

Assessment of pain: types, mechanism and treatment

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Abstract

Pain is the most common symptom of disease, which accompanies us from an early age. It is a protective mechanism to which the body responds to harmful stimulus. The definition of pain states that it is a subjective sensory and emotional experience. It is connected to the stimulus that it invokes and is also based on the observation of psychological interpretation of the phenomena taking place. Pain is individual for each person. Pain affects both our previous experience of pain and psychosomatic conditions, depending on the relationship between the psyche and the body. Pain is always an unpleasant sensation. The feeling of pain can be caused by irritation of pain receptors, which can be found in the skin, joints and many internal organs. The cause of pain may also be damage to the nervous system, both the peripheral nerves, brain and spinal cord. Pain can also occur without damage to tissues, although the patient refers to it (psychogenic pain). The process of pain is a complex phenomenon. Experience of pain depends on the strength of the stimulus, individual susceptibility and individual resistance to pain. Pain receptors are sensitive to mechanical, thermal or chemical stimuli. The operation of noxious stimulus to these receptors results in the processing into an electrical signal. This impulse is conducted by nerve fibres into the spinal cord and then to the brain. At this point, there is the realization that something hurts us. Pain is not only somatic in nature, associated with the condition of the body, but it is a multidimensional phenomenon. Therefore, in addition to the physiological process of pain, its subjective perception is also important, which is decided by the central nervous system. It consists of the emotional aspects: suffering and attitude towards pain and pain expression. A review of pain physiology is essential to fully understand the principles of pain management.

Key words

pain, pain treatment, health

INTRODUCTION

Pain is an unpleasant sensory and emotional feeling accompanying existing or impending tissue damage or referenced to such damage. Pain is the most common experience reported by patients, and patient anxiety is a form of warning signal. It is a sensual and perceptual phenomenon, which causes suffering and emotional state of risks connected with anxiety. Pain has many forms. It warns against damage to the body, which is important for avoiding injuries and consequently for survival. Pain not caused by acute injuries can be unpleasant for the patient, or it can alter a person's life, reduce the quality of life, and also have an impact on the patient's family. The word "pain" for the patient means disease and suffering, for the doctor it is a symptom, and for the physiologist it is a kind of feeling that has its own anatomical and physiological system which begins with the receptors and ends up in the brain cortex. Feeling is a physical sensation that can be confirmed by electrophysiological methods, but in practice it is only a subjective sensation. Its intensity and quality come under various internal and external factors; therefore, the same stimulus can be experienced differently in different circumstances, somatic and psychiatric conditions.

The way of receiving pain is very individual and varies from time-to-time in the same individual. The intensity of pain is

difficult to measure and an individual's perception of pain depends on the individual's emotional state, circumstances under which the pain was acquired, and whether it is perceived as a threatening signal. The perception of pain depends on such factors as arousal, attention, distraction and expectation [1, 2, 3]. Before we realize that something hurts, there are a number of physiological processes in our body. Painful stimuli have to be passed quickly – in (milli) seconds. Acute pain warns about impending or ensuing danger while chronic pain causes the afflicted part of the body, such as an immobilized and unused limb, increasing the chance for recovery. A single, sharp stimulus to pain can disappear, and probably not leave a trail. Stimuli that are repeated, cause adaptive changes in the central nervous system and the activation of a number of systems, both supporting and inhibiting pain. In the spinal cord and the brain there occurs synthesis and the activation of various receptor systems, as well as synthesis of various compounds modifying the sense of pain. It is known that an important role in this process is played by the glial cells. It is a very complicated process that can lead to the preservation of the pain, even after the disappearance of the pain stimulus [4].

Pain can also be generated without receptors, from the peripheral and central nervous systems. This is always a pathological pain which arises due to damage to the nervous system, and has a different nature from physiological pain and clinical presentation. It is important to distinguish receptor pain – nociceptive, physiological pain from non-receptor pain – pathological, central and peripheral (Tab. 1).

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Table 1. Characteristics of pain

Receptor pain	From irritation the receptors of integuments, muscle, joints and internal organs
	No changes in nervous system
Non-receptor pain	Skin, osteo-articular, muscular, and organ pain
	Nerve or central nervous system damage
Non-receptor pain	Damaged nervous system
	Neuropathic pain – from the nerves, central pain – from the spinal cord

Nociceptive pain is the feeling of warning against the danger of tissue damage or indicating already inflicted damage as a result of illness or injury. Pain receptor may come from external tissues – integuments, skin and mucosal pain – from internal organs (eye, ear, nasopharynx, heart, blood vessels, abdominal organs and pelvis minor). There is also pain in bones, joints and muscles. Chemical and physical factors acting outside the nervous system are incentives irritating pain receptors. This stimulus is converted into electrical impulses conducted by the physiological undamaged nervous system to centres where they are recognized as pain. They go to the reticular system where – as a non-specific impulses – they stimulate cerebral cortex activity and reach the limbic system, which determines the emotional response to pain. Defence reflex is formed in the brain centres [1].

Pathways of pain. The cause of pain is irritation of the receptors, called nociceptors. Nociceptors are free nerve endings that respond to painful stimuli. Nociceptors are found in skin, organ of motion (periosteum, joint capsule, ligaments, muscles), cornea of the eye and dental pulp. Inside the body they are also abundant in the meninges, pleura, peritoneum and organ walls. Stimulated by biological, electrical, thermal, mechanical, and chemical stimuli they transmit information to the brain. When stimuli are transmitted to the spinal cord, then to the central areas of the brain, pain perception occurs. Impulses run to the dorsal horn of the spine, where they synapse with dorsal horn neurons in the substantia gelatinosa, and then enter the brain. The basic sensation of pain occurs at the thalamus. It continues to the limbic system (emotional centre) and the cerebral cortex, Where pain is perceived and interpreted. Nociceptors are simple structures because they are at the end of the nerve fibres. There are two types of fibres: A δ and C, involved in pain transmission. The large one – A δ fibres, produce sharp, well-defined pain, which is typically stimulated by a cut, an electrical shock, or a physical blow. They are myelinated and can allow an action potential to travel at a rate of about 20 meters/second towards the central nervous system. Transmission through A δ fibers is so fast that the body responds faster than the pain stimulus. This results in retraction of the affected body part before the person perceives the pain. This allows a quick response: “escape” or preparation for “fight”. These fibres have practically no opioid receptors, while pain receptors located at the ends are always on standby. There are limited possibilities for pharmacological modification of these receptors. In practice, it is easy to inhibit chronic, “slow” pain, using analgesic drugs and difficult to block “sharp”, “fast” pain. After the so-called first pain, the smaller C fibres transmit dull burning or aching sensations, known as a “second pain.” [4, 5, 6, 7]. C fibres are very thin and susceptible to damage. They do not

have the myelin sheath, therefore the conduction of painful stimuli is very slow – around 0.5 – 2 m/s. Numerous C fibres are combined in a “net”; [4, 8]. therefore, the area covered by branching C-fibres is usually broad, and the patient is able to locate the pain only approximately. C fibres react to mechanical, thermal and chemical stimuli. They lead pain stimuli and also pruritic stimuli (which is a part of the fibres, especially sensitive to histamine) [9]. Patients describe pain conducted by C fibres as rapid, hitching, pulsing. At the ends of these nerve fibres there are different receptors, the most important of which are the opioid receptors. The proteins forming part of these receptors are synthesized in ganglion cells and transported inside the axons, both into the synapse in the corners of the spinal cord, and towards nerve endings in peripheral tissues. Inactive forms of receptors – “sleeping receptors” are incorporated in the cell membrane of nerve endings [10]. They may be “awakened” by inflammation. Various cytokines produced by inflammatory cells are able to penetrate the damaged perineurium and activate the receptors. In this way, the opioid receptors are activated and after sensitization are able to react to endogenous and exogenous opioids. C-fibre nerve endings are also “sensitized” by prostaglandin and other mediators. Inhibition of prostaglandin synthesis a non-steroidal anti-inflammatory drug, and inhibition of inflammation by corticosteroids reduces the fibres nerve sensitivity and increase the pain threshold. This basic defence mechanism is based on the cooperation between the immune and nervous systems [4]. As a result, pain comes in two phases. The first phase is mediated by the fast-conducting A δ fibers and the second part due to C fibres. Physiological pain has significant importance as a warning sign that ensures human safety [5, 6, 7].

Regulators of Pain

When tissue damage occurs, chemical substances that modulate the transmission of pain are released into the extracellular tissue. Pain receptors are activated by irritating the nerve endings. Chemical mediators responsible for pain activation include histamine, substance P, bradykinin, acetylcholine, leukotrienes, and prostaglandins. At the site of injury, mediators can produce other reactions, such as vasoconstriction, vasodilatation, or altered capillary permeability. Prostaglandins induce inflammation and other inflammatory mediators. Aspirin blocks cyclooxygenase 2, the enzyme needed for prostaglandin synthesis, thus reducing pain. This medications is often prescribed for painful conditions due to inflammation [11]. Our body has a built-in chemical mechanism which can manage pain. Fibres in the dorsal horn, brain stem, and peripheral tissues release neuromodulators, endogenous opioids, that inhibit the action of neurons transmitting the pain impulses. Endorphins are natural opioid-like substances responsible for pain relief. Endorphin levels differ between individuals; therefore, different patients experience pain differently. This endogenous opioid mechanism may play an important role in the placebo effect. A placebo is an inactive substance or treatment used for comparison with “real” treatment in controlled studies, intended to deceive the recipient and determine the efficacy of the treatment under study. However, despite the lack of any actual value, placebos can also have a surprisingly positive effect on patients. Placebos can and do produce an analgesic response in many patients. There are many reasons why patients might report less pain,

and may believe the treatment will change the condition and this belief may produce a subjective perception of a therapeutic effect, causing the patient to feel that their condition has been improved — or that there is an actual improvement in their condition. It has been suggested that placebo effects are created by these and similar cognitive biases [12, 13, 14]. According to the signal detection theory, the expectation of a treatment creates uncertainty about the sensory information of pain, and the placebo response is a case of perceptual error. There is some evidence that the tendency to use prior expectation when making perceptual decisions, instead of independently evaluating available perceptual information, is a general cognitive style that is positively associated with placebo analgesic responses. Placebo analgesia can affect nociceptive mechanisms in the cortex of the brain and ascending pathways of the spinal cord. It was found that expectations about pain and analgesia can modify pain perception by altering pain mechanisms in the spinal cord. Psychological factors, such as the threat of pain and expectations about analgesia, modify spinal pain transmission, therefore modifying pain [2, 14, 15].

Acute and chronic pain

The nervous system detects and interprets a wide range of thermal and mechanical stimuli, as well as environmental and endogenous chemical irritants. Acute and chronic pain are different clinical entities. Acute pain is associated with skeletal muscle spasm and sympathetic nervous system activation, provoked by a specific disease or injury, serves a useful biologic purpose, and is self-limited. In determining a persistent injury, both peripheral and central nervous system components of the pain transmission pathway exhibit huge plasticity, enhancing pain signals and producing hypersensitivity. When plasticity favours protective reflexes, it can be beneficial, but when the changes persist, a chronic pain condition may result. Chronic pain, in contrast, may be considered as a disease state. It is pain that outlasts the normal time of healing, if related with a disease or injury. Chronic pain may arise from psychological states, serves no biologic purpose, and has no distinguishable end-point. Persistent pain associated with injury or diseases (diabetes, arthritis, or tumour growth) can result from changes in the properties of peripheral nerves. This can occur through damage to the nerve fibres, leading to increased spontaneous firing or alterations in their conduction or neurotransmitter properties. In fact, the utility of topical and even systemic local anesthetics for the treatment of different neuropathic pain conditions (such as postherpetic neuralgia) probably reflects their action on sodium channels that accumulate in damaged nerve fibres [16].

Genetic, electrophysiological, and pharmacological studies explain the molecular mechanisms that underlie the detection, coding, and modulation of noxious stimuli that generate pain [17].

Clinical characteristics of pain

The clinical features include: location, intensity, duration and quality. These qualities are evaluated mainly subjectively. The location of pain allows determination of the possible cause. The location of a pain does not always correspond to the site of injury or disease process. Deep organ pains are particularly poorly located. This is clinically important as it can hinder the location of the disease. Pain often occurs

as a phenomenon reflected pain (projected). Phenomenon of projection stems from the fact that the internal organs do not have pain receptors, only the overlying peritonium has extensive sensory innervations. The intensity of pain experienced by the patient is individual and is the most difficult feature to assess. The exponent of the intensity of pain is its tolerance. Women have the highest tolerance, men and children the least.

To evaluate intensity, visual or analogue scales are used to compare pain with the strongest pain which the patient ever suffered. In practice, most popular scale divides pain into very strong, strong, moderate, weak and no pain. The visual-analogue scale is used to assess pain by an increasing score: from 0 – meaning no pain, to 10 – meaning the strongest pain endured in life.

The duration of pain is a measurable characteristic that allows differentiation between acute and chronic pain. After an acute phase of back pain, relapses may occur and with them, acute pain becomes chronic pain.. In migraine, the pain is acute but the disease is chronic. It is assumed that any pain that lasts longer than three months is chronic pain. Pain can be continuous and paroxysmal, as in headaches or neuralgia.

Considering the durations of symptoms, pain can be divided into groups:

- **Acute pain:** duration < 3 months, acts as a warning-defensive (post-operative pain, traumatic, associated with medical procedures).
- **Chronic pain:** duration > 3 months, does not fulfill the role of warning and defensive, due to the nature and symptoms of the disease is considered in itself, and requires a multi-therapeutic activities.
- **Survived pain:** most often occurs as a result of improper treatment of acute pain, persists despite the healed tissue, the damage to which resulted in acute pain.

Quality is a feature very useful in evaluation of the origin of pain. Rapid pain suggests neural origin, girdling pain, escalating while coughing, moving indicate core, indicates the root, burning pain, provoked any stimulus indicates neuropathy and nerve damage. Vascular pain is pulsatory, deep pain is dull, sometimes combined with nausea and is derived from organs.

Psychological reaction is responsible for the degree of suffering and depends on the tolerance for the pain, which is individual. This reaction may be very different and depends on the state of the nervous system and patient situation. In acute pain, this reaction has – the form of anxiety, in chronic pain – depression.

The response from muscles is expressed in intensification of paravertebral muscle tension, which leads to equalization of lordosis or lateral curvature of the spine. This is a muscular defence, visible and palpable, possible to register. An indirect reaction indicating suffering is the expression on a patient's face.

Autonomic and hormonal responses reveal increased blood pressure, heart rate, respiratory rate, mydriasis, and many other symptoms, which can be explored during experimental pain when the painful stimulus and stimulus duration are known [1].

Division of pain

- **Anatomic pain** – may be physiological receptor-functional (protective) or pathological, as a result of local changes.

- **Physiological pain** – superficial pain, caused by irritation of the skin receptors, mucous membranes and cornea by a damaging factor.
- **Pathological pain** – caused by chronic irritation of pain receptors by pain mediators released from damaged tissues.
- **Deep pain** – is pathological, can be caused by blood vessels, bone and joint system, muscles or organ structure.
- **Vascular pain** – caused by stimulation of mechano- and chemo- pain receptors, located in the outer membrane of large arteries and veins. Stretching of the vascular vessels causes pulsating, tension headaches.
- **Bone and joint pain** – the source of pain is stimulation of the pain receptors of the joint capsule and periosteum.
- **Myalgia** – caused by irritation of the receptors in muscles and fascias by accumulated metabolites, when they are over-load and tired.
- **Organ pain** – include biliary and renal colic.
- **Wired pain** – arises as a result of direct stimulation of the nerve fibers or pathways. Includes neuralgia, causalgia, radicalgia and phantom pain.
- **Neuralgia** – applies to the trigeminal nerve, sciatic, femoral and lateral femoral cutaneous nerve.
- **Radicalgia** – exacerbated by coughing and radiating movements to the appropriate areas of the skin.
- **Causalgia** – neuralgia with an autonomic component, results from large nerve injuries, with many of the sympathetic nerves. Pains are burning with dystrophic changes – cyanosis, oedema, muscle atrophy
- **Convolutional pain** – the result of compression on the nerve plexus, caused by cancer or inflammatory changes in the neck, top of the lungs, lower pelvis.
- **Phantom pain** – occurs in patients after amputation and relates to pain in the amputated limb. Incidence of this pain explains the existence of chronic pain of embedded memory.

Pain as a social phenomenon

Pain and its aftermath often cause unpleasant consequences for the patient and family. Pain has not only physical and psychological consequences, but also social consequences.

Social consequences of pain:

- severe and chronic pain hinder normal functioning and implementing daily duties;
- they lead to the elimination of signs of social activity
 - patient focus thoughts on the pain and the constant searching for the cause;
- can cause mental isolation and depression – patient has a sense of dramatically reduced availability of the surrounding world.
- may cause conflicts with family or friends – patient may fall into a depressive mood manifested by sadness, irritability and outbursts of anger.

Pain is more than a physical phenomenon, the psychological, social and spiritual aspects of pain should also be considered. Research suggests that the approach to pain should be multidimensional. Because the assessment of pain, physically expressed pain, psychological state, social and spiritual issues, are individual to a person's reaction to their pain experience. A comprehensive assessment of pain should consider the following spheres [18, 19]:

- physical effects and symptoms of pain;
- functional effects (interference with activities of daily living);

- psychosocial factors (level of anxiety, mood, fears, factors affecting pain tolerance cultural influences, effects on interpersonal relationships);
- spiritual aspects [20, 21, 22].

Why should we relieve the pain?

In all patients suffering from chronic pain there are changes related to the physiological and social disorders, affecting the quality of life. They depend mainly on the duration and the intensity of pain, not the cause of the pain. In patients with chronic pain there are common disorders connected with sleep and appetite, decreased libido and sexual activity, psychomotor heaviness and lowered threshold of pain. Sleep disorders are characterized by difficulty with falling asleep because of the patients inability to find a comfortable position, and the pain is then perceived as more annoying. Sleep is restless and interrupted by pain attacks. Many patients after waking up feel fatigue, and physical and mental exhaustion. Chronic pain also causes changes in behaviour associated with food. The patient often suffers from loss of the appetite and body weight. Some patients feel anxious and an excessive avidity to eat, which with insufficient activity (limited due to pain) may be the cause of obesity, impairing physical activity.

People suffering from chronic pain evince a depressed mood, revealing not only sadness, but also irritability and outbursts of anger. This results in frequent conflicts with family and friends, leads to the gradual elimination of social life, manifestations, psychological isolation, withdrawn, dramatically reduced sense of the world available to patients. Most of the time, patients remain in the supine position, and their thoughts focus on the pain and constant search for the causes and ways to find relief. Most patients are not able to work, their income, standard of living and position in the family are significantly reduced. Patients with strong and chronic pain perceive their situation as hopeless. In desperation, they demand more and more new surgical procedures, seek help from quacks, healers, and demand the prescription of painkillers to reduce their suffering.

Types of painkillers

- Opioid analgesics. Used to relieve pain of moderate intensity. Drugs belonging to this group are paracetamol and non-steroidal anti-inflammatory drugs – NSAIDs (eg, aspirin, ibuprofen). Most drugs in this class are available without a prescription, but it is impossible to predict which formulation is the most effective. Side-effects should also be considered, especially in the case of long-term use of this type of medication.
- Opioids. In the treatment of pain, both so-called weak and strong opioids have been applied. Weak opioids (tramadol, dihydrocodeine, codeine) show a trap effect. This means that exceeding the maximum dose will result in side-effects, but does not increase the analgesic activity of the drug. Strong opioids include: morphine, buprenorphine, fentanyl, methadone, oxycodone. Strong opioids do not show a trap effect.

Opioids differ in efficiency, operating time (short-acting, controlled-action), the bioavailability (absorption in the gastrointestinal tract), metabolism, possible use in combination with other drugs, or any kind of side-effect (e.g. constipation, shortness of breath). They limit the

psychomotor performance and using them precludes driving a motor vehicle, or operating machinery..

Guidelines for pain management

The primary method of pain treatment is pharmacotherapy. In 1986, The World Health Organization (WHO) developed and introduced guidelines for pain management, called the WHO scheme or three-stage analgesic ladder. It has become the global standard for analgesic care. Although it refers to the treatment of cancer pain, it is also commonly used to treat chronic pain with different substrate. If pain occurs, there should be prompt oral administration of drugs in the following order: nonopioids (aspirin and paracetamol); then, as necessary, mild opioids (codeine); followed strong opioids, such as morphine, until the patient is free of pain. To calm fears and anxiety, additional drugs – “adjuvants” – should be used. To maintain freedom from pain, drugs should be given “by the clock”, this means every 3–6 hours, rather than “on demand”. This three-step approach of administering the proper drug in the right dose at the right time is inexpensive, and according to a study conducted in Poland, thanks to the WHO instructions, about 85–90% of patients can be successfully treated. If the drugs are not wholly effective then surgical intervention on the appropriate nerves may provide further pain relief [23].

Strategies for the pain control

The treatment of chronic pain should be multidirectional. There are pharmacological methods of treatment, physical, rehabilitation, neuromodulation, psychological methods and in some cases, invasive techniques. It is extremely important to ensure mindful and comprehensive care for the patient, and to clarify and obtain acceptance of the chosen method of treatment from the patient.

Pharmacotherapy. pharmacotherapy should always be selected individually, because what helps one person does not necessarily help another, and may even be harmful. The choice of drug should be based on appropriate diagnosis and currently used analgesic treatment. It is important to take into account possible side-effects which occurred during the previous use of the drugs. It is also important to take into account possible interaction of the proposed drug with other medicines used by patient for other diseases. To obtain an effective pain control, a combination of drugs with different mechanisms of action are used. They are also available in the form of ready-prepared formulations containing a combination of two or more components,

Physical therapy and rehabilitation – a supporting method used in the treatment of pain. The most popular methods of physical treatment are: thermotherapy (heat), cryotherapy (cold), laser therapy, electrotherapy, manual technics, medicinal extracts, kinesitherapy. These methods – used in an appropriate manner – may improve life and mobility of some patients.

Neuromodulation – neuromodulating treatments are aimed at stimulating the pain systems. Currently, several neuromodulation methods are used: percutaneous nerve electrostimulation (TENS), peripheral nerve stimulation, acupuncture and vibration. Neuromodulation supports pain treatment methods and by activating the pain inhibitory

mechanisms can reduce pain and improve the quality of life patient with chronic pain.

Psychological therapies – psychological factors have a big influence on the perception of pain, as well as the effectiveness of the treatment. Therefore, all patients with chronic pain should be able to take advantage of professional psychological help, which can affect the emotional aspect of pain. Among the psychological methods that can be effective as a technique supporting the treatment of chronic pain, the most commonly used are: cognitive therapy, behavioural therapy, relaxation techniques and hypnotherapy.

Invasive methods – invasive methods of pain management should be implemented and enforced by experienced specialists in specific cases. There are many methods: from individual nerves blocks, by intrathecal administration of drugs (e.g. epidural anesthesia during childbirth) to neurodestructive methods (thermolesion, neurolysis) and neurosurgery. Modern medicine offers more and more ways to treat pain. This makes it possible to bring relief to people suffering from various ailments.

CONCLUSIONS

The experience of pain is a highly complex phenomenon with physical, behavioural, cognitive, emotional, spiritual, and interpersonal aspects. This multidimensional nature of pain must be

acknowledged in the assessment and management of patients [24]. Psychological factors can have a profound influence on the perception of pain and how the sufferer responds behaviourally and emotionally. As a chronic stressor, chronic pain can give rise to disability and distress, but this can be mediated by psychological factors. There is a large body of scientific evidence to support the role of anxiety and depression, fear, particular pain-related beliefs, and coping styles in the mediation of pain perception in chronic non-malignant pain. Cognitive behavioural interventions designed to minimise the impact of pain on mood and function are effective in this patient group [25].

The meaning of pain may be different for patients with cancer compared to those patients with pain relating to non-life threatening illness. Some cancer patients may see increased pain as a sign of disease progression, or the failure of strong medication, with possible consequences for mood and adherence to treatment protocols. There is emerging evidence that education and cognitive behavioural interventions for pain can alleviate some of the distress and disability associated with pain, as well as improve adherence to analgesic regimens [26, 27].

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