

Can GSR be Used as a Tool to Early Diagnose the Autonomic Dysfunction among GAD Patients

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Abstract

Background: 14% of global disease burden goes to anxiety. Generalised anxiety disorder is one of the manifestations of anxiety. There has been many studies correlating the association of generalised anxiety disorder with cardiovascular mortality and morbidity. This contribution has been attributed to imbalance in parasympathetic and sympathetic stems of autonomic nervous system. This imbalance in autonomic activity can be measured by many invasive & non invasive methods.

Material and Method: The present study was conducted on 60 subjects which were divided into 2 groups of 30 patients of generalised anxiety disorder and 30 age and sex matched normal subjects as control. Both groups were further subdivided based on gender with 15 subjects each. Basal galvanic skin response was recorded in all subjects and comparison was done among patients and controls.

Result: Basal galvanic skin response was decreased in both male and female generalised anxiety disorder patients when compared with controls. The difference was statistically non significant.

Conclusion: Basal galvanic skin response can not be used as an early diagnostic tool of autonomic dysfunction in generalised anxiety disorder.

Keywords: *Generalised Anxiety Disorder, Galvanic Skin Response, Autonomic Cardiac Function.*

Introduction

Several mechanisms such as poor health habits like smoking, poor diet, sedentary life style etc associated with negative emotions – anxiety, anger and depression have been stamped as the reason for increased coronary heart disease but the main culprit seems to be potential direct effect of the negative emotions on progression

of atherosclerosis as well as lowering the threshold for ventricular arrhythmia and sudden cardiac death¹. Credit of 14% of global disease burden goes to mental health disorders. Out of these anxiety contributes 4.7%^{2,3}. Anxiety disorders have been associated with increased risk of cardiovascular morbidity and mortality. Several studies have predicted the increased risk of CHD in patients with phobic anxiety or panic disorders³. One of the health professionals follow-up study found increased risk of sudden CHD death rather than nonsudden. One of the hypothesis predicts this association as a dysregulation of autonomic nervous system control activity⁴⁻⁶.

Populations exposed to traumatic events have higher prevalence of major depressive disorder (MDD)

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and generalised anxiety disorder (GAD). MDD and GAD are highly morbid psychiatric disorders. MDD has been associated with increased mortality mainly due to CHD⁷. Other manifestations of anxiety have been linked with increased CVD mortality^{8,9}. Anxiety has also been linked up with some chronic diseases like diabetes, hypertension and hypercholesterolemia³.

Possible mechanisms for the association of anxiety with CVD include changes in autonomic tone manifested as decreased vagal and increased sympathetic tone³. High level of anxiety has been associated with reduced heart rate variability (HRV). This reduced HRV predicts sudden cardiac death (SCD) in elderly and heart failure patients¹⁰. Increased incidence of SCD in population exposed to traumatic events has been implicated to increased sympathetic nervous system activity¹¹.

There has been many studies showing reduced HRV predicting the severity of association of cardiovascular morbidity with GAD. But there are no or very minimal studies which has used galvanic skin response as a predictor of association of GAD with cardiovascular mortality & morbidity.

Galvanic Skin Response: Galvanic Skin Response (GSR) is a type of an electrodermal response that represents a change in the electrical conductivity of the skin caused by an increase in activity of sweat glands. GSR measures skin conductivity from the fingers or palms. It is affected in an anxious person because of increased sympathetic activity¹². The activity of sweat glands in response to sympathetic nervous stimulation results in increase in conductance. Fowler et al have recommended that recordings can be taken from electrodes placed on the middle or distal phalanges of two fingers (either index and middle finger or index finger and thumb) or on the thenar and hypothenar eminences of palmar surface¹³.

Sympathetic activity and emotional arousal has a strong association. Tonic skin conductance changes with psychological arousal. It increases sharply when the subject wakes up and it is increased further with activity, mental effort and especially in stress. GSR is an automatic response under so much control of cerebral cortex that it can be considered an indication of emotional status of the subject¹⁴.

GSR is the measure of the skin resistance to very small electric current passage. Meditation and relaxation procedures lead to a increase in skin resistance. High and

low skin resistance has direct association with relaxation and stress respectively. High resistance depicts a relaxed state of mind and low resistance means tension. But in psychotherapy session it is exactly opposite. Whenever repressed material comes to surface as in guilt or pain, the skin resistance will increase. In therapy session high skin resistance indicates tension. Suppressed emotions leads to building up of stuck energy in mind. When such emotions are restimulated by past events as in the case of generalized anxiety disorder, there will be increase in basal resistance. The wave like increase in skin conductance is known as Phasic skin conductance¹⁵. Cardiac automaticity is intrinsic to various pacemaker tissues but heart rate and rhythm is mainly under the control of autonomic nervous system. Parasympathetic influence on heart is by vagus nerve via acetylcholine release. Sympathetic effect on heart is by release of epinephrine and nor epinephrine. Under resting conditions, vagal tone is the main regulator of variations in heart rate¹⁶.

Most organs of our body has dual innervations from sympathetic and parasympathetic stems of autonomic nervous system, often mediating opposite effects. The relative balance between sympathetic and parasympathetic nervous system is regulated by afferent input directed primarily to the brain¹⁷. Fine spray type of nerve endings in carotid sinus and aortic arch, as the arterial baroreceptors, are the major contributors in regulation of blood pressure and heart rate. On stretching baroreceptors get stretched and send signals are from carotid sinus through glossopharyngeal nerve and from aortic arch through vagus nerve to the nucleus tractus solitarius in the medulla oblongata. From medulla, signals are sent to two centers- Inhibitory to vasomotor center and excitatory to the vagal center. Effects of stimulation of baroreceptors results in vasodilatation and decrease in heart rate. And this effect decreases the blood pressure by reducing peripheral resistance and cardiac output¹⁸.

Increased blood pressure results in reflex slowing of the heart via baroreceptor reflex. Increase in heart rate in response to lowering blood pressure results from decreased vagal inhibition and increased sympathetic activity. The vagal effects are immediate one but the sympathetic effects are delayed until several seconds. Pressure fall results in "Unloading" of arterial baroreceptors and reduced inhibitory influences on nucleus tractus solitarius and vasomotor center in medulla, resulting in increased sympathetic

and decreased parasympathetic tone, which produces vasoconstriction, increased cardiac contractility and increased heart rate.

Multiple ailments have their effect on autonomic nervous system. Impaired autonomic functions may be caused by diseases affecting either the CNS or peripheral autonomic nervous system. Various chronic disorders also have their effects on autonomic nervous system. Several studies have documented increased incidence of morbidity and mortality in patients suffering from various chronic disorders with autonomic irregularity¹⁹.

Assessment of autonomic activity-Tests of autonomic functions have been proposed, formulated and standardized by various workers. These tests are broadly divided into two categories:

Invasive Tests: Intraneural recording of postganglionic sympathetic activity, Response of autonomic nervous system to infusion of pressor agents, Plasma catecholamine levels estimation.

Non-Invasive Tests: Basal heart rate variability, Postural challenge tests (Head Up Tilt testing), Valsalva manoeuvre, Sustained handgrip test, Cold pressor test, Pseudomotor (sweating) function test.

A combination of these tests are generally employed in assessment of autonomic nervous system as some of these tests give information about the cardiac sympathetic functions whereas others give information about the cardiac parasympathetic functions²⁰. Out of all these parameter, we included pseudomotor function test in the form of galvanic skin response in our study.

Material and Method

The present study was conducted in Department of Physiology in collaboration with Department of Psychiatry, Pt. B. D. Sharma University of Health Sciences, Rohtak. The study was carried out on 60 patients of Generalised Anxiety Disorder (GAD) of 18-45 years of age of either sex. The normal age and sex matched subjects were selected from our staff members, medical students and healthy attendants accompanying the patients to the institute. The subjects and patients were divided into the following two groups:

Group I (60 in number) included normal healthy subjects. This group was further divided into two subgroups based on gender (30 each):

Group I_A- 30 male healthy subjects.

Group I_B- 30 female healthy subjects.

Group II(60 in number) included GAD patients diagnosed as per ICD-10 guidelines with Hamilton Anxiety Scale score of 28 (i.e. moderate anxiety), further divided into two subgroups based on gender (30 each):

Group II_A- 30 male GAD patients.

Group II_B- 30 female GAD patients.

Exclusion Criteria: The patients with the history of any other major illness (like diabetes, hypertension, myocardial infarction and hyperthyroidism) in the previous one year & history of drug intake for any other ailments in last one month were excluded.

Tests Conducted: In each individual basal GSR was recorded.

Recording of GSR was done by digitalised polygraph (POLYRITE D system, supplied by RMS India PVT. Ltd. Chandigarh). Individual customization of data was done after acquiring.

The following recommendations were followed to make the results reliable and interpretable.

Sampling Rate: The sampling rate in our machine was 256 Hz.

Filters: The machine was provided with different filters. Appropriate filters were chosen for GSR since the baseline shifting may affect the spectrum analysis.

High Filter- 2 Hz

Low Filter- 0.05 Hz

Sensitivity: Sensitivity knob was set on moderate high sensitivity (50 μ V).

Sweep speed: The screen speed was 30 mm/sec.

Preliminary Preparation: The subjects were informed about the whole procedure in detail in their own language to allay any fear or apprehension. Consent was taken from every individual to undergo the whole procedure. All the experiments were conducted in a particular time period (from 10 AM to 1 PM) to avoid the diurnal variations.

Procedure: All the subjects and patients were tested under similar laboratory conditions. They were allowed

to get familiar with the experimental and environmental conditions of the laboratory to allay any apprehension. After performing physical examination they were asked to lie down in supine position on wooden table. For recording GSR, two copper lined electrodes were attached on the palmar aspect of distal digit of the thumb and index finger of right hand after applying the conduction jelly. Then basal recording of GSR was taken for 5 minutes.

Statistical analysis of data: For interpretation of the results the data set of each group was analysed statistically. Basal GSR of Group I (normal healthy subjects) were compared with Group II (Patients of GAD) by unpaired student t test. The comparison was done among subgroups IA & IIA and IB & IIB. Significance of result was predicted based on the p value.

Result

We observed the following result:

Table I: Basal GSR among Normal Healthy Males (Group IA) and Male GAD Patients (Group IIA)

Parameter	Group IA (Mean ± SD)	Group IIA (Mean ± SD)	P Value
GSR (μ Mho)	2.135 ± 2.242	1.813 ± 1.959	0.555

Table I shows decrease in GSR among group IIA in comparison to group IA. The difference is statistically not significant.

Table II: Basal GSR of Normal Healthy Female (Group IB) and Female GAD Patients (Group IIB)

Parameter	Group IB (Mean ± SD)	Group IIB (Mean ± SD)	P Value
GSR (μ Mho)	2.390 ± 2.230	2.071 ± 1.555	0.523

Table II shows decrease in GSR among group IIB in comparison to group IB. The difference is statistically not significant.

Discussion

Manifestations of Anxiety have been associated with cardiovascular morbidity due to autonomic nervous system disturbance. It has been observed that longstanding anxiety markedly increases the risk of heart attack. The role of anxiety in hiking heart attack also goes beyond the effects of depression, anger, obesity, type A behaviour and other negative emotions²¹. Autonomic Nervous System plays major role in determining heart rate, stroke volume and peripheral vascular resistance to meet the appropriate requirement of body. Numerous studies have demonstrated the increased sympathetic and decreased parasympathetic nervous system activity hikes the risk of cardiovascular mortality and morbidity²¹.

Present study was carried out to assess and clinically evaluate autonomic functions by recording of basal GSR. This study was conducted on 60 patients of GAD and, age and sex matched 60 controls. They are divided

into two groups. Group I comprised of 60 controls who are further divided into two subgroups based on gender (IA comprised of 30 male controls and IB of 30 female controls). Group II comprised of 60 GAD patients who are further divided into two subgroups based on gender (IIA comprised of 30 male patients and IIB of 30 female patients).

As shown in the results in table I, there is decrease in GSR among group IIA (1.813 ± 1.959) in comparison to group IA (2.135 ± 2.242). This decrease in GSR among male GAD patients as compared to the male normal subjects indicates the decreased parasympathetic tone or increased basal sympathetic activity among GAD patients. Table II shows decreased GSR in group IIB (2.071 ± 1.555) as compared to group IB (2.390 ± 2.230). Similar to the results in group I, this also shows decrease of GSR in female GAD patients in comparison to normal female subjects.

Our study shows decreased GSR among both male and female GAD patients in comparison to their respective normal subjects. This shows that GAD either decreases the basal level of parasympathetic tone increases the basal sympathetic tone among the affected persons. But in both the scenario the difference is statistically insignificant.

Conclusion

We concluded that though there is decrease in galvanic skin response among generalised anxiety disorder patients but statistically non-significant result does not warrant its use as an indicator for early diagnosis of autonomic dysfunction. Before coming to the final concrete conclusion there need to be done further research.

Ethical Clearance: Taken from PGIMS, Rohtak Institute Ethical Committee (IEC)

Source of Funding: Self

Conflict of Interest: Nil

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