

NARRATIVE REVIEW

PAIN MANAGEMENT

Chronic post-ICU pain: A review of the mechanism and the rehabilitation management

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ABSTRACT

Objectives: This review aimed to explore the pain mechanism and rehabilitation management of functional impairments due to chronic post-ICU pain (CPIP).

Methodology: Articles were searched using PubMed and Google Scholar databases with keywords chronic pain, chronic post-ICU pain, persistent pain, ICU-related pain, ICU survivor, and rehabilitation. All types of articles that were written in English and available in full-text format were considered for analysis.

Results: The cause of CPIP is not certainly known, but several factors associated with the incidence of CPIP have been identified including genetic, premorbid conditions, medical intervention, and ICU care, as well as psychological or social factors. CPIP management aims to prevent disabilities due to chronic pain and improve functional abilities. The rehabilitation program of CPIP begins with a prevention program from the acute phase to the follow-up phase. The rehabilitation program consists of physical modalities, exercise, occupational therapy, and psychological or social counseling, as well as cognitive behavioral therapy (CBT). The CBT program has been shown to be effective in improving long-term outcomes, preventing the incidence of PICS, and improving the functional status of ICU survivors.

Abbreviations: ADL- Activities of Daily Living; ARDS- Acute Respiratory Distress Syndrome; CBT- Cognitive Behavioral Therapy; CPIP- Chronic Post-ICU Pain; ICU- Intensive Care Unit; PTSD- Post-Traumatic Stress Disorder; QoL- Quality of Life

Conclusion: CPIP caused functional impairments in ICU survivors and rehabilitation management has been proven beneficial in improving functional outcomes.

Keywords: Chronic Pain; Counseling; Intensive Care Unit; Survivors

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1. INTRODUCTION

Chronic pain is often found in intensive care unit (ICU) survivors with an incidence rate of 14% - 77%. Pain can last up to 2 years after being discharged from the ICU and is known as chronic post-ICU pain (CPIP).¹⁻³ CPIP causes marked disability, ranging from impaired activities of daily living (ADL) to chronic intractable pain. Other functional disorders found in CPIP are psychological, vocational, and socio-economic

disturbances, as well as decreased quality of life (QoL).^{2,4}

The definite cause of CPIP is not known. A number of risk factors are thought to be associated with the incidence of CPIP including genetic, premorbid conditions, medical intervention, and ICU care, as well as psychological and social factors.^{1,2,5} Approximately 79% of ICU survivors experienced CPIP with moderate to severe pain intensity which was found four days after

being discharged from the ICU. Pain intensity decreased the following year with the most severe intensity at moderate intensity.⁶ The incidence of CPIP in ICU survivors with acute respiratory distress syndrome (ARDS) and severe sepsis was higher than in the non-ICU population.^{1,2}

The provision of adequate analgesia aimed at patients' comfort can prevent the transition from acute pain to chronic pain. Another factor that plays a role in reducing the incidence of CPIP is early rehabilitation (ER) carried out while the patient undergoing treatment in the ICU.^{4,7}

Interventions performed during acute care aim to modify risk factors for CPIP.⁷ Research evidence on the impact of ER and post-ICU rehabilitation was still limited. A review of the systematic reviews that have been conducted on physical rehabilitation interventions during ICU care found that most systematic reviews focused on interventions performed during the acute phase and short-term outcomes, therefore studies with long-term assessments are needed.⁸ In addition to the limited research evidence, the awareness of physicians or medical professionals on pain related to ICU care either during ICU admission or follow-up periods was still low.⁹ This review aimed to describe CPIP focusing on the pain mechanism and rehabilitation management in order to improve the knowledge and awareness of physicians or medical professionals about this issue and its functional impacts.

2. METHODOLOGY

Articles related to CPIP were searched from PubMed and Google Scholar databases. All types of articles written in English were considered for the review. Keywords used were 'chronic pain', 'chronic post-ICU pain', 'persistent pain', 'ICU-related pain', 'ICU survivor', and 'rehabilitation'. Articles that could not be accessed in full-text format were excluded.

3. RESULTS

Thirty-three articles were relevant for this review and further used to explain sub-topics.

4. DISCUSSION

4.1. Pain Physiology

The pain process begins with a pain stimulus that is received by free nerve endings as a pain receptor which is called a nociceptor. These receptors can be stimulated by several types of noxious stimuli such as mechanical, thermal, and chemical stimuli. Chemical stimuli cause the release of inflammatory mediators such as bradykinin, prostaglandins, histamine, and serotonin resulted from tissue damage. These mediators are

generally involved in the occurrence of chronic pain.^{5,10,11}

A series of processes that occur after a noxious stimulus received by pain receptors are, transduction, transmission, modulation, and perception. Transduction is the process of converting a noxious stimulus into electrical activity in the nociceptors. The impulses are then transferred to the dorsal horn of the spinal cord through a transmission process. Pain-afferent impulses are then transferred across the periaqueductal gray and thalamus to the somatosensory cortex, insula, cingulate gyrus, prefrontal cortex, and limbic system. Pain modulation is the process of amplification and inhibition of pain-related signals. The modulation process is followed by a perception of pain. Pain perception is the awareness of pain as the result of the interaction between transduction, transmission, and modulation processes, as well as psychological aspects and other individual characteristics.¹⁰⁻¹²

2.2. The Concept of Chronic Pain

The concept of chronic pain is described as a biopsychosocial model and a mechanism-based pain model. The biopsychosocial model describes pain as a multidimensional, dynamic interaction between physiological, psychological, and social factors that influence each other reciprocally, resulting in complex chronic pain. Excitation of pain fibers by a continuous stimulus can lead to a maladaptive state that causes hypersensitivity and progressive or chronic pain.⁵ Genetic factors such as gender, genotype, and epigenetic profile, as well as environmental influences, interact to form personality and psychological conditions that are susceptible to chronic pain such as pessimism, neuroticism, anxiety, and catastrophization. Acute injury during critical development and the occurrence of events that cause severe stress are examples of environmental influence.¹³ Social factors such as negative reinforcement, in which the family members or relatives give an excessive prohibition to the patient's activity, will affect individual behavior in dealing with pain. Negative reinforcement further results in physical inactivity and prolonged bed rest, which further results in the emergence of disuse syndrome.^{13,14}

Fear-avoidance model (FAM) is a form of mechanism-based pain model. Based on this model, pain is described as a repetitive sequential interaction between cognitive, affective, and behavioral elements that results in disability.¹⁵ Tissue injury leads to pain experience which will be responded to by confrontation and avoidance behavior. Confrontation behavior to pain results in recovery, while avoidance behavior results in a greater fear of pain and further persistence of pain due to restrictions of movement that are believed to cause pain. The avoidance behavior results in disuse syndromes,

depression, and disabilities. Moreover, the experience of pain increase and pain even persist over a long period of time as an impact of avoidance behavior.^{13,15}

2.3. Chronic Post-ICU Pain

There are several terms related to CPIP including chronic ICU-related pain, persistent ICU-associated pain, chronic pain disorder after critical illness, and persistence of pain after ICU discharge. It is defined as pain that persists or is recurrent 3 months after being discharged from the ICU.^{2,3,7,16} This pain is also known as chronic pain in ICU survivors.^{1,4}

Genetic factors affect an individual's internal analgesia system related to the ability to cope with noxious stimuli. It also affects the expression of genes which causes hyperalgesia.⁷ The experience of severe and recurrent pain before ICU admission and pain arising from medical interventions such as major surgery, invasive procedures, incision wounds, and tube or catheter insertion, are also found to cause CPIP.⁶ The presence of comorbidities such as degenerative diseases before ICU admission increases the likelihood of chronic pain.^{1,2}

ICU-related factors that cause ICU-acquired weakness (ICU-AW) or post-intensive care syndrome (PICS) increase the risk of development of CPIP. These factors include severe sepsis, ARDS, prolonged use of a ventilator, use of corticosteroids and non-depolarizing neuromuscular blockers, female gender, and post-traumatic stress disorder (PTSD), as well as post-ICU anxiety or depression. Pathophysiological changes that occur are continuous inflammation including involvement of neuropeptides and cytokines as well as repetitive neuronal damage resulting in impairment of membrane excitability, descending nociceptive control, and synaptic plasticity.^{1,5,7}

Other literature states that inadequate pain management during ICU care increases the possibility of CPIP.^{1,7} Inadequate pain management occurs due to a lack of knowledge and assessment of pain. In addition, the patient's inability to express pain, the thought that pain must be tolerated and as a part of a disease process, fear of the consequences of reporting pain, and also fear of painkiller side effects, cause pain management to be suboptimal. A non-ideal healthcare system is also known as a barrier in pain management.⁹ Premorbid psychological factors such as catastrophization are also known as risk factors for CPIP.^{1,7} Another factor is the fear of movement after experiencing illness. Archer et al. in their study found that the combination of catastrophization and fear of movement contributed to the intensity of pain, pain interference, and physical health by 29%, 34%, and 19%, consecutively.¹⁷

2.3.1. Clinical Features

Battle et al. found that 22% of ICU survivors experienced chronic pain in the shoulder area. As many as 95% of patients experienced a decrease in the range of motion of the shoulder joint and 80% had persistent shoulder dysfunction up to one year after being discharged from the ICU. Shoulder pain may be due to the patient's unwillingness and inability to move the shoulder girdle due to a central catheter, dialysis, or ventilator line. Lack of muscle tone and muscle strain due to ICU treatment can also cause shoulder pain.^{1,18}

Other common locations for CPIP are upper arms, lower back, legs, feet and ankles, pelvis, as well as abdomen area.^{1,3} In patients with blunt chest trauma, the most frequently reported persistent pain was in the ribs area, which was 37% with moderate to very severe intensity. At the 3-month follow-up period, 29% of patients still required strong opioids.¹⁹

Around 20%-50% of ICU survivors with a history of major surgery had CPIP.² Baumbach et al. found that the intensity of pain experienced by CPIP patients after 6 months of ICU discharge was pain with a numerical rating scale (NRS) ≥ 4 - < 7 of 21.2% and pain with a NRS ≥ 7 of 36.4%.¹⁶

2.3.2. Functional Impairments due to CPIP

One survey found that as many as 38% of ICU survivors experienced chronic pain, 27% experienced PTSD symptoms, and 21% experienced a decreased quality of life.⁵ Approximately one-third of ICU survivors with CPIP experienced physical disabilities up to 1 year after being discharged from the ICU, with impairment of mobility and deconditioning syndromes.²⁰

Around 59%-62% of CPIP patients had ADL disorders.^{1,19} Chronic pain also triggers anxiety, sleep disturbances, stress, and depression which deteriorate an individual's control of pain and cause pain exacerbations.⁹ Choi et al. in their study found a correlation between the severity of pain with the level of sleep disturbances and fatigue of ICU survivors after 2 months of ICU discharge.²¹

CPIP was also found to cause vocational problems such as inability to work and causing the patients to miss their jobs or be forced to quit their jobs. These problems were found in one-third to two-thirds of patients.^{2,19,20} A review by Edward et al. identified that 32% of ICU survivors with CPIP needed medical assistance which further caused a bigger health financial burden.¹⁹

2.3.3. Assessment of CPIP

Assessment is needed to obtain complete information to make a diagnosis, choose an appropriate treatment program, and conduct an evaluation. Assessment is carried out by identification of nociceptive factors that

may be corrected, problems due to disuse syndromes, and psychosocial factors which is causing persistent pain.^{20,24}

Anamnesis of CPIP can be done with PQRSTUV mnemonics, including 1) P (provocating and palliative), identification of conditions that trigger or reduce pain; 2) Q (quality), identification of the quality of pain, whether the pain is throbbing, aching, burning, stabbing, shooting, numb, and others; 3) R (region), identification of the location or distribution of pain; 4) S (severity), a subjective description of the level and impact of pain by the patient; 5) T (time and treatment), identification of the onset of pain, whether it is constant or intermittent, and the therapeutic interventions which have been undertaken; 6) U (understanding), identification of the patient's understanding about the effects of pain and the disease; and 7) V (value), identification of how the patient measure the pain in the context of tradition, religion, and socio-cultural environmental conditions.^{20,24}

Assessment of psychosocial aspects is not only provided to the patients but also to spouses or family members, workmates, or people who are considered to be associated with the onset of chronic pain.²³ The negative support from family members or the environment in the form of assistance will cause the patient to become inactivity and experience persistent pain. On the other hand, positive support in the form of motivation will cause the patient to cope with the pain.^{13-15,23}

Physical examination including a general examination, neurological, musculoskeletal, and local status were carried out according to the diagnosis of the underlying disease. The functional status examination was performed to assess the impact of chronic pain related to inactivity. Examination of various systems including cardiovascular, respiratory, musculoskeletal, and neurological systems, as well as mobilization and ADL functions should performed carefully. Careful physical and functional examinations are carried out at the first contact with the patient. The impact of pain on a patient's movements and activities should be evaluated while performing an examination.^{6,24}

Instruments that are often used in the assessment of chronic pain include 1) instruments to assess the quality or quantity of pain; 2) instruments to assess disability due to chronic pain; 3) instruments to assess psychological conditions or disorders related to chronic pain; and 4) instrument to identify impairment of quality of life due to chronic pain. Assessment of the quality and quantity of pain was carried out using the numerical rating scale (NRS), visual analog scale (VAS), Face Scale, Graded Chronic Pain Scale, and Verbal Descriptor Scale.^{24,25}

The Brief Pain Inventory (BPI) is a tool that can assess disability due to chronic pain and the severity of pain. This tool can be used as an initial assessment of CPIP or as a 1-year follow-up measurement. The BPI is recommended for pain assessment in all clinical trials of chronic pain because this instrument is valid and reliable in measuring chronic pain.⁴

The BPI is a self-reported questionnaire filled out by the patient to assess the impact of pain on seven domains, including ADL, walking ability, work, sleep, mood, enjoyment of life, and relationships. The impact of pain is expressed on a 0-10 scale. A score of 0 is given for no impact pain and a score of 10 for full impact. This questionnaire also assesses the location and severity of pain on the same 0-10 scale. A score of 0 for no pain and 10 for the worst pain.⁶

The Pain Catastrophizing Scale (PCS) can be used to assess pain-related catastrophization. Fear of movement can be assessed using the Fear-avoidance Beliefs Questionnaire (FABQ) or the Tampa Scale for Kinesiophobia (TSK).¹⁷ Anxiety and depression that may occur can be measured using the Pain Anxiety Symptoms Scale (PASS) and the Beck Depression Inventory-II (BDI-II). Chronic Pain Acceptance Questionnaire (CPAQ), Pain Scale and Self-efficacy Questionnaire (PSEQ), and Short Form-12 Health Survey (SF-12) can be used to assess self-acceptance and quality of life.^{2,13,26,27}

2.3.4. Management of CPIP

Every patient with CPIP must be provided a treatment that is designed based on their needs or desires, and their environmental situations or conditions.³ The goals of CPIP management are to prevent disability due to chronic pain and improve functional abilities.²² Chronic pain management consists of pharmacotherapy, prevention, and comprehensive management by giving multimodalities. These modalities include physical modalities to reduce somatic pain, exercises for reconditioning, occupational therapy, and psychosocial counseling. Ideally, the management of CPIP begins with the prevention programs from the acute ICU admission. There is no single effective treatment for chronic pain recommended by experts.^{1,2,20,23}

2.4. Rehabilitation Intervention in CPIP

Rehabilitation interventions in CPIP include pharmacological and non-pharmacological approaches to prevent the transition from acute to chronic pain. Rehabilitation intervention is given from the time of admission to the ICU until the follow-up phase.^{2,19}

The use of non-opioid and non-pharmacological interventions are necessary to reduce the need for opioid

and to prevent the side effects of using opioids, such as delirium and hyperalgesia.^{2,7,19} Adequate analgesics help to maintain the sleep cycle in the ICU, thereby it could prevent disorders of modulation and perception of pain.³

The incidence of CPIP can be prevented by ER in the ICU, through early mobilization and exercises include mobilization of ventilated patients. Early mobilization in the ICU reduces the length of ventilator use and ICU stay, thereby it can improve physical and mental health including the incidence of chronic pain.^{5,18,28} Research by Söderberg et al. found that positive encouragement from the caregiver made mobilization activities easier to do for the patient. This study also found that although early mobilization required a big effort from the patient, it could increase the emotional feeling of recovery when the patient begins to move and increase physical activity.²⁹

The physical exercises given focus on general reconditioning (aerobic), joint range of motion, stretching, muscle strengthening, balance, and coordination exercises. Occupational therapy is a component of CPIP management that focuses on modifying daily activities as needed to increase functional independence and participation. This therapy includes basic instrumental and advanced ADL exercises, as well as environmental modification for safety purposes, body mechanics, activity planning, fall prevention, and techniques to perform daily activities and work in ergonomic and efficient ways.^{3,7,23}

Psychosocial counseling and cognitive-behavioral therapy (CBT) can be provided in the prevention and management of CPIP. Psychosocial counseling can be done by group discussion or individual counseling. The topic of psychosocial counseling include psychosocial impairment, the form and goals of therapy, pain cycle, pain behavior, lifestyle changes, problem-solving, and exercises including relaxation therapy, stress relief or others.^{23,30}

2.4.1. Cognitive-behavioral Therapy

CBT is an approach that aims to help patients eliminate maladaptive thoughts and behaviors through the identification of problems and finding ways to overcome these problems.³⁰ CBT is a combination of cognitive therapy and behavioral therapy.³¹

Cognitive therapy aims to change maladaptive core beliefs such as negative thoughts, assumptions, and beliefs into positive ones.³² This therapy is given individually according to each patient's condition. Cognitive therapy started with the identification of pain-related issues such as experiences of ICU care and somatosensory input that can trigger anxiety and fear, guiding patients to change trauma memories, then revisiting the trauma care unit including the ICU if

possible. All of these efforts aim to change maladaptive core beliefs.³¹

Behavioral therapy is done by scheduling daily or weekly activities and exercises, as well as breaking down complex activities or exercises into small and simple ones. Activities started from the one that provoked the lowest pain intensity to the highest one. This therapy aims to reduce catastrophization and anxiety about exposure to activities that cause pain. In addition, it also aims to increase active behavior through regular exercise and help the patient to prove that exercise will not provoke pain.^{32,33}

A study found that CBT which was given from the ICU admission could become the basis for evaluating the efficacy, effectiveness, and implementation of rehabilitation programs to improve long-term outcomes of ICU survivors. The protocol given in this study was Self-Management for Acute Respiratory Failure (SMARF). Patients were given interventions which included: 1) education about the relationship between medical conditions and changes in anxiety levels, structure and format of sessions, and setting treatment goals; 2) eliminating worries about treatment, developing problem-solving skills, and also determining the type of approach to be taken including measurable goals; 3) identification of the relationship between thoughts and anxiety, as well as identification of maladaptive thoughts and beliefs; 4) identification of the relationship between anxiety and physiological responses, as well as provide relaxation skills such as guided imagery, body scans, and breathing exercises through relaxation exercises; 5) understand the pattern of fear-avoidance and then exposed the patient to events that trigger anxiety; and 6) education about on anxiety and identification of danger signs related to anxiety, as well as given follow-up programs when the patient being discharged from the hospital.³⁴

CBT intervention is also given to prevent PICS with impairment of physical, cognitive, and psychological functions. PICS can be found in ICU survivor months and even years after being discharged. A combination of physical, cognitive, and psychological interventions is carried out from the ICU admission. Physical rehabilitation is provided in the form of physical therapy and early mobilization. Cognitive therapy is given from the acute phase to a home after being discharged. Cognitive therapy includes computer-based cognitive therapy, ICU diaries, and psychological interventions to overcome cognitive and psychological problems. Rehabilitation programs can be continued to a long-term home-based program for physical reconditioning and a group discussion to improve mental or social health.^{35,36}

Research by Kurklinsky et al. in a pain rehabilitation center found that interdisciplinary rehabilitation

intervention for 3 weeks clinically improved functional status. Improvement was in the form of a 6-minute walk distance and self-care abilities, work productivity, as well as leisure activities. Interdisciplinary rehabilitation includes physical exercise and occupational therapy, and CBT consists of psychological counseling, intervention for fear avoidance, and family meetings.²³

3. CONCLUSION

CPIP causes a significant functional impairment including disuse and deconditioning syndromes, and impairment of mobilization, ADLs, vocational, psychological, as well as social. The cause of CPIP is not certainly known, but several factors have been identified to be associated with the incidence of CPIP, which including genetic, premorbid conditions, medical intervention, ICU care, psychological, and social factors.

The management of CPIP is generally similar to chronic pain which aims to prevent disabilities due to chronic pain and improve functional abilities. The rehabilitation program of CPIP begins with a prevention program from the acute phase when the patient is undergoing ICU admission until the follow-up phase.

The rehabilitation program includes multimodality intervention consisting of physical modalities, exercise, occupational therapy, and psychological or social counseling, as well as CBT. Research evidence of rehabilitation intervention in CPIP is still limited. The CBT program is effective in improving long-term outcomes, preventing the incidence of PICS, and improving the functional status of ICU survivors.

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5. Conflict of Interest

The author declared there is no conflict of interest.

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7. Author contribution

Arnengsih Nazir is the sole author of this manuscript.

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