Pain in Decreased Consciousness Patients

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A B S T R A C T

The International Association for the Study of Pain (IASP) defines pain as an unpleasant sensory and emotional experience associated with potential or tissue damage or described in terms of such damage. Pain in patients with decreased consciousness is individual and needs to consider many aspects. Following the expansion pain definition according to the IASP in 2020, the inability to communicate does not exclude the possibility that humans experience pain. Therefore, a good pain assessment in patients with decreased consciousness can increase the value of disease management and improve the patient's quality of life both during the treatment period and after hospitalization. Because of the inability of patients with decreased consciousness to verbally convey their pain, this poses a challenge for the clinician. This literature review was aimed to describe how to understand the pain in decreased consciousness patients.

1. Introduction

Pain in patients with decreased consciousness is individual and needs to consider many aspects. A good pain assessment in patients with decreased consciousness can increase the value of disease management and improve the patient's quality of life both during the treatment period and after hospitalization. There are several definitions of pain. According to Hours, the pain has physical, psychological, social, spiritual, and cultural components. All of these components can affect the onset of pain in an individual. Therefore, to obtain good results from pain management, it is necessary to pay attention to all these components.[1,3]

The IASP issued a special note and entomology accompanying the revision of the definition of pain, namely: pain is always a personal experience that is influenced by various levels of biological, psychological, and social factors; pain and nociception are different phenomena. Pain cannot be inferred solely from sensory neuron activity; through their life experiences, individuals learn the concept of pain; someone's complaint about the experience as pain should be appreciated; although pain usually has an adaptive role, it can adversely affect social and psychological functioning and well-being; the verbal description is only one of several behaviors to express pain; the

individual's inability to communicate does not exclude the possibility that the human or animal experiences pain.[4,5]

Epidemiology

The World Health Organization (WHO) states that nearly 83% of the world's population does not have access or inadequate access to pain management. Pain that is not handled optimally can harm physiological function and, at high levels, also have consequences for post-traumatic stress disorder. According to one study, approximately 40-70% of patients admitted to the intensive care unit experience moderate to severe pain. Patients who experience pain at rest are almost 30% and experience pain during medical procedures by 50%.[6,7]

Pain physiology

Nociceptors are receptors for free nerve endings found in the skin, connective tissue, blood vessels, muscles, joints/periosteum, and many internal/visceral organs. Free nerve endings form these nociceptors with various characteristics and morphology. Table 1 describes afferent nerve fibers by size and function.[8,10]

Table 1. Comparison of primary afferent nerves

Nerve fiber type	Characteristics	Nerve diameter (μm)	KHS (m/s)	Function
Aα and Aβ	Big size and thick myelin sheath	5-20	30-70	Touch and pressure
A-γ	-	3-6	15-30	Aferen spindle
A-δ	Small size, thin myelin sheath	2-5	12-30	Pain (sharp and localized) and temperature
C	Small size, no myelin sheath, polymodality	0.3-1.1	0.5-2	Slow pain (unable to localize) and temperature.

These primary afferent nerve fibers have cell bodies in the dorsal root ganglion, whose axons transmit signals to particular layers of the dorsal horn of the spinal cord. Signals from A-δ nerve fibers will mostly go to the superficial layer, while signals from C nerve fibers go to the deep layer. Each sensory unit consisting of sensory nerve cells in the dorsal root ganglion with structures extending towards the central (spinal cord) and peripheral (receptors) has a segmental distribution for each area of the human body, forming a topographic map called a dermatome.[3,11]

In the dorsal horn of the spinal cord, neurons of order I will synapse with neurons of order II. Neurotransmitters involved in pain conduction at these synapses include excitatory amino acids (glutamate and aspartate), adenosine 5-triphosphate (ATP), and neuropeptides (substance P), nociceptive stimulation with a broad and dynamic range of stimuli. The axons of these second-order neurons will cross to the contralateral side through the anterior commissure of the spinal cord, which will form the lateral spinothalamic tract, which will ascend to the brain. This tract is divided according to the vertebrae level, with the sacral portion located posterolaterally and the cervical portion anteromedially. In addition to the spinothalamic tract, several other tracts play a role in the pain process, namely spinoreticular tract and spinomesencephalic tract. Spinoreticular tract was started from the spinal cord to neurons in the reticular formation and then to the intralaminar nucleus. Spinomesencephalic tract begins in the spinal cord, passes through the medulla oblongata and pons, and ends in the periaqueductal gray.[12]

Second-order neurons ending in the thalamus will synapse with third-order neurons projected to the primary sensory cortex. In addition, order III neurons will also project to the secondary sensory cortex and insula in terms of the perception of the sublime function of pain. At the same time, the emotional perception of pain involves the structures of the anterior cingulate cortex, posterior insula, and parietal operculum.[13,15]

Pain pathway

Understanding the anatomy of the pain pathway and the chemical mediators involved in a noxious stimulus and pain perception is the key to optimal acute pain management. The pain pathway follows four main processes. They are transduction, transmission, modulation, and perception process. The transduction process is a process in which noxious stimuli will be converted into electrical impulses at the nerve endings, which are converted into depolarizing currents with the help of nociceptive receptors (high threshold mechanical, mechanothermal and polymodal), which will then be received by peripheral nerve endings or organs of the body.[16]

The process of transmitting impulses through sensory nerves is a continuation of the transduction process through Aδ fibers and C fibers from the periphery to the spinal cord. The transmission of depolarization currents from first-order neurons, second-order neurons, then third-order neurons to the cerebral cortex. In acute pain, some of the pain impulses by Aδ and C afferent fibers are transmitted directly to neuron cells in the anterolateral horn and partly to neuron cells in the anterior horn of the spinal cord. Activation of neuron cells in the anterolateral horn will cause an increase in sympathetic nervous system tone, while activation of neuron cells in the anterior horn of the spinal cord will cause an increase in skeletal muscle tone.[17,18]

The interaction between the endogenous analgesic system produced by our bodies with pain input that enters the posterior horn of the spinal cord is an ascending process controlled by the brain. The posterior horn, as a door, can be opened and closed to channel pain impulses for these endogenous analgesics (enkephalins, endorphins, serotonin, and noradrenaline). The cerebral cortex discriminates against pain. Subcortical structures such as the anterior cingulate cortex (including the limbic system) will produce the emotional aspect of pain. This is thought to occur in the thalamus, with the cortex discriminating from sensory.[19]

Pain on decreased consciousness

Decreased consciousness is a state of unconsciousness in oneself and the environment or the suspension of mental activity towards self-awareness and the environment and reduced ability to respond to environmental stimuli. This case includes the term coma, unresponsive wakefulness syndrome or vegetative state, and minimally conscious state. In a coma, the presence of lesions in the RAS system or diffuse bihemispheric damage results in loss of arousal (arousal) from the brainstem. Patients in a coma do not have aspects of awakeness. In patients with a vegetative state, there is arousability of the brain but no aspect of consciousness. Whereas in patients with a minimally conscious state, showing signs of altered or fluctuating consciousness; patients are sometimes conscious and awake with varying degrees of consciousness.[20,21]

In patients with a vegetative or minimally conscious state, metabolic dysfunction has been reported in the bilateral lateral and medial frontal brain regions, bilateral parietotemporal and posterior parietal areas, and posterior cingulate areas and precuneus cortex.[4] This area is an area that is active when a person is resting and affects the individual's awake aspect.[14] The relationship between the anterior/precuneus cingulate cortex and the dorsolateral prefrontal cortex in patients with the vegetative state has a weaker relationship than in patients with the minimally conscious state.

In the minimally conscious state, the patient can express emotional and behavioral responses to sounds, object manipulation, visual movements, and other non-functional communication. This behavioral response is fluctuating so that it becomes a challenge for clinicians in assessing the patient's pain.[4] On activation of the PET scan image with noxious stimulus, there is brain activation in the thalamus area, primary somatosensory cortex, insula, or secondary somatosensory cortex, precuneus/posterior cingulate cortex, and anterior cingulate area. The latter area, known to be associated with the perception of unpleasant pain, also affects cognitive function.[15] In addition, greater cortical activation in patients with a vegetative state and minimally conscious disorders has also been compared with providing auditory stimulation. In this case, there was an increase in brain

activation; there was a better correlation between the primary cortex in these two patients.

The central nociceptive system in healthy subjects, known as the pain matrix, consists of the primary somatosensory cortex (S1), the secondary somatosensory cortex (S2), lateral thalamus, insular cortex, anterior cingulate cortex (ACC), dorsolateral prefrontal cortex (DLPFC), and parietal cortex. Specifically, the cortex S1 and S2, the lateral thalamus, and the posterior insula belong to the lateral network of neurons encoding discriminatory sensory information. In contrast, the anterior insula, ACC, and prefrontal cortex belong to the medial network that codes for affective and cognitive information.[13] The pain matrix also consists of other structures, including the primary motor cortex, accessory motor areas, cerebellum, and frontal cortex.[5]

A study conducted by Markl et al., compared MRI images of 30 subjects of vegetative and minimally conscious state and 15 healthy patients, found that in a healthy population, pain induces activation in S1, S2, ACC, inferior frontal gyrus, insula, thalamus, and cerebellum. Whereas in patients with decreased consciousness, both MCS and VS, the pain will induce activation of discriminative sensory in 50% of patients and affective in 30% of patients.[22,23]

Based on an observational study on pain perception based on activation contained in the PET Scan, conducted by Melanie Boly et al. at the Coma Science Group in 2008, both in a minimally conscious state and control patients, noxious stimulation will activate the thalamus, primary and secondary somatosensory cortex or insular, frontoparietal cortex and anterior cingulate cortex (known as the pain matrix). No area of activation was reduced in patients with MCS when compared to controls. All areas of the pain matrix cortex showed greater activation in patients with MCS when compared to patients in the vegetative state.[15] Thus, it can be concluded that the pain process in the brains of normal subjects with MCS is the same but broader than that of vegetative state patient. These findings support the need for analgesic management in patients with MCS.[24]

Assessment of pain in decreased consciousness

The following is a pain assessment tool for use in patients with decreased consciousness who are unable to verbalize the intensity of their pain: [22]

Behavioral pain scales

Behavioral pain scales (BPS) is an instrument for assessing pain in critically ill patients developed by Payen et al.[23] Based on several studies, it is shown that the advantage of the BPS instrument is that it can be used on intubated (Behavioral pain scales) and non-intubated (Behavioral pain scales-non intubated) patients in critically ill patients in the intensive care unit, with high validity and reliability values.[24] The BPS consists of 3 indicators, namely facial expression, upper extremity movement, and tolerance to mechanical ventilation, while in the BPS-NI, the indicator of tolerance to mechanical ventilation is replaced by vocalization.

Critical care pain observation tool

Critical care pain observation tool is a pain assessment instrument developed by Gelinas et al.[25] The pain assessment instrument consists of 4 assessment items, including facial expressions, body movements, muscle tension, and regularity with the ventilator. The advantage of CPOT is that it can be used for pain assessment in surgical and non-surgical patients, as indicated by a relatively high interrater reliability value. The weakness is that CPOT has never been tested in patients with decreased consciousness with agitation and delirium. This instrument consists of 4 aspects: facial expressions, body movements, muscle tension, and tolerance with a ventilator (for intubated patients) or vocalizations (for non-intubated patients). Each aspect is worth 0-2 with a total value ranging from 0 to 8.[3]

Nonverbal adult pain assessment scale

This instrument was developed by Other et al., which is used to measure pain in intubated and sedated adult patients.[21] This instrument was developed based on the FLACC pain assessment instrument in children. The assessment components of the NVPS include three behavioral indicators and physiological indicators I (blood pressure, heart rate, respiratory rate, skin), which were then revised in their development by replacing the name of the second

physiological indicator on the respiratory component. 20 The assessment of each of these indicators is from a score of 1 to 2 with a total score of 0 (no pain) and 10 (maximum pain).

Pain assessment and intervention notation algorithm

The PAIN algorithm developed by Puntilo et al. consists of 12 behavioral indicators and eight physiological indicators[20]. PAIN is used to assess postoperative pain in intubated and ventilated ICU patients. The pain assessment instrument was used to assess the presence or absence of pain in postoperative patients, where the patient's behavior indicators were assessed based on the Numeric rating scale from a score of 0-10. The weakness of this PAIN instrument takes a long time to assess pain in patients because it consists of 12 behavioral indicators and eight physiological indicators. Besides that, the assessment of behavioral indicators is assessed from the NRS scale from the nurse's point of view.

Nociception coma scale

There is a scale for assessing nociceptive pain in patients with reduced consciousness who have recovered after a coma. The name "nociception" is used for two reasons. The first is that the NCS aims to assess the patient's vegetative state, where there is a low-level brain process related to nociception, and minimally conscious state, where there is a high-level brain process. The second is that where the pain is a subjective experience, it is difficult to use this termination because the patient cannot express his pain.[21,25]

Diagnostic examination

The diagnostic examination is intended as support for the history obtained and physical examination. Diagnostic examination mostly shows the anatomic location of the pain. For patients with reduced consciousness, to date, the use of positron emission tomography (PET scan) and functional magnetic resonance imaging (fMRI) has played a central role in identifying specific patterns of cortical activation associated with pain stimulation in patients.[11]

The first finding from a PET scan study showed an increase in neuronal activity in the midbrain, contralateral thalamus, and primary somatosensory cortex in vegetative state patients after noxious stimulation was given. In comparison, activation of this primary somatosensory cortex was not associated with the higher associative cortex. This was interpreted as a sign of possible broken functional connections and the isolation of the primary somatosensory cortex from other areas of the brain that are usually well connected.

Several researchers from the Massachusetts International of Technology discovered a tool for detecting pain that is noninvasive by using neuroimaging with functional near-infrared spectroscopy. The use of this fNIRS is by placing a sensor above the patient's head. Infrared with different wavelengths will enter the brain. Oxygenated hemoglobin will absorb the wavelength and provide a signal on imaging (figure 1).
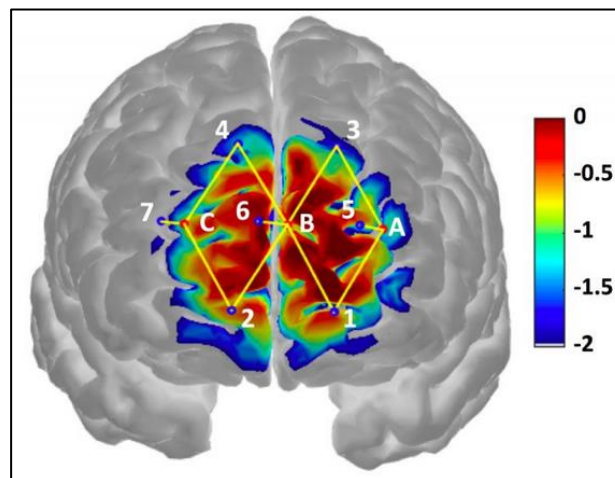

Figure 1. Signal imaging contained in fNIRS.

Pain Management

Nowadays, no specific recommendations are available for the management of pain in patients with reduced consciousness. Therefore, as a practical matter, the clinician can provide appropriate treatment by considering the patient's general condition, the pathological condition causing the loss of consciousness, the possibility of the patient's recovery, and involving the role of the patient's family.[1,3]

Management of pain in patients with a decreased level of consciousness should begin with identifying specific factors that cause pain and not only provide treatment for pain symptoms unless the source of pain is challenging to identify. Pain may be related to persistent or intermittent invasive procedures, the patient's clinical condition, or chronic pain that the patient may have suffered before undergoing treatment.[24]

A research study conducted by Fariba et al., at the University Medical Science Iran found that complementary methods, namely music therapy given for three sessions for 30 minutes and reflexology for 30 minutes once a day, can reduce pain intensity in patients with decreased consciousness. However, several studies were not in line with this study. Bessel et al., found that there was no significant decrease in pain intensity after giving music therapy to patients with decreased consciousness on a mechanical ventilator, and the research by Mohammadaliha et al., found that there was no significant difference in pain intensity in post-abdominal and chest surgery patients. Studies on complementary therapies are still being carried out considering that this method is a simple, practical, and convenient method for patients.[25]

2. Conclusion

Acute pain management is pain elimination and restoring the patient's condition as soon as possible through aggressive therapy to not continue to become chronic. Elimination of chronic pain is challenging and requires a multidisciplinary approach.

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