Sympathetic skin response test in essential hypertensive patients

<u>Thesis</u>

Submitted in the partial fulfillment of the master degree in clinical Neurophysiology

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Abstract

Background: Essential hypertension is the most prevalent hypertension type affecting 90-95% of hypertensive patients. Although no direct cause has identified itself, but there are many factors such as sympathetic nervous system over activity.

Objectives: To Study the predictive value of sympathetic skin response (SSR) test to detect the role of sympathetic over activity in essential hypertensive patients.

Methods: The study was conducted on 30 essential hypertensive patients and 15 normal controls of similar age and sex. Through history taking, neurological and cardiological examination and neurophysiological technique (SSR) test were done to both groups.

Results: No statistically significant difference between both controls and patients groups regarding the upper and lower limbs latency or amplitude of the (SSR) test.

Conclusion: We conclude that the SSR test had a low diagnostic value in essential hypertensive patients. As if the sympathetic over activity is involved in pathogenesis of these patients, this leads to alteration in arterial baroceptors sensitivity to blood pressure changes which affect the blood vessels of muscle and relatively sparing the skin blood vessels.

Recommendation: Several electrophysiological techniques providing evidence that sympathetic over activity is present in patients with essential hypertension should be done such as muscle sympathetic nerve activity, plasma noradrenalin measurement and baroceptors sensitivity assessment.

Key words:

Essential hypertension.

Sympathetic skin response test (SSR).

Sympathetic over activity.

Arterial baroceptors.

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LIST OF ABBREVIATIONS

ABP	Arterial blood pressure
ANS	Autonomic nervous system
BAT	Baroreflex activition therapy
BRS	Barorelex sensitivity
CNS	Central nervous system
CVP	Central venous pressure
DHPG	Dihydroxyphenylglycol
DOPAC	Dihydroxyphenylacetic acid
ECG	Electrocardiogram
EMG	Electromyogram
HR	Heart rate
HRV	Heart rate variability
HTN	Hypertension
MIBG	Metaiodobenzylguanidine
nTS	Nucleus of solitary tract
PNS	Peripheral nervous system
QSART	Quantitative sudomotor axon reflex test
REM	Rapid eye movement
SA node	Sinoatrial node
SD	Standard deviation
SNS	Sympathetic nervous system
SPECT	Single photon emission computed tomography
SSR	Sympathetic skin response
TPR	Total peripheral resistant
TST	Thermoregulatory sweat test

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INTRODUCTION

The human internal environment is regulated in large measure by the integrated activity of the autonomic nervous system and endocrine glands. The autonomic nervous system is the part of the nervous system concerned with the innervations of involuntary unstriated muscles and many of the secretory glands ***(Guyton and Hall, 2006).***

Autonomic function can be evaluated by a large number of tests, both invasive and non-invasive. Non –invasive tests may be used to confirm a clinical diagnosis of autonomic neuropathy and assess the relative involvement of sympathetic and parasympathetic pathways. To localize the site of the lesion more precisely, complex and often investigations may be required ***(Aminoff, 2005)***.

The sympathetic skin response (SSR) is a polysynaptic reflex generated in deep layers of the skin by activation of sweat glands via sudomotor sympathetic efferent fibers ***(Claus and Schordorf., 1999)***.

The efferent part of the SSR reflex arch consists of mylinated sympathetic fibers of neurons from intermediolateral nucleus in thoraco-lumber(T1-L2) part of the spinal cord that terminate in paravertebral sympathetic ganglia. Post ganglionic fibers are unmylinated (type c)fibers and innervate the eccrine sweat glands. The central part of the reflex arch is not fully understood. It is presumably polysynaptic with a connection to the structures of hypothalamus, ventrolateral part of the brain stem, medial and basal parts of the frontal lobe and medial part of the temporal lobe ***(Linden and Berlitl.,1995).***

Essential hypertension is the most prevalent hypertension type, affecting 90-95% of hypertensive patients ***(Caretero and Oparil,2000).***

Although no direct cause has identified itself, there are many factors such as sympathetic nervous system over activity **(*Takahshi, 2008).***

The autonomic nervous system plays a central role in maintaining the cardiovascular homeostasis via pressure, volume, and chemoreceptor signals. Done by altering peripheral vasculature and kidneys, causing increased cardiac output, increased vascular resistance, and fluid retention. Disorder of the system, as in case of sympathetic nervous system over activity, increases blood pressure and contributes to the development and maintenance of hypertension ***(Takahashi, 2008).***

The primary recognized role of the sympathetic nervous system in cardiovascular control is the maintenance of blood pressure and the regulation of blood flow for seconds to minutes via the arterial baroreflex (short term regulation). However, this view of the sympathetic nervous system is evolving as new evidence emerges about its additional role in the long-term regulation of blood pressure ***(Joyner et al, 2008)***.

The mechanisms of increased sympathetic nervous system activity in hypertension are complex and involve alterations in baroreflex pathways at both peripheral and central levels. Arterial baroceptors are reset to a higher pressure in hypertensive patients and this peripheral resetting reverts to normal when arterial pressure normalize ***(Joyner et al, 2008)***.

AIM OF THE WORK

To study the value of sympathetic skin response test in already diagnosed patients with essential hypertension hoping for better understanding of sympathetic neural mechanism in cardiovascular disease and ultimately lead to remarkable improvements in clinical managements.

AUTONOMIC NERVOUS SYSTEM

The human nervous system is divided into the central nervous system (CNS), comprising the brain and spinal cord, and the peripheral nervous system (PNS), consisting of all the nerves and neurons that reside or extend outside the central nervous system, such as to serve the limbs and organs ***(Sherwood,2008).***

The peripheral nervous system, in turn, is commonly divided into two subsystems, the somatic nervous system and the autonomic nervous system ***(Sherwood, 2008).***

The autonomic nervous system (ANS) is that part of the peripheral nervous system(PNS) that largely acts independent of conscious control (involuntarily) and consists of nerves in cardiac muscle, smooth muscle, and exocrine and endocrine glands. It is responsible for maintenance functions (metabolism, cardiovascular activity, temperature regulation, digestion) that have a reputation for being outside of conscious control. The other main subdivision of the peripheral nervous system, the somatic nervous system**,** consists of cranial and spinal nerves that innervate skeletal muscle tissue and are more under voluntary control (Figure 1**)** ***(Sherwood, 2008).***

The autonomic nervous system is typically divided into two main subsystems, the sympathetic nervous system and the parasympathetic nervous system. These tend to balance each other, offering opposite and yet complementary effects .The sympathetic nervous system deals with the response to stress and danger, releasing epinephrines (adrenaline), and in general increasing activity and metabolic rate(fight or flight reaction). The parasympathetic nervous system counters this, and is central during rest, sleeping, and digesting food and, in general, lowers metabolic rate, slows activity, and restores blood pressure and resting heartbeat, and so forth ***(Furness, 2006).***

A third subsystem, the enteric nervous system**,** is classified as a division of the autonomic nervous system as well. This subsystem has nerves around the intestines, pancreas, and gall bladder. In terms of numbers of neurons, the enteric is the largest autonomic division. In humans, it contains 200–600 million neurons ***(Furness, 2006).***

<u>Sensory and motor neurons</u>

Neurons active in the autonomic nervous system (and the PNS in general) can be divided into sensory neurons and motor neuron. A more comprehensive definition is that the reflex arcs of the ANS comprises both a sensory (or afferent) arm, and a motor (or efferent, or effector) arm ***(Guyton and Hall, 2006).***

<u>Sensory neurons</u>

The sensory arm is made of "primary visceral sensory neurons" found in the peripheral nervous system (PNS) and in "cranial sensory ganglia:" the geniculate, petrosal, and nodose ganglia, appended respectively to cranial nerves VII, IX, and X. Primary sensory neuron project (synapse) onto "second order" or relay in the medulla oblongata, forming the nucleus of the solitary tract (nTS), which integrates all visceral information ***(Fox, 2006).***

<u>Motor neurons</u>

Motor neurons of the ANS are also located in ganglia of the PNS, called "autonomic ganglia ***(Furness, 2006)***.

Figure (1) Organization of Somatic and Autonomic Nervous System Neurons

(*a*) The cell body of the somatic neuron is in the CNS, and its axon extends to the skeletal muscle.

(*b*) The cell body of the preganglionic neuron is in the CNS, and its axon extends to the autonomic ganglion and synapses with the postganglionic neuron. The postganglionic neuron extends to and synapses with its effector organ ***(Seeley et al ., 2004).***