Original Article

Effect of Neutral Immersion Bath with Epsom Salt on Hypertensive Individuals

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ABSTRACT

OBJECTIVES: Aquatic bath with Epsom salt is a simple and effective Hydrotherapy treatment used in Naturopathy, which has a deep-rooted biological effect. Full immersion is generally given in the management of hypertension. This study has been done to assess the effect of Neutral Immersion Bath (NIB) with Epsom salt on blood pressure and heart rate variability (HRV) and thereby to substantiate the clinical understanding of its effect on Hypertensive individuals. **METHODS:** Randomized controlled trial with 100 subjects diagnosed with hypertension belonging to the age group of 30 to 50 years were recruited for the study and were randomly allocated into Group I NIB with Epsom salt given, and Group II was in supine rest. Subjects underwent the intervention or supine rest for about 20 minutes. They were assessed for blood pressure and heart rate variability before and after the intervention. **RESULTS:** After 20 minutes of NIB with Epsom salt showed a significant reduction in Systolic Blood Pressure (SBP) and HRV attained reduction in the frequency domain and a significant increase in the time domain values compared to the control group. **CONCLUSION:** The result of the study reported that NIB with Epsom salt shows reduced sympathetic tone with parasympathetic dominance. Hence, it can be concluded that can be effectively used in the management of hypertension.

Keywords- *Hypertension, Immersion bath, Epsom salt, Hydrotherapy.*

Hypertension has a global impact on human quality of living and the healthcare system, caused by a variety of interconnected factors [1]. A hypertensive person experiences vascular damage before they get adequate treatment. Thereby, damaging the heart, blood vessels, brain, kidneys, and even other organs. It can lead to the early occurrence of various diseases and even death [2, 3]. As a result of improved diagnosis and management of high blood pressure, the hypertensive crisis is becoming less common. However, its progress needs immediate management with suitable therapy according to the severity of the blood pressure levels [4]. With age, the disease's prevalence and complications increase [5]. It has been listed as the third major cause for shortened years of life due to disability [6], Elevation in sympathovagal balance is associated with decreased stress, positive emotions, relaxation, and yoga [7, 8] and they cause physiological changes such as reduction in the anxiety, cardiac irritability, blood pressure [9, 10]. In the present scenario, the awareness towards a complementary and alternative system of medicine has been increased as it has a potential role in the prevention and management of lifestyle disorders. And the people find these health care alternatives to be more identified with their own beliefs, values, and philosophical orientations towards their health and life [11, 12].

Naturopathy, classified under CAM therapy is a distinct system of primary health care and prevention of illness [13]. One of the therapeutic modalities used in Naturopathy is hydrotherapy which employs water as a mode of therapy in the treatment of many diseases. Water is applied to the body externally and internally in different forms like baths, packs,

douches [14]. It was believed that the external application of water produces diverse physiological effects in our body [15]. The most important effects on blood vessels are vasodilation and vasoconstriction, which were the terms used to describe the relaxing and tensing of the blood vessels in the body. Physical changes in the blood vessels can cause metabolic functions and the rate of blood flow [16].

In an Immersion bath, water was used at different temperatures. Immersion in the water has a deep-rooted biological effect [14]. It also causes significant physiological changes in blood pressure, HRV, autonomic nervous system (ANS), and changes in the temperature of internal organs in young healthy subjects [17]. These effects are both immediate and delayed and can be used with therapeutic efficacy for a great variety of rehabilitative problems [18]. A study by Mooventhan & L Nivethitha has shown a reduction in Heart rate, and an increase in systolic and diastolic biventricular functions during acute warm water immersion. In contrast, an increase in Heart rate and a decrease in Systolic blood pressure and Diastolic Blood pressure were observed in 30 min of head-out immersion bath [19]. The research titled critical review on trends in hydrotherapy by Arankalle et al. stated that a single session of neutral immersion bath for 30 mins can effectively help in the reduction of systolic blood pressure [15].

Various Minerals are important for good health. Magnesium is a cofactor in over 300 enzymatic processes, including protein and DNA synthesis, blood pressure and serum glucose control, and detoxification channels [20]. Magnesium was needed for potassium absorption, and it is a calcium antagonist, which is essential for nerve, muscle, and heart function [21]. In addition, Epsom salt added to the water improves blood circulation. Helps in the elasticity of arteries, prevention of heart disease, stroke, prevents blood clots, and lowers blood pressure. Magnesium ions in it are considered to be responsible for the treatment of blood clotting [22]. It was well understood that hypertension was linked to autonomic dysregulation, which can be quantified using the HRV index, which was an easy non-invasive, and accurate instrument for assessing cardiac autonomic function [23]. The immersion bath of varying temperatures such as cold, warm, tepid, and neutral have shown to produce changes in blood pressure and HRV. Since the effect of NIB with Epsom salt added to the water and its efficacy on hypertensive subjects have not been studied so far, thus the current study is undertaken to evaluate it.

METHODS AND MATERIALS

An approval was obtained from the institutional (SDM college of naturopathy and yogic sciences) ethical committee before starting the study. Signed informed consent was obtained, from each subject by explaining the study objectives, methods, intervention, and all the rights of the subject about the study both in oral and written form.

Subjects- 100 hypertensive individuals of both gender and age ranging between 30 to 50 years were recruited from SDM (Sri Dharmasthala Manjunatheshwara) Nature Cure Hospital, Dakshina Kannada, and Karnataka for the study.

Inclusion and Exclusion Criteria- Both males and females are involved. Subjects with Systolic Blood Pressure (SBP) ≥ 140mmHg and diastolic blood pressure (DBP) ≥ 90 mmHg; with or without hypertensive medication. Subjects were excluded if they had Secondary hypertension, Diabetes mellitus associated with hypertension, Cardiac disorders, thyroid abnormalities, chronic renal failure, subjects with open wounds, and Pregnancy.

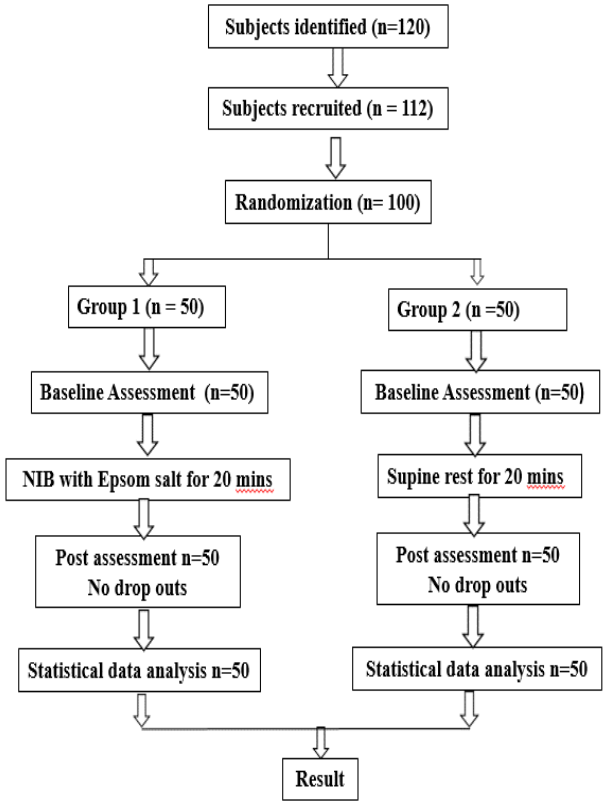

Figure 1 - Illustration of Study Design

Study Design- It is an open-label randomized controlled trial. Detailed instructions and guidance were provided to practice the intervention. Hundred hypertensive individuals were randomly allocated into two groups by computer-generated randomization. Group, I received NIB with Epsom salt added to the water, and Group II subjects were on supine rest. All the subjects were assessed 5 minutes before and 5 minutes after the intervention.

Intervention- The tub was filled with neutral temperature water of about 230 liters approximately and 200g of Epsom salt was added to it. The temperature of water in the tub was measured by a hydraulic thermometer (water thermometer) [14]. The subjects were requested to remove all clothing and made to lie inside the tub with the head raised and placed out of the tub, a cold compress (i.e. a cloth dipped in cold water) was applied over the head, and the intervention was about 20 minutes. The temperature of the water was maintained at 92º to 95º F (34º C) throughout the session. After the bath, the patient should dry himself quickly.

Assessments- The autonomic variables measured were heart rate variability (HRV), and blood pressure (BP). HRV was recorded in the form of electrocardiogram (ECG) using standard bipolar limb lead II configuration and an AC amplifier with 1.5 Hz high pass filter and 74 Hz low pass filter settings. (BIOPAC, Montana, USA; BSL 4.0 MP 36). The participants were lying on the bed, with recording leads linked to the four-channel polygraph machine and a closed-circuit TV monitoring them. The heart rate was obtained based on R-R inter-beat interval analysis. Low frequency (LF) band power value in the HRV spectrum is the indicator of the sympathetic activity of the heart while the high frequency (HF) band power values are for the parasympathetic activity [24]. The LF/HF power ratio has been presented as a valid indicator of sympathovagal balance [25]. BP was measured using a standard mercury sphygmomanometer, auscultation over the left brachial artery, and before and after the intervention.

Statistical Analysis- The study was done to assess the immediate effect of a neutral immersion bath with Epsom salt in hypertensive individuals. The data obtained were analyzed for normality by using the Kolmogorov Smirnov test. The pre, post-test data of Group I and Group II were analyzed separately by using paired t-test, and comparative analysis between Group I and Group II were done by using Mann-Whitney U test and Wilcoxon matched-pairs tests.

RESULT

The results of the pre-post comparisons for both the groups are a Significant decrease seen in SBP ($p<0.05$) in Group I, while in Group II no many changes were noted, and in DBP ($p<0.05$) no many changes were seen. In the time domain of HRV, there was a significant increase in Mean RR ($p<0.05$), RMSSD ($p<0.05$), NN50 ($p<0.05$), pNN50 ($p<0.05$) in Group I, as in Group II no significant decrease was noted and a significant reduction in HR ($p<0.05$) in NIB group while in supine rest group it remained the same. In the frequency domain of HRV, there was a significant increase in HF ($p<0.05$), and a significant decrease in VLF ($p<0.05$), LF ($p<0.05$), and LF/HF ratio ($p<0.05$) while in group II no significant decrease was noted.

DISCUSSION

Sramek P et al. showed Immersion in water at 32º C was shown to reduce SBP and DBP, heart rate, aldosterone concentration with diuresis, reduction of plasma renin, and plasma cortisol [26]. The warmth and buoyancy of water may block nociception by acting on thermal receptors, mechanoreceptors [27], thereby reducing the BP. Studies showed that neutral temperature improved stroke volume, cardiac output, and ejection fraction, as well as decreased systematic vascular resistance and further improved hemodynamic effect [28]. A rapid rise in central blood volume, central venous pressure, distension of the atria occurs after immersion in neck-deep water [29].

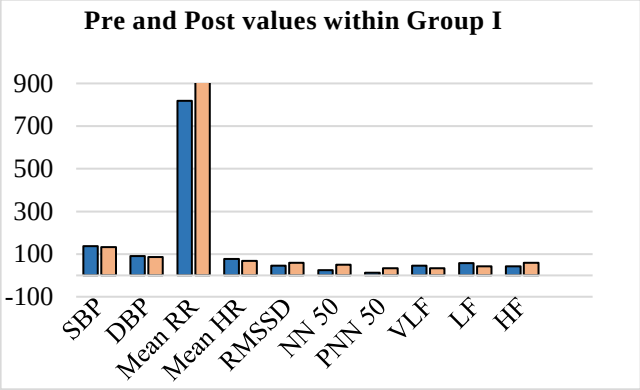

Figure 2- Pre and Post Values within Group I

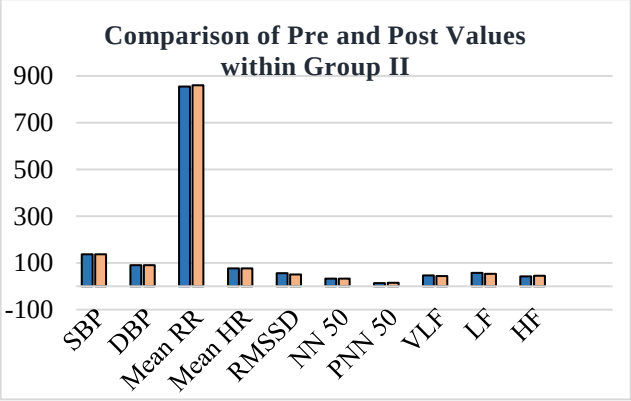

Figure 3- Pre and Post Values within Group II

This distension of the atria is a major mechanism of Atrial natriuretic peptide release, according to evidence presented in Myers BD et al. [30, 31] which results in increased rejection of sodium bicarbonate at the proximal tubule with improved distal transmission indicates an increased rejection of sodium bicarbonate at the same site with a

concomitant increase in the urine to blood Pco2 ratio [32]. Water immersion in normal subjects having depleted sodium levels was associated with a rapid doubling of the atrial natriuretic peptide within 30 minutes of immersion, with these amounts persisting for the continuation of the 3-hour immersion study, according to Leung et al. [33]. Though ANP increased during water immersion to the neck, it did not increase during water immersion to the mid-chest level [34]. So by these results, we can understand the posture of the person, and the level of water immersion means changes in the body. The water immersion method is thus a convenient, effective analytical method for determining the modulation of atrial natriuretic peptides in humans, in addition it is effective in assessing cardio-renal reflexes and baroreceptor mediated control of the kidney [35]. Further, Epsom salt added to the water causes the magnesium ions to separate from the salt molecules as magnesium ions and sulfate ions, both of which are easily absorbed by the skin. Magnesium decreases stress by promoting serotonin release, which is responsible for feelings of calmness, and by reducing the effect of adrenaline [22].

Table 1- Comparison of Post Values of Case and Control Group

Variables	Case pre Mean (SD)	Case post Mean (SD)	Control pre Mean (SD)	Control post Mean (SD)	P Value
Age	42.60 ± 5.84		43.12 ± 5.81		0.656
SBP	137.36 ± 9.24	132.24 ± 8.69	137.30 ± 9.20	137.92 ± 8.95	0.0017*
DBP	90.80 ± 4.24	86.56 ± 4.28	90.04 ± 3.63	90.16 ± 3.74	0.0001**
Mean RR	818.10 ± 144.56	909.64 ± 136.32	855.16 ± 109.31	860.33 ± 102.18	0.0434
Mean HR	77.81 ± 11.76	68.83 ± 8.26	76.58 ± 15.31	76.14 ± 16.26	0.0056
RMSSD	46.02 ± 51.66	59.74 ± 53.94	56.56 ± 58.40	50.91 ± 58.06	0.4327
NN50	25.71 ± 27.86	50.84 ± 34.60	33.46 ± 31.20	33.67 ± 33.51	0.0133
PNN50	13.85 ± 22.90	34.14 ± 27.45	14.06 ± 20.31	15.20 ± 20.30	0.0002**
VLF	45.47 ± 22.05	47.84 ± 21.78	47.84 ± 21.78	44.53 ± 22.44	0.4560
LF	58.07 ± 22.20	43.96 ± 21.33	57.01 ± 14.92	54.30 ± 15.35	0.0065
HF	43.99 ± 22.91	59.05 ± 23.20	42.99 ± 14.92	45.70 ± 15.35	0.0010*
LF/HF	2.43 ± 2.98	1.04 ± 0.91	1.66 ± 1.04	1.53 ± 1.07	0.0154

Magnesium controls the tonicity of the vessels and reactivity by modulating Calcium, potassium, and sodium at the intracellular level [36]. Although the specific biological cause of magnesium's molecular contractile activity is unknown, it is thought to impact calcium, which is a key factor of contraction of the vascular smooth muscle [37]. Magnesium functions intracellularly as a calcium antagonist, modulating the vasoconstrictor activities of enhanced (ca2+) or extracellularly as a calcium antagonist, inhibiting transmembrane calcium transfer and calcium entry and decreasing contractile actions of vasoactive agents [38]. As the above said this could be the possible mechanism in the present study for the reduction of systolic blood pressure and HRV changes. It is proved that the magnesium in the warm water has a possible effect in reducing BP, the present study use up Epsom salt might have contributed to the reduction of blood pressure. The limitation of the study is the prolonged effect of neutral immersion bath with Epsom salt not found. The effects attained after several days or months were not noted.

CONCLUSION

We can conclude that NIB with Epsom salt on hypertensive individuals shows reduced sympathetic tone with the parasympathetic dominance. Still, the findings of serum magnesium levels before and after the intervention can be considered in future studies.

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How to cite this article: Joicy MS, Shetty GB, Sujatha KJ, Shetty P. Effect of Neutral Immersion Bath with Epsom Salt on Hypertensive Individuals. Indian J Intgr Med. 2021; 1(3) 75-79.

Funding: None *Conflict of Interest: None Stated*