Physiology of Pain

Deborah L. Ellison, PhD, MSN

KEYWORDS

• Physiology of pain • Nociception • Neuropathic • Acute pain • Chronic pain

KEY POINTS

- Nociception involves the normal functioning of physiologic systems, which encompasses four stages: transduction, transmission, perception, and modulation.
- The patients' pain threshold and tolerance are subjective and influence an individual's perception of pain.
- The perception of pain can therefore be influenced by genetics, gender, cultural perceptions, expectations, role socialization, physical and mental health, past pain, and age.
- Pain is one the body's most important, adaptive, and protective mechanisms.

INTRODUCTION

Assessing pain in the critical care unit (CCU) is challenging for the frontline nurse. Regardless of patient diagnosis, all patients in the CCU share a common complaint of pain. Although many patients in the CCU can self-report pain, there are also many patients in this setting that have difficulty communicating because of a variety of reasons, such as mechanical intubation, high-dose sedation, level of consciousness, neuromuscular blocking agents, and language or cultural barriers.[1] Effective pain management results in improved patient outcomes and increased patient satisfaction if delivered with an individualized, balanced approach, using interdisciplinary methods.[2] The frontline nurse can improve pain assessments and interventions by first understanding the physiology of pain, while practicing safe quality patient-centered care. This article discusses the physiology of pain to include the neuronal receptors that respond to various painful stimuli, substances that stimulate nociceptors, the nerve pathways, modulation of the perception of pain, and acute verses chronic physiologic changes.

SCOPE OF PROBLEM

The International Association for the Study of Pain defines pain as "an unpleasant sensory emotional experience with actual or potential tissue damage, or describe in terms

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School of Nursing, Austin Peay State University, 601 College Street, Clarksville, TN 37043, USA
E-mail address: ellisond@apsu.edu

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of such damage."[3] This definition is accepted universally and by the American Nurses Association.[2] Pain is difficult to define because of the subjective nature of self-reporting, which encompasses sensory, emotional, cognitive, and social components.[4]

Assessing and treating pain is a responsibility of all nurses in all health care settings. Nurses have a legal and ethical responsibility to have the knowledge, skills, and attitude to provide the best pain care possible. Nevertheless, with more than 100 million Americans suffering from chronic pain,[5,6] this complicates the pain assessment in the CCU setting because nurses are confronted with patients with acute pain and life-threatening issues. How pain is transmitted and perceived is complex because of the level of subjectivity in reporting and because of the nature of the fully integrated constantly changing structure of the central nervous system, the symphony of chemical mediators. Most CCU patients experience pain while in the CCU setting and concerns about having pain during the stay certainly add stress to patients. Patients expect and have a right to receive adequate pain relief.[7] **Table 1** outlines the physiologic impact of pain, the impact on quality of life, and the financial impact of unrelieved pain.

NOCICEPTION

Nociception is the term that is used to describe how pain becomes a conscious experience.[8] Nociception involves the normal functioning of physiologic systems. A nociceptor is a free nerve ending (dendrites) preferentially sensitive to a noxious stimulus or to a stimulus that would become noxious if prolonged. Nociceptors are a highly specialized subset of primary sensory neurons that respond only to pain stimuli[9] and convert the stimuli into nerve impulses, which the brain interprets to produce the sensation of pain.[10] Nociceptors are categorized either as myelinated or unmyelinated, which indicates the kind of stimulation they respond to: chemical, mechanical, and thermal stimuli.[9,11,12] There are four phases in the nociception of pain: (1) transduction, (2) transmission, (3) perception, and (4) modulation (**Fig. 1**).

Transduction is the first process of nociception. Transduction refers to the conversion of a noxious stimulus (thermal, mechanical, or chemical) into electrical activity in the peripheral terminals of nociceptor sensory fibers.[9] This first process begins when

Table 1
Impact of unrelieved pain

Physiologic Impact	Quality of Life Impact	Financial Impact
• Prolongs stress response • Increases heart rate, blood pressure, and oxygen demand • Decreases gastrointestinal motility • Causes immobility • Decreases immune response • Delays healing • Poorly managed acute pain increases risk for development of chronic pain	• Interferes with activities of daily living • Causes anxiety, depression, hopelessness, fear, anger, and sleeplessness • Impairs family, work, and social relationships	• Costs Americans billions of dollars per year • Increases hospital length of stay • Leads to loss of income and productivity

Data from Refs.[4,8,13]