenced by the level of painful stimulus but also by peripheral and central sensitization. Peripherally, nociceptors can be changed via inflammatory mediators or repeated stimulation to fire at a lower intensity of stimuli that would not normally be painful (e.g., temperatures below 43 °C) (Petho and Reeh, 2012). Centrally, second-order neurons that transmit nociceptor input to the cortex and thalamus can also be sensitized to increase rate of firing by direct injury or ongoing inflammation (Cheng, 2010; Stemkowski and Smith, 2012). Lastly, neurons that originate from the periaqueductal gray and rostroventral medulla can amplify or decrease pain signaling (Ossipov et al., 2014).

Acute pain resolves after tissue healing in most individuals. However, certain persons progress from acute to chronic pain, known as pain chronification. Although the processes underlying chronification are not yet well understood, central nervous system changes to pain facilitation and inhibition (such as those mentioned above) are thought to play a role (Ossipov et al., 2014).

The rates of pain chronification vary based upon the type of acute pain (e.g., low back, post-surgical, diabetic neuropathy) (Ossipov et al., 2014). However, the most consistent predictors of chronification across most types of acute pain are social and psychological factors. For example, Chou and Shekelle (Chou and Shekelle, 2010) found that maladaptive pain coping behaviors and co-occurring psychiatric illnesses were two of the strongest baseline predictors of chronic back pain. Pain catastrophizing, a validated set of negative emotional/cognitive processes involving pessimism, perceptions of helplessness, and magnification of pain-related symptoms, is associated with pain chronification after surgery (Edwards et al., 2009; Theunissen et al., 2012). Once developed, chronic pain may be considered a separate disease process that will need tailored interventions other than repair of the original injury to improve function. In that cure is rarely possible, a chronic disease approach is helpful in conceptualizing care of patients with chronic pain.

2.2. The prevalence of chronic pain

Approximately 100 million adults in the United States are affected by chronic pain at any given time, with chronic low back pain and headaches the most commonly diagnosed conditions (Gaskin and Richard, 2012). There are known demographic factors that predispose a person to develop chronic pain. For instance, women are more likely to report chronic pain than men (34.3% vs. 26.7% in a nationally representative sample in the US) (Johannes et al., 2010). In addition, the prevalence of chronic pain increases with age (Rustoen et al., 2005; Tsang et al., 2008; Shmagel et al., 2016). Persons with lower annual household income have greater odds of reporting chronic pain compared to persons with higher annual income (Shmagel et al., 2016). Lastly, persons with mental illness (McWilliams et al., 2003) have greater odds of chronic pain compared to the general population without these disorders. Irrespective of these differences in chronic pain prevalence, the total health care costs for chronic pain treatment are estimated to range between $560 to 635 billion per year in the United States, eclipsing the annual costs of heart disease, diabetes and cancer (Gaskin and Richard, 2012).

3. A history of chronic pain management: follow the money

3.1. The beginning: multidisciplinary in nature

John J. Bonica, an anesthesiogist, is widely considered to be the father of modern pain management. He was trained in an era of the "specificity theory of pain" that stated pain resulted from an identifiable injury. According to this perspective, correction of that injury (through surgery or rehabilitation) or blockade of the nociceptors in that area ("regional anesthesia") should provide complete pain relief. Dissatisfied with the results of his own management of chronic pain in soldiers using regional anesthesia during WWII, John Bonica began consulting with clinicians from different disciplines (e.g., neurology, psychiatry, and orthopedics) on difficult patients to improve analgesic response and functional outcomes. As he noticed an improvement in pain relief and function in this consultation practice, he developed the first multidisciplinary pain clinic based upon these experiences at Tacoma General Hospital in the 1950s. This clinic attempted to increase the efficiency of consultative practice and decrease patient burden by co-locating all staff members in the same space. He transferred the clinic to the University of Washington in Seattle in the 1960s (Benedetti and Chapman, 2005) when he became chair of the Department of Anesthesia. Dr. Bonica's original clinic had inpatient and outpatient components.

The subsequent addition of operant conditioning methods from the psychologist Wilbert Fordyce allowed the clinic to provide marked improvements in patient self-management of pain (Fordyce et al., 1973). These methods included rewarding patient behaviors associated with improvement through positive staff feedback (e.g., improved exercise tolerance, increases in work and social activities) and extinction of "pain behaviors" (e.g., verbal or facial pain complaints, reliance on medications for pain management, and stopping exercise to sit) by administering medication on a schedule (as opposed to whenever a patient reported increased pain) and providing rest only after exercise regimens are completed (as opposed to when pain increases).

Over time, the pain community came together to provide guidelines to what constitutes a multidisciplinary pain treatment program. First, the clinic should be staffed with clinicians trained in pain management from various disciplines: at least two physicians, a pain psychologist, a physical therapist, and additional health care providers as needed to address unique patient populations served in the clinic (e.g., occupational therapist with knowledge about return to work evaluations) (Gatchel et al., 2014). Second, there should be regular meetings with all staff members present to discuss ongoing patient care issues. Third, assessment and treatment options should be comprehensive and include (at a minimum): physical exam, medication management, biopsychosocial evaluation, cognitive behavioral treatment for chronic pain, physical therapy, occupational therapy, and ability to refer to specialists not

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