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Sympathetic Nervous System Evaluation in Patients with Tension-Type Headache

Physiology

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ABSTRACT

Context: Tension type headache is a painful and common symptom and is one of the most frequent causes of consultation in both general practice and neurological clinics.
Objectives: The purpose of the study is to investigate the involvement of sympathetic nervous system in tension-type headache.
Methods: The evaluation was done by standard, bedside, non-invasive tests like orthostatic test, cold pressor test and sustained hand grip test.
Results: In the present study the basal heart rate was significantly decreased in tension type headache patients as compared to healthy controls. Also sympathetic function as evaluated by the cold pressor and sustained hand grip tests was found to be abnormal as compared to controls.
Conclusion: We conclude that sympathetic dysfunction was present in Tension type headache.

KEYWORDS:

Sympathetic nervous system, Orthostatic test, Cold pressor test, Sustained hand grip test.

Introduction

Tension type headache is the most common type of primary headache characterised by a predisposition to attacks of mild to moderate headache with few associated symptoms. Due to its varied postulated etiopathogenesis it is also known as psychomyogenic headache, muscle contraction headache, stress headache.[1,2] The International Classification of Headache Disorders, Second Edition classifies Tension Type Headache [TTH] as a form of primary headache with following features: bilateral pain, mild to moderate intensity lasting from 30 minutes to 7 days and has only one accompanying symptom e.g. nausea, vomiting, photophobia, phonophobia.[3]

Stress and mental tension are the most conspicuous precipitating factors in TTH.[4] Cardiovascular stress reactivity has been variously described as the magnitude of hemodynamic and emotional responses from baseline levels to acute mental or physical challenge tasks.[5] There is a lack of prospective studies evaluating sympathetic autonomic function in TTH. The present study is an attempt to evaluate the status of the sympathetic nervous system in TTH patients using reliable & well validated non-invasive, simple & reproducible cardiovascular reflex tests.

Materials and Methods

The study was conducted in a major Teaching Hospital and Medical College in Mumbai. All experimental procedures were approved by the ethics committee and subjects gave written informed consent prior to their participation. 50 consecutive diagnosed patients of TTH selected as per International Headache Society Diagnostic Criteria (age 20-50 years) and age and sex matched controls were evaluated in a quiet, temperature controlled room between 10 am to12 pm to avoid diurnal variations in autonomic function. Subjects were non-smokers, had no history of taking alcohol or tobacco products and with no personal or parental history of cardiovascular, respiratory or any other known systemic disease. They did not regularly consume large caffeine (< 350 mg / day).

Basal Parameters:

After reporting subjects were asked to relax for 15 minutes in supine posture and resting blood pressure (BP) and heart rate were recorded. The blood pressure was recorded from the right arm using a standard mercury sphygmomanometer.

Protocol of tests:

The sympathetic reactivity was assessed by the following battery of tests:

Orthostatic Test:

Procedure: The blood pressure cuff was tied to the arm and kept inflated and the sphygmomanometer was held at heart level. With this arrangement, the subject was asked to attain standing posture in 3 seconds from the supine position and was instructed to remain motionless for two minutes. The subject's blood pressure was recorded when lying down quietly and again when subject stands. Fluctuations of blood pressure are assessed based on somewhat later responses to standing and they are expressed as the difference between the baseline supine and the minimal blood pressure after standing up.[6]

Cold Pressor Test:

Procedure: The cold pressor test was originally described by Hines and Brown in 1930.The subject was made to immerse one hand in ice water at 40 C for one minute. The blood pressure response was measured in the opposite arm at the end of 1 minute.[7]

Hand Grip Test:

Procedure: A hand grip dynamometer was used for this test. The subject was asked to use the maximum voluntary effort (maximum voluntary - MVC) and press the hand grip dynamometer. The reading of the handgrip dynamometer was noted. Then the subject was asked to maintain the handgrip at level of 30% of maximum effort for 5 minutes. The rise in blood pressure was measured.[6]

The reference values of Ewing and Clark were used for interpretation of tests.[6]

Statistical analysis: Each parameter was tested for distribution of data. The data was entered into MS-Excel work sheet and statistical analysis was done by using SPSS software version 20.0. Descriptive statistics i.e. mean and standard deviation was used for numerical data. Comparison of numerical variables among various groups was done by using unpaired t-test. The level of significance was set at 5%. All p-value < 0.05 was considered as statistically significant.

Results:

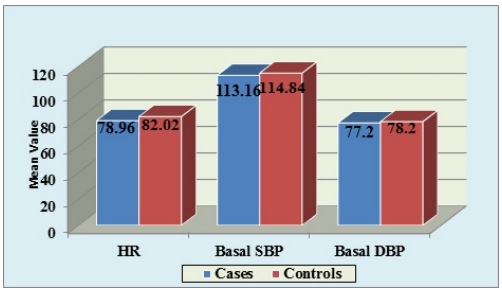
Sixty-five patients of TTH were referred from the neurology department for recruitment in the study over duration of 14 months (from July 2013 to September 2014). Only 50 patients were selected after exclusion and consent. The diagnosis of TTH was confirmed in the laboratory as per criteria laid by the American Academy of Neurology (1996). Fifty age matched and sex matched healthy subjects were recruited for the study as controls.

Basal Parameters:

Tests for normality of distribution found normal distribution for age and sex parameters between TTH patients and controls. The basal heart rate was significantly decreased in TTH patients (78.96 ± 7.225) as compared to healthy controls (82.02±7.731). No statistically significant difference was found between mean systolic BP of TTH patients (113.16± 6.41) and controls (114.84± 5.80). Also mean

diastolic BP of TTH cases (77.20±5.34) was not significantly different from that in controls (78.20±5.27). [Graph 1]

Graph 1: Comparison of basal parameters in cases and controls



The results of all the tests in each subject were classified as normal, borderline or abnormal (Table 1).

Table 1: Comparison of percentage of sympathetic autonomic function tests showing normal, borderline and abnormal results.

Test		Normal	Borderline	Abnormal
Orthostatic Test	n	50	0	0
	%	100.0%	0.0%	0.0%
Cold Pressor Test	n	26	-	24
	%	52.0%	-	28.0%
Sustained Hand Grip Test	n	11	17	22
	%	22.0%	34.0%	44.0%

Cold pressor test was found to be abnormal in 24 patients while sustained hand grip test was borderline in 34% patients and abnormal in 22 TTH patients. A significant difference was found between cases and controls for cold pressor and sustained hand grip test (Table 2).

Table 2: Comparison of sympathetic function tests in cases and controls.

	Cases	Control	P value	Significance
Orthostatic Test	5.64 ± 2.96	5.56 ± 3.05	0.894	Not Significant
Cold Pressor Test	11.16 ± 4.37	16.24 ± 3.09	0.000	Significant
Sustained Hand Grip Test	11.12 ± 4.52	16.24 ± 3.09	0.000	Significant

Discussion

In the present study, a relatively large group of well defined patients with TTH was investigated using the standard cardiovascular autonomic function tests for sympathetic involvement. The basal heart rate was significantly decreased in TTH patients as compared to controls. Similar findings were reported by Deniz Yerdelen et al. who found that resting heart rate in patients with episodic TTH was significantly lower than that of controls.8 Variations in heart rate at rest are mediated by the combined effects of cardiac vagal and sympathetic nerves acting on the sino-atrial node. Hence lower resting heart rate would be suggestive of sympathetic dysfunction in TTH.

Several mechanisms have been hypothesized in the etiopathogenesis of TTH. Muscular factors are considered to be of importance in pathophysiology of TTH. A common symptom in patients with TTH is increased tenderness of pericranial myofascial tissue also known as 'myofascial pain'. [9] In addition, TTH is associated with referred pain caused by active trigger points (TrPs) in the head, neck and shoulder muscles.[10] Epidemiological studies have also suggested an increased genetic predisposition in chronic TTH in general population.[11]

Stress can increase sensitivity to pain and lower the pain threshold in sensory receptors, making individuals more prone to headache pain and intensity. Chronic stress is responsible to increase pain sensitivity in both headache sufferers and healthy controls.[12] Gannon LR. et al and Haynes SN. et al have done series of experimental studies and demonstrated that tension type-like headaches can be induced by psychological stress.[13,14] Previous studies have postulated that prolonged autonomic responses to a stressor may cause disease or other subjective symptoms.[15]

Sympathetic nervous system involvement in TTH has been demonstrated by limited clinical and laboratory tests. Pupillary sympathetic hypofunction and subtle anisocoria was detected by physiologic pupillary tests evaluation in muscle contraction headache.[16] Serum dopamine-beta-hydroxylase activity which is an index of peripheral sympathetic was significantly lower in TTH patients as compared to controls.[17] Pogacnick T. et al. did not find significant findings using orthostatic test while significant changes for rise in blood pressure using sustained hand grip test have been reported.[18] This also co-relates well with similar findings in our study.

The present study was initiated due to the apparent paucity of studies investigating sympathetic limb of autonomic nervous system in TTH. Our findings confirm sympathetic dysfunction in TTH patients. However further studies in a larger population would be required to corroborate our findings.

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