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REVIEW ARTICLE

CENTRAL SENSITIZATION OF PAIN IN PHYSIOTHERAPY

CENTRALNA SENSYTYZACJA W FIZJOTERAPII

Elżbieta Skorupska
Department of Physiotherapy, University of Medical Sciences, Poznań, Poland

ABSTRACT
Nowadays, there are three main pain descriptors: nociceptive pain, neuropathic pain, and nociplastic pain. The last one is the newest expression defining pain as 'Pain that arises from altered nociception, despite no clear evidence of actual or threatened tissue damage causing the activation of peripheral nociceptors or evidence for disease or lesion of the somatosensory system causing the pain' (International Association for the Study of Pain). The implementation of modern pain neuroscience in practice is said to be the most important for musculoskeletal physical therapists around the world. One of the examples of the nociplastic pain mechanism can be myofascial trigger points that are connected with central sensitization (one of the subtypes of nociplastic pain). Central sensitization (CS) is defined as an amplification of neural signaling within the central nervous system that elicits pain hypersensitivity and ongoing neuronal excitation which outlasts the initial nociceptor input. Features typical of that state are abnormally low peripheral thresholds for pain from pressure, temperature, electrical, and other stimuli and it has been proposed that trigger points may function as peripheral mediators of CS.

Keywords: central sensitization, trigger point, musculoskeletal pain, nocyplastic pain

STRESZCZENIE
Trzy główne deskryptory opisujące mechanizm powstawania bólu to: ból receptorowy, neuropatyczny oraz nocyplastyczny. Ten ostatni definiowany jest jako „ból powstający na skutek zaburzonej nocycepcji pomimo braku oznak potencjalnego lub faktycznego uszkodzenia tkanek oraz pomimo braku uszkodzenia bądź choroby somatosensorycznego układu nerwowego" (Międzynarodowe Towarzystwo Badań nad Bólem). W ostatnim czasie wskazuję się na konieczność wprowadzenia najnowszych osiągnieć z zakresu neurofizjologii bólu do codziennej praktyki fizjoterapeuty. Jednym z przykładów bólu nocyplastycznego mogą być punkty spustowe kojarzone z centralną sensytyzacją (jeden z podtypów bólu nocyplastycznego). Centralna senstyzacja (CS) definiowna jest jako wzmocnienie przekaźnictwa nerwowego wywołujące trwałą nadwrażliwość bólową pomimo braku aktywności pierwotnego bodźca receptorowego. Typowe cechy tego stanu to: obniżony prób bólu czucia nacisku, temperatury, bodźca elektrycznego i innych, a punkty spustowe są wskazywane jako potencjalne zaburzenie bólowe prowadzący do CS.

Słowa kluczowe: centralna sensytyzacja, punkt spustowy, ból mięśniowo-szkieletowy, ból nocyplastyczny

Author responsible for correspondence:
Elżbieta Skorupska
Department of Physiotherapy, University of Medical Sciences
Smoluchowskiego Street 11/13
60-179 Poznań, Poland
e-mail: skorupska@ump.edu.pl
e-mail: paulina.wietrzak@gmail.com
https://orcid.org/00-0002-9448-6720

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Introduction

The dynamic development of pain medicine over recent years has led to some significant changes in the understanding of different types of pain pathomechanism. Currently, the classification and diagnosis based on the identification of the appropriate pain mechanism are promoted, which will hopefully lead to a significant improvement of treatment efficacy. There are three main pain descriptors: nociceptive pain, neuropathic pain, and nociplastic pain. The last term was introduced in 2016 to describe pain states caused by the activation of peripheral nociceptors despite no clear evidence of actual or threatened tissue damage or any disease or lesion of the somatosensory system (Kosek *et al.* 2016). As the research was progressing, the definition and understanding of two pain pathomechanisms known for years, namely neuropathic and nociceptive pain, was also changing. The feature differentiating these two types of pain is the somatosensory system function. Nociceptive pain is defined as pain due to stimulation of primary nociceptive nerve endings, whereas neuropathic pain is understood as the state associated with damage or dysfunction of the nervous system, including altered nociception. In the end, all the changes and the intensive development of the field resulted in recognizing the chronic pain to be a separate condition and in May 2019 it was included in the so-called ICD-11 classification (International Classification of Diseases).

Currently proposed methods of determining the dominating pathomechanism, out of the three mentioned above, in a patient/group of patients mainly include statistical methods of symptom analysis and some original questionnaires providing quantitative sensory testing (QST) that evaluate the somatosensory system function to complement the clinical assessment. Among paper questionnaires, the following two are recommended: the Pain Sensitivity Questionnaire (Ruscheweyh *et al.* 2009) and the Central Sensitization Inventory (Mayer *et al.* 2012; Neblett *et al.* 2013).

QST is the method of measurement of the sensory perception threshold in response to different external stimuli (mechanical, thermal, chemical, electrical) of controlled intensity, both increasing and decreasing. According to the consensus published by the International Association for the Study of Pain, QST has been recommended for the assessment of small and large fiber neuropathies, monitoring of the somatosensory system deficits and provoked pain, as well as for allodynia and hyperalgesia.

Different laboratory methods such as nerve conduction study, somatosensory evoked potentials, laser evoked potentials or intraepidermal nerve fibers assessment are also applied. Moreover, the importance of genetic and brain neuroimaging research has been indicated for a better understanding of mechanisms causing altered somatosensory system function.

It is crucial for physiotherapists to gain the knowledge and skills that would allow them to differentiate among the three mechanisms. The basic fact is that chronic neuropathic pain is outside of the competence of a physiotherapist and such a patient should be referred to a doctor. The other two mechanisms, i.e. nociceptive pain and nociplastic pain, require a completely different therapeutic approach. Nociceptive pain and applied physiotherapeutic strategies have been known for years and many studies and papers have been devoted to the topic. However, nociplastic pain is a newly introduced concept that requires a detailed discussion.

Nociplastic pain is a broad term that involves central sensitization (CS), which is defined as an excessive reaction of nociceptive neurons in the central nervous system to the afferent stimulus. The reaction occurs as a result of a dysfunction of endogenous pain control systems. While the dysfunction manifests itself in the neurons of the central nervous system, no functional abnormalities of its peripheral nerves occur. CS is initiated by short-term noxious peripheral stimulus

input of high intensity or long-term, continuous noxious stimulus input of low intensity. As a result, abnormal connections and activity between Aβ mechanoreceptors and C and Aδ fibers occur, as well as the extension of the pain area, allodynia or referred pain without any clear cause (secondary hyperalgesia). That is when clinicians can observe abnormally low peripheral thresholds for pain from pressure, temperature, electrical, and other stimuli (Woolf *et al.* 1991).

CS development is more probable for chronic pain states, especially among the group of patients showed in Table 1. However, it can be also observed in the acute stage, e.g. some data indicate that abnormal sensory processing can develop within the first 7 days after whiplash injury (Sterling *et al.* 2003).

Table 1. Diseases with confirmed central sensitization process.

Diseases with confirmed central sensitization process	
Typical for whole population	**Characteristic of some subpopulations**
fibromyalgia chronic fatigue syndrome irritable bowel syndrome	low back pain whiplash pelvic pain subacromial impingement syndrome persisting neck pain osteoarthritis rheumatoid arthritis tennis elbow pain shoulder pain tension-type headache migraine nonspecific arm pain patella tendinopathy

Aim

Patients and methods

The importance of the central sensitization process in physiotherapy

The biggest group of pain patients in physiotherapeutic practice are patients with musculoskeletal disorders (MSDs), who comprise around half of the general population experiencing pain (Hagen *et al.* 2000; Hagen *et al.* 1997; Murray *et al.* 2013). The prevalence of MSDs in Europe has been estimated at around 12–30%, most commonly in Poland, Norway, and Italy but also in UK, Spain, and Irland (Breivik *et al.* 2006). Further, the involvement of CS in musculoskeletal disorders has been estimated at around 30% (Nogueira *et al.* 2016). This indicates how much the knowledge about the central sensitization process is important for physiotherapists. A widely accepted approach assumes patient education about pain physiology in order to change illness perception, and thus reconceptualize pain. Modern manual therapy, e.g. joint manipulation, can provoke central analgesic effects. However, it is just for a short time (35 minutes maximum) (Sluka *et al.* 2006) and the use of such a therapy for CS has been questioned because it has been believed for years that CS is an irreversible process not modulated peripherally. Interestingly, in 2018, Harte *et al.* proposed two types of CS: 'top-down', where increased sensitivity to both painful and non-painful stimuli is observed, and 'bottom-up' – central pain mechanisms, traditionally referred to as central sensitization, where only pain processing might be augmented (Harte *et al.* 2018). This division has a huge impact on the choice of treatment because it is believed that the 'bottom-up' type can be modulated by therapy aimed at blocking the peripheral stimulus input, i.e. also by physiotherapy. This new idea supports the concept that myofascial pain can become a useful therapy for bottom-up central sensitization thereby for MSD, where CS is indicated as dominant pain process for some patients. However, it is not clear whether trigger points (TrPs), which are a typical feature of myofascial pain, are the expression or the promotor of CS. Both possibilities are equally

likely which reflects the idea of the two types of CS mentioned above (Fernández-de-las-Peñas C *et al.* 2014; Ge *et al.* 2006; Chiarotto *et al.* 2016).

Trigger points are defined as hyperirritable palpable nodules within skeletal muscle fibers. The term 'palpable nodule' should be understood as a limited number of fibers with an increased stiffness, also named 'taut band'. Other features characteristic of myofascial pain are referred pain as well as autonomic, motor, and somatosensory abnormalities. The basic TrPs classification distinguishes between the active and latent forms and the only differences between the forms is the occurrence for the active form of spontaneous daily pain, as well as the increased concentration of pain mediators such as H+, bradykinin, calcitonin gene-related peptide, substance P, TNF-α, IL-1, serotonin and norepinephrine.

There are two clinical features assumed to be an expression of CS: decreased pressure pain thresholds and the referred pain phenomenon, both indicate a dysfunction of the somatosensory nervous system. Both TrPs features of CS can manifest themselves in any part of the body, but the referred pain can present the case variability of the perceived size and intensity as regards Travell and Simons pain pattern (Travell and Simons 1983).

Different theories are assumed to explain the referred pain phenomenon. Srebely *et al.* tried to persuade that TrPs occurrence is a segmentary phenomenon that depends on the neurogenic mechanisms secondary to CS, which is in opposition to the theory of Travell and Simons who assumed non-segmental characteristic of that pain (Srbely *et al.* 2010). However, Hong *et al.* assumed the existence of 'TrPs circuits' (neuromeric fields), i.e. a neural network of 'TrPs related sensory nerves', resulting from the connection between nociceptors in a TrP region and a group of dorsal horn cells (sensory neurons) in the spinal cord (Hong and Braddom 2011).

Results

Conclusions

The current understanding of TrPs phenomenon is that they work as peripheral nociceptive input which can sensitize previously silent dorsal horn neurons. It is highly probable that in some cases with CS a therapy towards TrPs can provoke reversible pain process, which has been postulated some time ago (Giamberardino *et al.* 2007: Affaitati *et al.* 2011; Freeman *et al.* 2009) and induction of spinal inhibition (Srbely *et al.* 2008; Srbely *et al.* 2010; Arendt-Nielsen *et al.* 2000). Nevertheless, it is widely accepted that the TrPs presence is common in many chronic pain states and can facilitate and maintain sensitization of the central pathways, thus pain chronicity. All of this data indicate that in clinical practice TrPs should be deactivated as soon as possible in order to attenuate central sensitization and finally to avoid pain persistence.

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