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IMMEDIATE EFFECT OF BLUE COLOURED LIGHT ON AUTONOMIC VARIABLES ON PRIMARY HYPERTENSION

Vibha Bhat[1], Prashanth Shetty[2], Shashikiran H. C.*[3], Sujatha K. J.[4] and Prajna Amruth[5]

[1]Intern, SDM College of Naturopathy and Yogic Sciences, Ujire.
[2]Principal, SDM College of Naturopathy and Yogic Sciences, Ujire.
[3]Assistant Professor, SDM College of Naturopathy and Yogic Sciences, Ujire.
[4]Professor, SDM College of Naturopathy and Yogic Sciences, Ujire.
[5]Assistant proFessor, SDM College of Naturopathy and Yogic Sciences, Ujire.

***Corresponding Author: Dr. Shashikiran H. C.**
Assistant Professor, SDM College of Naturopathy and Yogic Sciences, Ujire.

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ABSTRACT

Background: Hypertension is one of the leading causes of coronary heart disease. Our body is exposed to various sources of coloured lights in the contemporary life environments, which may affect our physiological functions and psychological status. In this study we examined the impacts of blue coloured light on autonomic functions by the analysis of heart rate variability on primary hypertensive. **Methods:** Two square shaped LED panel lights of blue colour which was having the size of 170× 170mm, power of 12watts and voltage of 260 volts were used in this study. The lights were secured 90cm above the eyes of the subject lying supine in light- shielded research laboratory in day time. After 5min of supine rest, the pre data of autonomic variables like Heart rate, respiratory rate, blood pressure and pulse rate were measured in the well ventilated and naturally illuminated room. The data were collected after 30min of exposure to blue light. **Results:** There is significant difference between average breaths taken per minute by the patients Pre and post treatment. And we also observe there is significance difference between the pairs of Pre SBP – Post SBP, Pre DBP – Post DBP and Pre Pulse – Post Pulse, $p<0.05$. In the remaining cases there is no enough evidence to conclude the significant difference between their pairs. **Conclusion:** Vagal cardiac modulation is suppressed by blue coloured illumination in patients with primary hypertension. This study suggests that, we need to consider the difference in physiological effects with blue colour illumination.

KEYWORDS: Primary Hypertension**,** Blue coloured light, Heart rate variability.

INTRODUCTION

Blood pressure is the force exerted by the blood against the walls of blood vessels, and the magnitude of this force depends on the resistance and on the cardiac output of the blood vessels. Hypertension is a chronic medical condition in which the blood pressure in the arteries is elevated. The number of people living with hypertension (high blood pressure) is predicted to be 1.56 billion worldwide by the year 2025. Systolic and diastolic pressures are the two measurements expressed in blood pressure, which are the maximum and minimum pressures, respectively. Normal blood pressure at rest is within the range of 100–140 mmHg systolic and 60–90 mmHg diastolic. High blood pressure is present if the resting blood pressure is persistently at or above 140/90 mmHg for most adults.[1,2] Hypertension can also lead to problems in the organs affected by high blood pressure. Long-term hypertension can cause complications through arteriosclerosis, where the formation of plaques results in narrowing of blood vessels. Autonomic Nervous System plays a crucial role in the maintenance of homeostasis of body and its potential role in alleviating and exacerbating various disease conditions and process in the human body. Naturopathic medicine is an art and science of disease diagnosis, treatment and prevention using natural therapies including: herbal medicine, clinical nutrition, hydrotherapy, naturopathic manipulation, colour therapy and other non invasive therapies.

Chromotherapy is the Application of colour for the purpose of healing. Chromotherapy is a narrow band in the cosmic electromagnetic energy spectrum, known to humankind as the visible colour spectrum [3, 4]. The sun rays have seven colors those have already universally accepted and proved by scientists. These termed in short form as V I B G Y O R, i.e. V-Violet, I-indigo, B-Blue, G-Green, Y-yellow, O-Orange, and R-Red. Sun rays have an abundance of elements favorable for health. Sun rays have properties and strength to cure many acute/ chronic diseases. Primary colors of sun rays are: green,

red and blue. In contrast yellow, green, and blue are therapeutic colours.[4]

Colour is a wavelength of light transmitted through our eyes. Human beings are very sensitive to light. In the contemporary life environment, our body is increasingly exposed to various artificial lightings with various colours.[5] Light affects both the physical and etheric bodies. Colours generate electrical impulses and magnetic currents are the prime activators of biochemical and hormonal processes in human body to balance entire system and its organs.[4] Light can elicit acute physiological and alerting responses in humans, the magnitude of which depends on the timing, intensity, duration of light exposure.[6] Recent researchers have found that light received by the eyes could travel to the hypothalamus, pineal body and effects metabolism.[5] Colour can shift many physiological parameters like secretion of hormones, affects melatonin, body temperature, heart rate, heart rate variability.[7,8] This current study conducted to report the impacts of blue coloured light on cardiac autonomic functions by the analysis of HRV, Blood pressure and pulse rate. Clinical observations suggest that coloured lights can influence HRV and can be distinguished by HRV analysis.[8]

Blue colour has wavelength 450-500nm and frequency 600-670Hz. It slows down the heart rate, lowers the blood pressure and lowers the body temperature.[6,7] It can be linked to throat and thyroid gland, deepens the breathing and reduces perspiration.[6] It stimulates the pituitary gland which regulates the sleep patterns, circadian rhythms [6, 9]. Blue is cooling, smoothening and relaxes the mind.[10] The emotional state of an individual has independent effect on HRV.[11] Blue light increases parasympathetic activity, suppresses vagal cardiac modulation through melanopsin dependent non-image forming effect.[7,11,12]

METHODOLOGY

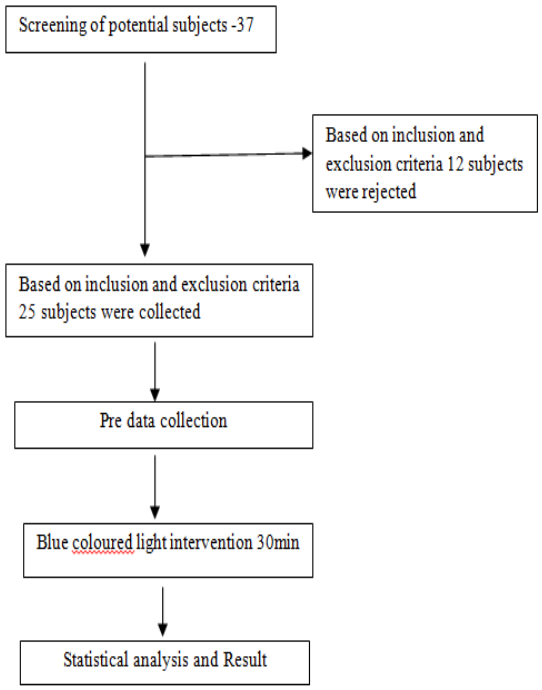
A total 25 subjects with the age of 30-60 were required for the study. Subjects who fulfilled the inclusion criteria were appraised the purpose of the study and their rights as the research subjects. The subjects were selected from In-patients department of Sri Dharmasthala Manjunatheshwara Yoga and Nature cure Hospital, Shanthivana.

The Patients with primary hypertension, age ranging between 30 – 60 years, both the genders, willing to participate in the study and under medication for primary hypertension were inclusion criteria.The patients with secondary hypertension, Coronary artery disease, Diabetes mellitus, Hypothyroidism, Liver and Lung diseases, Neurological disorders, Cancer, Cerebrovascular accidents, spinal cord injury and any chronic illness were excluded.

Design

A self controlled trial of sample size of 25, Subjects was screened for inclusion and exclusion criteria. A total number of 25 subjects was recruited. Subjects satisfying the selection criteria and who have agreed to give consent for participation in the study are assessed at baseline and institution ethical clearance was obtained. The procedure of the study was briefly explained to each. In the study, subject is made to lie down in supine position in a room arranged with blue coloured light. Patient were well relaxed and exposed for blue colour for 30min.

Illustration of the study



Intervention

A room is well arranged with blue colour which has short wavelength of 450-500nm and high frequency of 600-670Hz.Two square shaped LED panel lights of blue colour which was having the size of 170× 170mm, power of 12watts and voltage of 260 volts were used in this study. The study took place during day time in special research laboratory of SDMYNCH. The persons were lying on the bed with closed eyes and measurements started after a resting period of 5min.HRV, BP and Pulse rate were measured before and after the exposure of blue light.

DATA EXTRACTION

Heart rate variability

The HRV power spectrum was obtained using Fast Fourier Transform analysis (FFT). The energy in the HRV series of the following specific bands was studied viz. the very low frequency component (0.0-0.05 Hz), low frequency component (0.05-0.15 Hz), and high frequency component (0.15-0.50 Hz). The low frequency and high frequency values are expressed as normalized

units. In addition to frequency domain analysis, time domain analysis was also done. The following components of time domain HRV were analyzed: mean RR interval (the mean of the intervals between adjacent QRS complexes or the instantaneous heart rate); mean HR , the R waves from the electrocardiogram are detected, to obtain a point event series of successive R-R intervals, from which the beat to beat heart rate series are computed. The heart rate is obtained based on R-R inter-beat interval analysis. The heart rate in beats per minute (bpm) was obtained by continuously counting the QRS complexes in successive 60 s periods. Fourier analysis of the R-R interval series was done using the HRV analysis software version 2.1 developed by the Biomedical Signal Analysis Group, University of Kuopio, Finland.

Respiratory Rate

Respiratory rate (in cycles per minute) was calculated by counting the breath cycles in 60seconds epochs. The readings obtained from the 5 minute data was averaged.

Blood pressure and pulse rate

The data will be collected by self-reported sphygmomanometer, pulse rate assessed manually.

RESULT

Table 1: Summary of the paired t-test applied for data given below, the values are expressed in Mean±SD,

	Mean	95% Confidence interval		t-value	Degree of freedom	p-value
		lower	Higher			
Respiration Pre – Respiration Post	1.72529	.33556	3.11501	2.562	24	0.017
Pre_HR - Post_HR	4.95425	-1.09954	11.00804	1.689	24	.014
Pre_Mean_RR - Post_Mean_RR	-5.52040E1	119.13633	8.72833	-1.782	24	.087
Pre_VLF - Post_VLF	2.77200	-8.05243	13.59643	.529	24	.602
Pre_LF - Post_LF	7.90400	-2.78770	18.59570	1.526	24	.140
Pre_HF - Post_HF	-7.88400	-18.56681	2.79881	-1.523	24	.141
Pre_SBP - Post_SBP	3.84000	2.98338	4.69662	9.252	24	.000
Pre_DBP - Post_DBP	2.48000	1.93239	3.02761	9.347	24	.000
Pre_Pulse - Post_Pulse	2.44000	2.00905	2.87095	11.685	24	.000

From the above table we note that in respiration calculated t-value is 2.562 and p-value is 0.017 which is less than 0.05. Hence we reject the null hypothesis. There is significant difference between average breaths taken per minute by the patients Pre and post treatment.

And we also observe there is significance difference between the pairs Pre SBP – Post SBP ($p<0.001$), Pre DBP – Post DBP(<0.001)and Pre Pulse – Post Pulse(<0.001). In the remaining cases there is no enough evidence to conclude the significant difference between their pairs, The data were found to be normally distributed across groups($p>0.05$).

DISCUSSION

To investigate the acute physiological effects of blue coloured light on patients with primary hypertension, we looked into the HRV indices, blood pressure, pulse rate and respiratory rate with colour illumination. We found that blue light caused greater difference in Heart rate, blood pressure, pulse rate and respiratory rate after and before the treatment. But there was no significant difference in Mean heart rate, mean RR VLF, HF, LF.

Earlier studies have reported mixed results for the effects of coloured fluorescent lights on HRV. For example Choi et al[13] have also analyzed HRV before and after 5min exposure to blue, red and white fluorescent light in 92 healthy adults with spontaneous breathing. They observed decrease in absolute HF power after exposure to red light while there were no significant changes with exposure to blue and white light. Their result seems partially consistent with ours. Schafer et al[14] have also analyzed the changes in HRV, with 10min exposure to red, green and fluorescent and followed by 15min darkness in 12 healthy young subjects. Their results indicated a significant decrease in absolute HF power during darkness after exposure to blue light, while there were no significant changes with red or green lights. Their result seems to be inconsistent with ours, the difference in body positions during HRV measurement may be critical because the HF power is strongly suppressed by gravitation stress.

In the present study, for autonomic assessment, along with HRV we used blood pressure, respiratory rate in post data compared to pre data and pulse rate. And we could find decrease in Mean BP, PR, RR even though there were no significant changes in Mean HR, RR, VLF, HF and LF, could be due to parasympathetic dominance. In the study we used blue light because it has lowest parameters like illuminance, irradiance, and photon flux density. The method for standardizing the light intensity for comparing the effects of colours of light has been established. Thus investigated the effects of intensity of blue light to examine whether the autonomic effect of blue light is caused by its low intensity or not. We used LED lighting devices for this study, we were unable to determine whether the results we observed are specific to LED or not. Led is gathering

attentions as non- glaring comfortable surface illumination and is expected to be used as a new lighting source at home, workplace and healthcare environments, it should be considered on their utilization. Further studies are required to understand these influences most comprehensively.

Limitations

In this study, the main limitation is the small sample size with low power significance on HRV.

CONCLUSION

We examined the impact of blue coloured lights on HRV in patients with primary hypertension. Our observation indicates that vagal cardiac modulation is slightly suppressed by blue coloured illumination in patients with primary hypertension. This study suggests that, we need to consider the difference in physiological effects with blue colour illumination.

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