



Editorial comment

Preoperative quantitative sensory testing (QST) predicting postoperative pain: Image or mirage?

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In this issue of the *Scandinavian Journal of Pain*, Sangesland, and coworkers in a systematic literature review examine the value of preoperative quantitative sensory testing in predicting postoperative pain outcomes [1].

The authors are to be congratulated upon a diligent piece of work on a clinically important and relevant issue. Does preoperatively conducted quantitative sensory testing mirror the clinical endpoints pertaining to postoperative pain-related issues, i.e., pain-scores, the requirement of analgesics, or functional scores? An unsatisfactory acute postsurgical recovery may pave the way for severe persistent post-surgical pain – a peril to 2–10% of the surgical population [2].

The conclusion of the review is obviously disappointing, but hardly surprising, taking the heterogeneity in research methods regarding outcomes, characteristics of patient cohorts, surgical procedures and statistical methods into consideration. Nonetheless, it is of major value once in a while to meticulously and systematically, update and assemble data in a specific research field, using the “carrot and stick” modus operandi, inspiring and compelling researchers to improve and standardize their research methods. Furthermore, the review is well performed, extremely well-written, a good “read” and really, a “must” for all anesthesiologists and surgeons interested in prediction of post-surgical recovery trajectories [1].

1. Basics of quantitative sensory testing

Quantitative sensory testing is a well-known method assessing the psychophysical responses to graded sensory stimuli, e.g., chemical, electrical, mechanical, or thermal modalities, primarily in the skin [3]. However, a number of studies have also been performed in deep somatic and visceral tissues [4–6]. The quantitative sensory testing relies on assessment of perception, and thus apparently is subjected to inherent, confounding factors, like age, cognition,

comorbidities, gender, motivation, and, both modality- and tissue-specific constituents. The method is used in pre-clinical and clinical pharmacological and pathophysiological research, assessing detection thresholds, pain thresholds and response to suprathreshold stimuli. The subjective aspect of discrimination analysis has been mitigated, but not overcome, by use of nociceptive polysynaptic reflexes, e.g., the RIII-reflex or the blink-reflex, or the use of various neuroimaging procedures [7].

2. Variance in quantitative sensory testing data

To overcome and manage the considerable variance in quantitative sensory testing data, influential researchers in the German Research Network on Neuropathic Pain (DFNS) have propagated for the implementation of standardized guidelines and published an impressive array of normative data [8,9]. Furthermore, in recent years large-scale perioperative quantitative sensory testing studies with superior statistical effect sizes have been published [10–14], significantly contributing to a strengthened knowledge base in postoperative pain outcomes.

3. Preoperative testing paradigm

The preoperative quantitative sensory testing paradigm infers a potentially successful evaluation of the subject's propensity for neuroplasticity changes [15], ultimately predicting the postoperative recovery trajectory, regarding pain-scores, the requirement of analgesics and functional scores. Neuroplasticity is a term covering maladaptive and adaptive responses to tissue injury [16]. Maladaptive responses include the development of hyperalgesia, augmentation of the physiological stress responses, and increased pain due to central sensitization facilitated by a compromised descending pain modulation [17]. The ability to preoperatively test the nociceptive system's propensity for development of neuroplasticity changes depends on modality-specific variables, and, on the sensory stimulus intensity, duration, rate, and, application of dynamic or static test modes. Due to the importance of spinal and supra-spinal summation phenomena, repetitive stimuli delivered at suprathreshold intensities (higher than pain threshold limits),

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using large stimulation areas are promising for testing the propensity for neuroplasticity changes [15]. Conditioned pain modulation (CPM) is also a promising method. However, there is no consensus regarding test algorithm [18] and several test factors have been shown to influence the results [19–21].

4. Ambiguities

A preoperative stimulation paradigm with suprathreshold heat impulses has attracted some research attention [22]. In a meticulously well-planned study including patients undergoing groin hernia repair ($n=442$), predictive risk factors for the development of persistent post-surgical pain were examined [10]. Logistic regression analyses identified four significant risk factors: preoperative functional assessment scores, preoperative pain to tonic suprathreshold heat stimulation, one-month postoperative pain intensity, and six months sensory dysfunction in the surgical field. A prediction model including preoperative functional assessment scores, preoperative pain to heat stimulation and surgical technique (open vis-à-vis laparoscopic procedures) demonstrated an increased risk of development of persistent post-surgical pain. This study demonstrated that subject-related and surgical-related factors interdependently contribute to the risk of a negative postoperative pain outcome [10].

In contrast, a study of patients undergoing total knee arthroplasty ($n=92$) preoperative sensory testing with a short and a prolonged tonic suprathreshold heat stimulus were compared to pain intensities at postoperative Day 1–30, only modest correlations were demonstrated [11]. However, multivariate linear and logistic regression analyses did not support the predictive potential of quantitative sensory data, where only anxiety (HADS), pain catastrophizing behaviour (PCS) and preoperative pain were significant explanatory variables [11]. The putative superiority of self-reported data, e.g., pain scores and psychometric data, compared with quantitative sensory testing data is supported by a recent study examining the prevalence of nerve injury in persistent post-surgical pain [13].

5. Image or mirage?

The literature seems to support a correlation between preoperative testing of thermal and mechanical responses vis-à-vis postoperative pain outcomes: “Thermal heat pain above the pain threshold and temporal summation of pressure pain were the QST variables, which showed the most consistent association with acute or chronic pain after surgery” [1]. Preoperative quantitative sensory testing thus may render an image of the postoperative pain trajectory. However, the image is at best highly pixelated! *First*, regression analyses did not demonstrate any clinical significance in 11/30 studies, and 9/19 of the remaining studies the coefficient of determination (R^2) was ≤ 0.10 , indicating that the independent variable (QST-variable) could explain at most 10% of the variance of the dependent variable (clinical outcome). Good from far, but far from good. *Second*, the correlation probably depends on several issues like the surgical procedure tested, gender and sensory testing modality. *Third*, although a correlation between preoperative sensory testing data and postoperative pain outcomes are in the potential realm of research, a clinically relevant benefit from preoperative testing has hitherto not been demonstrated. Unless, preoperative sensory screening can translate to meaningful clinical changes in postoperative patient management, e.g., identifying individuals at risk for the development of severe acute or chronic post-surgical pain, quantitative sensory testing is at best wishful thinking: a mirage.

6. Conclusion

However, regardless of the preferred selection of term, either pixelated image or mirage, more evidence is needed delineating the clinical role of preoperative quantitative sensory testing. The postoperative recovery trajectory is a complex process affected by interactions of a number of factors, and sophisticated multivariate data analyses are indeed needed to investigate the potential mandate for quantitative sensory testing in predicting postoperative pain outcomes.

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