MEDASENSE
pain monitoring solutions

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Toward automatic pain monitoring: Method for classification of pain level based on statistical processing of multiple non-invasive physiological measures

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Introduction: One of the major difficulties in efficient pain care is assessing the perceived pain a patient is suffering from. Over the years researchers have reported on multiple physiological measures (e.g., blood pressure, heart rate, level of perspiration) that correlate, at least to some extent, with the pain level. Nevertheless, none of these measures alone can in fact reliably predict a patient's pain level, either in experimentally induced pain or in a clinical setting. The aim of the present study was to assess the performance of a method based on a combination of multiple pain-related physiological measures in predicting pain response to experimental heat pain stimuli.

Methods: Multiple physiological signals related to the autonomic nervous system, including electrocardiogram, galvanic skin response, finger photo-plethysmography, blood pressure, skin temperature, respiration, electroencephalography, and electromyography, were acquired in 36 (female 13; male 23) healthy subjects. Signals were recorded during the application of four 60-second conditions: non-painful heat (39°C), low pain and high pain stimuli (individually adjusted), and a stressful arithmetic mental task.

Results: Our data show that although some measures (e.g., heart rate) are significantly different between conditions (e.g., HR RM-Anova $p<0.001$; $F=8.39$), this correlation by itself is not sufficient to accurately predict the pain level (e.g., HR as a single linear pain predictor success rate 0.61 (95% CI 0.57–0.64)). On the other hand, a combination of multiple measures, including even those that are not significantly correlated with pain level, is capable of providing a powerful predictor of pain levels (success rate 0.83 (95% CI 0.8–0.86)).

Summary: This preliminary study demonstrates that a combination of multiple physiological pain-related measures with modern statistical methods is a promising direction of research toward reliable and automatic pain assessment and monitoring.