CHRONIC SYMPATHETIC ACTIVATION IN MIGRAINE HEADACHE: UNIQUE TO MIGRAINE OR COMMON TO SYMPATHETIC NERVOUS SYSTEM DISORDERS?

Biofeedback Treatment Centre, Toronto & Whitby, Ontario, Canada


Background

Dysfunction in the autonomic nervous system has been implicated in migraine headache. Stress has been shown to be the most frequent trigger for migraine (Kelman, 2007). It has been proposed that chronic or excessive sympathetic nervous system (SNS) activation contributes to a migraine episode by rapidly depleting norepinephrine stores while at the same time increasing the release of dopamine, adenosine triphosphate, adenosine and prostaglandins (Peroutka, 2004). While evidence has been found suggesting parasympathetic system dysfunction (Sanya et al., 2004), there appears to be more evidence that migraine involves SNS dysfunction. Micieli et al. (1995) studied migraineurs between headaches and found that migraineurs' responses to a cold pressor test revealed an excessive SNS response compared to a non-migraine control group. Giving migraineurs Clonidine, a SNS pathways suppressant, prior to testing, normalized their response suggesting that excessive SNS activity is a significant factor in the production of migraine headache. Shechter et al. (2002) also showed autonomic nervous system abnormalities in migraineurs between headaches when compared to a non-headache control group. Muller and Marziniak (2005) compared middle cerebral artery flow velocity and blood pressure in migraineurs between headaches with a healthy control group and found a completely different pattern of responding in the migraineurs. They suggest that this can be interpreted as a lack of sympathetic and parasympathetic control of cerebral blood flow.

A recent Finnish study (Zaproudina et al., 2014) showed female migraineurs had significantly colder hands than healthy controls between headaches. Since hand skin temperature (HST) is an indirect measure of SNS outflow causing peripheral vasoconstriction and has been shown to be responsive to stress (Herborn et al., 2015; Vinkers, 2013), the Finish results do appear to provide evidence of chronic and/or excessive SNS activation in migraineurs.

Method

A routine audit of standardized clinical assessment data collected over several years during a 26 minute psychophysiological stress assessment revealed interesting results which shed light on this dilemma. To determine whether chronic and/or excessive SNS activation is unique to migraine or is a common feature of SNS disorders, peripheral skin temperature was recorded from 10 female migraineurs (MH) (age= 36.1) between headaches, 10 female subjects with debilitating muscle contraction headache (MCH) (age= 35.8) and 10 female panic disorder (PD) (age= 38.4) subjects during a 26 minute psychophysiological assessment. First 6 minutes = social stress (math). Remaining 20 minutes = attempted relaxation (listening to 20 min. pre-recorded autogenic style relaxation procedure). Mean or total activity were recorded for each minute for frontal muscle tension (sEMG), heart rate (HR), skin conductance (SC), peripheral hand skin temperature (HST) and respiration (RR). Subjects also completed a Modified Mood Adjective checklist (MMA) prior to the session. They also completed the Depression, Anxiety, and Stress Scale (DASS), the Anxiety Sensitivity Index (ASI) and the Fear Survey Schedule (FSS).

The MCH group was considered to be a control for the effects of having a chronic distressing headache disorder that is not considered to be an SNS disorder. The PD group was considered to be a control for the effects of having a chronic distressing non-headache disorder that is considered to be an SNS disorder. The PD and MCH groups did not report migraine headache. The MCH and MH groups didn't not meet the criteria for PD.

Repeated measures ANOVAs were used to examine group differences for the physiological measures and one-way ANOVAs were used for age, problem duration and the MMA, DASS, ASI and FSS. Duncan Multiple range and Tukey Post Hoc tests were used after a significant F test.
Results

One way ANOVA's showed no significant difference in age or test scores between groups except for the PD group who not surprisingly had significantly higher scores than the other two groups on the ASI and the anxiety subscale of the DASS.

![Figure 1](image)

A repeated measures ANOVA showed a significant difference between groups on HST $F(2,27)=9.02$, $p<.001$. The MCH group was in the normal range throughout the session. The MH group was below normal and were colder than the MCH group. The PD group was somewhat colder than the MH group and much colder than the MCH group. All differences were significant. There was no significant difference in HST responsiveness to the procedure (trials effect).

There was no significant difference between groups on HR, SCR, and RR. There was also no difference between tension and migraine groups on sEMG but the Panic disorders group was significantly higher than the other two.
All three groups showed an appropriate response to the math stressor (significant trials effect) on all measures (except HST) but there was no group x trials effect.

* Note: Specific statistical results available upon request.

Conclusions

The consistently low HST across the session for the MH group suggests chronic/excessive SNS arousal. However the same appears to be true for the PD group. Since the PD group did not have a history of migraine, the results suggest that chronic/excessive SNS arousal is likely a factor in migraine but by itself it is insufficient to explain migraine episodes.

Micieli et al. (1995) suggest that excessive arousal in the SNS interacts with intracerebral vasomotor instability in migraine. They demonstrated this instability in migraineurs with and without aura compared to control subjects using a 5 minute cold pressor test to provoke the SNS. The present study reinforces the requirement of an additional factor (e.g. intracerebral vasomotor instability) to interact with excessive/chronic SNS activation to produce migraine episodes. Presumably the panic disorder group in the present study lack this additional factor and as a result, they do not experience migraine despite maintaining excessive/chronic SNS arousal.

References


