NeuroSensory Assessments of Migraine

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Introduction

Headache medicine has very few quantifiable biological markers for diagnosis. Sensitivity to potentially subjective aspects of pain is a hallmark of this disease and limits treatment decisions to the duration of treatment but do not offer a standard among various clinical populations. There is need to eliminate subjective quantification of pain and chronic pain in order to track improvements in treatments and pain levels on chronic outcomes.

Quantitative sensory testing was rapidly and non-invasively conducted via multi-site vibrotactile stimulation in patients with episodic and chronic migraines. Quantification of sensory discriminative ability was conducted under the hypothesis that centrally-mediated metrics remain effectively constant across a subject population provided that the somatosensory system is healthy. Within the migraine population, sensory metrics were expected to differ from healthy controls due to neurological dysfunction such as cortical hyper-sensitivities and impairment of habitation mechanisms in patients with migraine.

Methods

Fifty-two subjects ranging from 19 to 60 years of age (age: 45.4 ± 13.6, n = 52) were recruited with migraine (simple or chronic) were纳入入 this study. Because subjects were permitted to withdraw from sensory testing due to fatigue or pursuit of the battery, only 13 of patients completed all evaluations. All subjects were naïve to the study design and blinded to the issues under investigation.

Five categories of sensory evaluations were conducted:
1. Reaction Time: simple and choice
2. Sensory Adaptation: vibrotactile static and dynamic
3. Discriminative Metrics: with and without single-site adaptation
4. Temporal Order Judgment with and without single-site conditioning stimulation
5. Duration Discrimination with and without amplitude conditioning

Upon completion of the sensory neglect was performed in the form of multiple parameters of different populations yielded a better segregation of vulnerable populations. Utilizing Support Vector Machine (SVM), there is a higher success rate in identifying neurological dysfunction in various clinical populations.

Simple multi-parametric analysis shows a distinct segregation between migraineurs and healthy controls. Furthermore, separation among concussed subjects and migraineurs imply that these two clinical populations are also separable. Integrating multiple parameters via PCA demonstrates potential utility of the method for screening for neurological dysfunction in various patient populations.

Results

The results suggest that migraineurs not only reflect dysfunction in lateral inhibitory mechanisms through labile measures of amplitude discrimination, but they also failed to adapt to single-site conditioning stimulation. The measures of amplitude discrimination capacity has been shown to be a robust metric to identify and characterize chronic migraine. Simple multi-parametric analysis shows a distinct segregation between migraineurs and healthy controls. Furthermore, separation among concussed subjects and migraineurs imply that these two clinical populations are also separable. Integrating multiple parameters via PCA demonstrates potential utility of the method for screening for neurological dysfunction in various patient populations.

Conclusions

Although the neurological mechanisms involved in migraine are only partially understood, accumulating evidence suggests that functional and pharmacologic changes occur in the brains of migraineurs. Structural changes include subcortical white matter lesions, thalamic alterations, and a shift in the thalamocortical gray region. Functional alterations include focal areas of brain hypo-metabolism, cortical hyper-excitability, central sensitization, and dysregulation of thalamic gating to modulate sensory input. Previous studies also suggest involvement from pre- and post-synaptic mechanisms as well as glial interactions that may be associated with hyperexcitability and/or cortical spreading depression. Pharmacologic influences may produce paradoxical responses to opioids and changes to levels of cortical hyper-excitability. The presence of such alterations in brain pathways suggest a potential for a biologically-based assessment to quantify and measure these differences with scores that could be characterized, validated, and ranked over-time. The ultimate objective of this work is to develop methods that can improve diagnosis and enable more accurate assessments of migraine disease efficacy. Currently, there are no standardized methods or algorithms quantitative measures to test the impact that migraine has on cognitive function and processing, or the degree to which treatments are effective. The non-invasive techniques in this study have the potential to be utilized in a manner that could enable improves in diagnosis and assessments of treatment efficacy.

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References