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Hypertension treatment for covid-19 vaccination

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Abstract

The objective of this study is to investigated the simplest treatment of reducing blood pressure or hypertension (HTN) for covid-19 vaccination by maximizing parasympathetic nervous system (PNS) and lowering sympathetic nervous system (SNS). We involved 250 people who were vaccinated against COVID-19 from Bangpo hospital in Bangkok, Thailand. We conducted 2 parts data collection. First is for the blood pressure measurement for group1 people who have high blood pressure (systolic BP level ≥ 160 mmHg or diastolic BP level ≥ 100 mmHg) and took a rest with slow, deep breath for 15 minutes. Second the blood pressure measurement for group 2 people who have high blood pressure (systolic BP level ≥ 160 mmHg or diastolic BP level ≥ 100 mmHg) and took a rest with slow, deep breath for 15 minutes but remained high so they had to sleep and rest for a further 15 minutes. Both resulted in variety of interest findings.

Keywords: Hypertension", "Covid-19 vaccination", "Sympathetic Nervous System

INTRODUCTION

In this literature review, we will investigate the treatment to lower blood pressure of people who are willing to get vaccinated but have HTN by reducing the SNS. Due to the covid-19 pandemic people are willing to get vaccinated, but because of HTN it may cause several risk factors if vaccinated. HTN is a common health problem worldwide due to its high prevalence around the world and is defined as abnormally high arterial blood pressure (1), it causes around 7.5 million deaths or 12.8% of the total of all deaths worldwide (2). HTN is defined as abnormally high arterial blood pressure, according to the Joint National Committee 7 (JNC7), normal blood pressure is a systolic BP < 120 mmHg and diastolic BP < 80 mm Hg. HTN is defined as systolic BP level of ≥140 mmHg and/or diastolic BP level ≥ 90 mmHg (1). The grey area falling between 120–139 mmHg systolic BP and 80–89 mmHg diastolic BP is defined as "prehypertension" which significantly increase over the last years (3), it is not categorized as a disease but are known to be at high risk developing HTN. (4)

HTN or the "Silent Killer" is the most common major risk factor for cardiovascular disease (CVD) including coronary heart disease, stroke, myocardial infection, atrial fibrillation and peripheral artery disease, chronic disease (CKD) and cognitive impairment. It is a silent killer as very rarely any symptom can be seen in its early stages until a severe medical crisis takes place and there are several factors predisposing to HTN (5-6). HTN is grouped in to two main categories, these include primary and secondary HTN. Primary HTN causes are not yet known unless it is secondary high blood pressure, factors such as aging, excessive salt intake, stress, as well as genetic factors associated with the occurrence (7). Another major factor is the ANS and its sympathetic arm play important roles in the regulation of blood pressure (8) which we will focus in this systematic literature review.

Methodology

In order to gather sufficient information to analyze, electronic searches of PubMed and Google scholar were conducted to identify observational studies of

HTN using the medical subject headings "hypertension," "blood pressure," "treatment", "sympathetic nervous system" and "cardiovascular risk factors", we included only studies that were conducted within the past 10 years and limited to articles published in English.

Furthermore, study data of total 247 people's blood pressure before Covid-19 vaccination are also collected at Bangpo hospital in Bangkok, Thailand. People should have systolic BP level of ≤160 mmHg and/or diastolic BP level ≤100 mmHg to be able to vaccinate, people with blood pressure higher than stated will have to perform HTN treatment.

Results

Table 1 Shows a total of 250 people who were vaccinated against COVID-19.

They were divided into 107 men (43%) and 140 women (57%).

Total	247 people	100%
Men	107 people	43%
Women	140 people	57%

Table 2 Shows the blood pressure measurement of people who have high blood pressure (systolic BP level ≥ 160 mmHg or diastolic BP level ≥ 100 mmHg) from the above sample group.

They were 28 people with high blood pressure, representing 15% of the total sample.

They were divided into 13 men (5%) and 25 women (10%) of the total sample.

Total	38 people	15%
Men	13 people	5%
Women	25 people	10%

Table 3 Shows the blood pressure measurement for group1 people who have high blood pressure (systolic BP level ≥ 160 mmHg or diastolic BP level ≥ 100 mmHg) and took a rest with slow, deep breath for 15 minutes

Number of people	Gender	Age	Weight (Kg)	Height (Cm)	1st blood pressure measurement		2nd blood pressure measurement after resting for 15 minutes	
					Systolic pressure	Diastolic pressure	Systolic pressure	Diastolic pressure

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1	Male	55	70	60	171	108	152	92
2	Male	84	60	165	161	77	152	79
3	Male	44	127	178	184	89	155	88
4	Male	70	75	172	182	98	150	83
5	Male	72	60	170	164	93	153	98
6	Male	70	66	170	162	75	158	70
7	Male	60	68	165	168	79	151	74
8	Female	57	75	149	169	88	139	84
9	Female	64	56	145	197	82	144	72
10	Female	40	54	150	171	72	153	74
11	Female	68	59	156	176	105	155	98
12	Female	61	59	149	179	88	154	74
13	Female	69	68	155	174	81	150	73
14	Female	79	59	160	163	76	151	79
15	Female	25	67	170	195	113	159	64
16	Female	58	48	154	173	72	160	71
17	Female	63	60	149	167	86	143	74
18	Female	73	50	150	179	88	157	65
19	Female	72	55	150	198	93	159	96
20	Female	71	62	160	178	84	151	77
21	Female	64	70	163	171	100	147	77
22	Female	25	67	170	195	113	109	84

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23	Female	71	66	154	186	90	153	82
	Max	84	127	178	198	113	160	98
	Min	25	48	60	161	72	109	64
	Mean	62	65	155	177	89	150	79
	Average rate decreases in blood pressure						-17	-10

Table 4 Shows the blood pressure measurement for group2 people who have high blood pressure (systolic BP level ≥ 160 mmHg or diastolic BP level ≥ 100 mmHg) and took a rest with slow, deep breath for 15 minutes but remained high so they had to sleep and rest for a further 15 minutes

Number of people	Gender	Age	Weight (Kg)	Height (Cm)	1st blood pressure measurement		2nd blood pressure measurement after resting for 15 minutes		3rd blood pressure measurement after sleeping for 15 minutes	
					Systolic pressure	Diastolic pressure	Systolic pressure	Diastolic pressure	Systolic pressure	Diastolic pressure
1	Male	68	77	176	193	93	190	93	158	88
2	Male	76	81	161	194	93	183	68	153	75
3	Male	65	79	170	195	95	190	94	150	87
4	Male	65	76	173	174	86	161	84	148	78
5	Male	75	63	162	180	87	176	84	160	84
6	Female	79	70	150	166	93	175	81	141	67
7	Female	47	86	161	188	118	193	90	155	81
8	Female	54	81	155	170	84	161	82	160	83
9	Female	60	61	155	165	85	165	89	150	85
10	Female	67	53	153	169	79	188	87	160	80
11	Female	81	56	148	183	84	174	77	160	76

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12	Female	58	74	150	172	77	162	81	151	74
13	Female	60	58	153	173	89	162	88	155	85
14	Female	77	47	152	171	76	163	84	137	66
	Max	81	86	176	195	118	193	94	160	88
	Min	47	47	148	165	76	161	68	137	66
	Mean	67	69	159	178	89	175	84	153	79
	Average rate decreases in blood pressure								-25	-9

Summary

In the vaccination to alleviate COVID-19, 38 people with high blood pressure accounted for 15% of the 247 total samples found out that

1. After taking a rest with slow, deep breath for about 15 minutes, the results are: The average systolic blood pressure dropped about 17 points.The average diastolic blood pressure dropped about 10 points.
2. People with high pressure that took a rest with slow, deep breath for 15 minutes, but still remained high, so they had to sleep and rest for a further 15 minutes, the results are:
    a. The average systolic blood pressure dropped about 25 points.
    b. The average diastolic blood pressure dropped about 9 points.

Discussion

Sympathetic nervous system

The SNS is one of the two divisions of the ANS, along with the PNS, these systems primarily work in opposite ways to regulate many functions and parts of the body. The SNS controls the "fight or flight" response while the PNS controls the "rest and digest" response. The main function of the SNS is to prepare the body for physical activity, a whole-body reaction affecting many organ systems throughout the body to redirect oxygen-rich blood to areas of the body needed. (9) The actions of the SNS occur in concert with other neural or hormonal responses to stress, including increases in corticotropin and cortisol secretion. If there are long term stimulation of "fight or flight response", constant production and secretion of catecholamines and cortisol will occur which can lead to HTN. (10)

General Sympathetic pathway

1. The preganglionic neurons of the SNS arise from the thoracic and lumbar regions of the spinal cord (segments T_1 through L_2). Most of these preganglionic axons are short and synapse with postganglionic neurons within ganglia found in the sympathetic ganglion chains. These ganglion chains, run parallel along either side of the spinal cord, each consist of 22 ganglia. The preganglionic neuron may exit the spinal cord and synapse with a postganglionic neuron in a ganglion at the same spinal cord level from which it arises. The preganglionic neuron may also travel upward or downward in the ganglion chain to synapse with postganglionic neurons in ganglia at other levels. In fact, a single preganglionic neuron may synapse with several postganglionic neurons in many different ganglia The long postganglionic neurons originating in the ganglion chain then travel outward and terminate on the effector tissues.

2. The preganglionic neurons exit the spinal cord and pass through the ganglion chain without synapsing with a postganglionic neuron. Instead, the axons of these neurons travel more peripherally and synapse with postganglionic neurons in one of the sympathetic

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collateral ganglia. These ganglia are located about halfway between the CNS and the effector tissue.

3. The preganglionic neuron may travel to the adrenal medulla and synapse directly with this glandular tissue. The cells of the adrenal medulla have the same embryonic origin as neural tissue and, in fact, function as modified postganglionic neurons. Instead of the release of neurotransmitter directly at the synapse with an effector tissue, the secretory products of the adrenal medulla are picked up by the blood and travel throughout the body to all of the effector tissues of the SNS.

An important feature of this system is that the postganglionic neurons of the SNS travel within each of the 31 pairs of spinal nerves. This allows for the distribution of sympathetic nerve fibers to the effectors of the skin including blood vessels. (11)

Sympathetic neural mechanisms in the regulation of blood pressure

Sympathetic neural influences on cardiovascular function can be divided into 4 main categories:

1. The influences of cardiac sympathetic nerves
2. The influences of vascular sympathetic nerves
3. Adrenal medullary influences caused by circulating epinephrine and norepinephrine
4. The sympathetic stimulation of renal juxtaglomerular cells that activates the renin-angiotensin-aldosterone axis.

Most sympathetic innervation in the human cardiovascular system is noradrenergic. Norepinephrine is the primary neurotransmitter, and epinephrine and other co-transmitters perform secondary. (12)

Cardiac sympathetic innervation of the heart includes innervation of the sinoatrial (SA) node, which allows sympathetic nerves to increase heart rate by increasing the slope of diastolic depolarization during the spontaneous SA node action potential. Sympathetic nerves also innervate the myocardium; increases in SNS activity increase myocardial contractility and, therefore, increase stroke volume. Sympathetic innervation of the peripheral vasculature causes vasoconstriction primarily through the action of norepinephrine at postsynaptic α-adrenergic receptors. Co-transmitters such as neuropeptide Y also have a role in this vasoconstriction. (13-14)

Sympathetic neurotransmitters that increase vasoconstriction:

α_1 adrenergic receptors are expressed in vascular smooth muscle proximal to sympathetic nerve terminals.

Their activation elicits vasoconstriction. There are also some low expressions of α_1 receptors in cardiomyocytes.

α_2 adrenergic receptors are expressed in vascular smooth muscle distal from sympathetic nerve terminals.

Their activation also elicits vasoconstriction.

Endocrine/Paracrine reflexes and the regulation of the blood pressure regulation

Cardiovascular function is also influenced by numerous endocrine hormones. Released from the adrenal gland, epinephrine and dopamine and norepinephrine are all involved in the initiation of the "fight-or-flight" response

Adrenal medulla (epinephrine) - Epinephrine and norepinephrine are the two main catecholamines that can activate or deactivate sympathetic receptors within the cardiovascular system. Another neurotransmitter dopamine that has limited actions in the ANS may excite or inhibit depending on the receptors. Dopamine can be converted into norepinephrine and thus can increase heart rate and blood pressure. epinephrine is produced (from phenylalanine and tyrosine) and released from chromaffin cells in the adrenal medulla of the adrenal glands. Epinephrine at low concentrations is β_2-selective, producing vasodilatation, while at high concentrations it also stimulates α_1, α_2, and β_1 receptors, producing vasoconstriction (mediated by α_1 and α_2 receptors), and increases heart rate and contractility (mediated by β_1 receptor). Blood pressure is regulated through a system of vasoconstriction and vasodilatation (*i.e.*, vascular resistance).

Posterior pituitary gland - Vasopressin (antidiuretic hormone) increase blood pressure and maintain organ perfusion. Vasopressin serves to regulate water retention and vasoconstriction. Vasopressin is

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produced and released from the parvocellular neurosecretory neurons. It is synthesized in the hypothalamus, and then stored in the posterior pituitary gland. Within the cardiovascular system, vasopressin is a vasoconstrictor which increases arterial blood pressure. An increase in blood volume results in increased cardiac output and improved cardiovascular function.

Endothelin-1- Endothelin-1 is a potent vasoconstrictor that is produced by endothelial cells. There are four endothelin receptors, which are mainly expressed in vascular smooth muscles, each with varying actions upon activation. Activation of ET_A results in smooth muscle vasoconstriction; ET_B causes the release of nitric oxide from endothelial cells, thus resulting in vasodilatation, while activation of ET_{B2} causes vasoconstriction.

An overactive SNS has become an identified characteristic of several cardiovascular diseases including HTN, sympathetic overactivity has been implicated in the initiation and progression of numerous pathophysiological processes independent of increases in BP. (15)

Treatment and control of high blood pressure from other studies

1. **Resting and controlled breathing** - Particularly at 6 breaths per minute, is associated with augmented BP fluctuations of respiratory origin, as compared to the BP oscillations observed during spontaneous breathing. (16) Controlled breathing has been shown to maximize PNS. (17)
2. **Sleeping and resting -** Both sleep deprivation and insomnia have been linked to increases in incidence and prevalence of HTN. Note that participants with insomnia who slept > 6 h did not show an increased risk for HTN compared with control subjects. During normal sleep, there is a decrease in blood pressure (18)
3. **Meditation-** Mind- Body interventions such as meditation have been evaluated as potential treatments for high blood pressure, by breathing techniques such as alternate nostril, utilizes rhythmic breathing to guide practitioners into a deep meditative state of relaxation and promote self-awareness. Meditation can affect neuroendocrine status, metabolic function, and related inflammatory responses and stimulate the vagus nerve, thus enhancing PNS output and shifting the ANS balance from mainly SNS to PNS. (19-20)

Conclusion

From the results from this study, it can be concluded that people with HTN can maximize PNS, decrease vasoconstriction and their blood pressure by controlling their breathings, a short sleep and medication as those are the simplest, quickest and saftest way with effective results before vaccination. Vaccination will be allowed only if a systolic BP level ≤ 160 mmHg and/or diastolic BP level ≤ 100 mm Hg. From the results above, people with HTN after several times of treatment all of their blood pressure decreases to a systolic BP level ≤ 160 mmHg and/or diastolic BP level ≤ 100 mm Hg and all 247 people are able to be vaccinated.

References

1. Janet Oyedi Kofi PREVENTION AND MANAGEMENT OF HYPERTENSION: A study on knowledge and attitudes of women of childbearing age(8) Sympathetic Nervous System and Blood Pressure in Humans Individualized Patterns of Regulation and Their Implications
2. Michael J. Joyner, Nisha Charkoudian and B. Gunnar Wallin
3. Alshak MN. Neuroanatomy, sympathetic nervous system.2019 Available from: https://www.ncbi.nlm.nih.gov/books/NBK542195/
4. Britannica, The Editors of Encyclopaedia. "Sympathetic nervous system". Encyclopedia Britannica, 13 Sep. 2019, https://www.britannica.com/science/sympathetic-nervous-system.
5. McCorry L. K. (2007). Physiology of the autonomic nervous system. American journal of pharmaceutical education, 71(4), 78. https://doi.org/10.5688/aj710478

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6. Charkoudian, N., & Rabbitts, J. A. (2009). Sympathetic neural mechanisms in human cardiovascular health and disease.
7. Mayo Clinic proceedings, 84(9), 822–830. https://doi.org/10.1016/S0025-6196(11)60492-8
8. Nonnoradrenergic mechanism of reflex cutaneous vasoconstriction in men. Stephens DP, Aoki K, Kosiba WA, Johnson JM Am J Physiol Heart Circ Physiol. 2001 Apr; 280(4):H1496-504.
9. Neuropeptides in the sympathetic system: presence, plasticity, modulation, and implications.Benarroch EE Ann Neurol. 1994 Jul; 36(1):6-13.
10. Gordan, R., Gwathmey, J. K., & Xie, L. H. (2015). Autonomic and endocrine control of cardiovascular function. World journal of cardiology, 7(4), 204–214. https://doi.org/10.4330/wjc.v7.i4.204
11. Nuckowska, M.K., Gruszecki, M., Kot, J. et al. Impact of slow breathing on the blood pressure and subarachnoid space width oscillations in humans. Sci Rep 9, 6232 (2019). https://doi.org/10.1038/s41598-019-42552-9
12. Stromberg SE, Russell ME, Carlson CR. Diaphragmatic breathing and its effectiveness for the management of motion sickness. Aerosp Med Hum Perform. 2015 May;86(5):452-7. doi: 10.3357/AMHP.4152.2015. PMID: 25945662.
13. Charkoudian, N., & Rabbitts, J. A. (2009). Sympathetic neural mechanisms in human cardiovascular health and disease. Mayo Clinic proceedings, 84(9), 822–830. https://doi.org/10.1016/S0025-6196(11)60492-8
14. Barnes, V. A., Pendergrast, R. A., Harshfield, G. A., & Treiber, F. A. (2008). Impact of breathing awareness meditation on ambulatory blood pressure and sodium handling in prehypertensive African American adolescents. Ethnicity & disease, 18(1), 1–5.
15. Carter, K. S., & Carter, R., 3rd (2016). Breath-based meditation: A mechanism to restore the physiological and cognitive reserves for optimal human performance. https://doi.org/10.12998/wjcc.v4.i4.99