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Editorial comment

Spatial summation of pain and its meaning to patients

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Neuro-physiologically, spatial summation occurs when subliminal inputs arising from multiple afferents induce action potentials in neurons. When applied to human pain physiology, this notion supports the observation that non-painful stimuli can induce pain when applied to larger body areas. Accordingly, painful stimuli that are applied to small areas become more painful when the stimulation area is enlarged. The likely pathophysiologic mechanism underlying spatial summation of pain is the convergence of low-intensity input from multiple afferents to common nociceptive pathways, ultimately eliciting a pain sensation after innocuous stimulation or amplifying pain after painful stimulation.

Spatial summation of pain has been extensively studied in human research using different experimental models. Most investigations have confirmed the aforementioned phenomenon of increasing pain sensation with increasing stimulation area [1–3]. Interestingly, while spatial summation is particularly strong with stimuli applied within the same dermatome [4], it occurs also when stimuli are applied to different and even contralateral dermatomes [5]. This suggests that spatial integration of nociceptive stimuli occurs not only at spinal cord level, but also at supraspinal centres.

The clinical significance of spatial summation is obvious. Nociceptive input from wide areas or multiple sources are more likely to lead to uncontrolled pain with all related consequences, including disability, mental health co-morbidities and more need for treatment, among others.

The notion of spatial summation is useful for both the health care provider and the patient. Both of them are interested in explanations on the nature of the symptoms. However, knowing this hardly satisfies the need to improve pain management. The next question is therefore: how to make use of this knowledge to improve patient-related outcomes?

The paper by Holbert et al., published in this issue of the *Scandinavian Journal of Pain*, is an attempt to better understand the role of spatial summation in the pathophysiology of specific pain syndromes [6]. The hypothesis was that spatial summation is more pronounced at the back, compared with other body regions, which would contribute to the higher prevalence of back pain. The hypothesis was not confirmed by the results, indicating that the back is not a particularly vulnerable region in terms of facilitation of spatial summation. Therefore, facilitated spatial summation is an improbable explanation for the high prevalence of back pain.

Translational studies on spatial summation are sparse. One open question is whether high degrees of spatial summation are associated with poor outcomes. Better prediction of outcomes may support clinical decision-making. For instance, one could hypothesize that the higher the spatial summation, the more likely the occurrence of persistent post-surgical pain. The literature on other biomarkers of nociceptive processes is equivocal [7], but studies have shown that facilitated temporal summation is a risk factor of persistent pain after knee surgery [8,9].

Spatial summation reflects central integration of nociceptive stimuli and is attenuated by ketamine [10]. Other centrally-active medications, such as antidepressants and anticonvulsants, have the potential to modulate spatial summation. Therefore, another area of potential research is whether the efficacy of these medications is correlated with the degree of spatial summation. This may allow more targeted treatments. In this regard, the concept of mechanism-based pain treatment has recently received much attention [11]. Unfortunately, also this research has not produced convincing results. Studies on the prediction of drug effects based on sensory phenotypes have not been consistent [12–15]. Whether spatial summation can contribute to better patient phenotyping for a more individualized pain treatment remains to be determined.

In conclusion, spatial summation of pain likely contributes to the magnitude of pain. Therefore, it has probable clinical relevance. So far, this remains "good to know". The challenge of future research is to determine whether this knowledge can be used to improve the life of patients with chronic pain.

Conflict of interest

None declared.

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