Original Article

Effect of head down tilt on heart rate variability

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Abstract

Context: Sirshasan is supposed to increase blood flow to the brain and considered to be beneficial for intellectual function, however mastering these techniques may be difficult. **Aims:** To see the effect of headstand using a tilt table on heart rate variability (HRV). **Settings and Design:** A cross-sectional study that was done on 26 healthy volunteers. **Methods and Material:** HRV was assessed in the supine position and 30° head tilt position for 5 min. HRV recording was done on the power lab (AD Instruments P Ltd, Castle Hill Australia). The tilt table used was Medica Podium, New Delhi, HLT-200. **Statistical analysis used:** Paired *t*-test. **Results:** All the HRV parameters showed non-significant change except low-frequency parameters which showed significant change during head tilt. **Conclusions:** Headstand to a 30° using tilt table cause a decrease in the autonomic activity which is mainly because of decrease in sympathetic activity.

Keywords: Headtilt, heart rate variability, Yoga

Introduction

Yoga benefits both physical and mental health of an individual. Yoga has been considered to be effective as exercise. Yoga may be more effective than exercise in terms of benefits to health.[1] Yoga has various components. These include Asanas (Postures), Pranayama (voluntary breath regulation), and Dhayana (meditation). One of the Asanas is Sirsasana which is also called a headstand. In this posture, the body is completely inverted and supported by the forearm and crown rest on the floor. Some variation has also been described for doing this Asan. It was considered to increase blood flow to the brain and considered to be beneficial for intellectual function.[2] Recently, it was found that cerebral blood flow does not increase as result of preserved cerebral auto regulation.[3,4]

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Mastering these techniques is an art. It is advised to do Sirshasan under supervision. It involves head and neck loading hence supervision is a must. Also, it may have a delirious effect on intraocular pressure.[5,6] It may also cause neck injuries, spine, and joint injuries involving shoulder and wrist.[7] Headstand-induced subdural hematoma has been also reported.[8] Traditionally, Sirshasan or headstand is done without the support of the wall. It would require a lot of practice. It is also done with wall support which may be preferred by beginners. We had come across a study where these two types were compared. The author got sympathetic activation in heart rate variability (HRV) irrespective of the different practicing methods.[9]

The present study was planned to see the effect of headstand using a different technique. We aimed to give full support to the subject, even minimum stress was given on the head. This was done using a tilt table where the subject is stripped to the table and thereby there is no chance of fall. We thought that it would allay anxiety in the subjects and thereby it would be more beneficial to subjects. Also, this technique with a tilt table may be suitable for an old age person. During our literature search, we did not come across any such study.

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Patients have a very good relation with primary care physician. Lifestyle promotion is the need of time. For lifestyle promotion, yoga is promoted not only in India but also all over the world. Sirsasana is considered to be beneficial for health. Patient may come to primary care physician for advice about this Asana. This asana may not be advised for all. With this study, effect of headstand using a tilt table on autonomic function is studied. Thus it would be useful to primary care physician regarding use of tilt table for headstand/Sirsasana posture.

Aim of the study to see the effect of headstand using a tilt table on autonomic function. HRV is considered to be a good indicator of autonomic function. Also, it can be assessed non-invasively using a simple technique. With this study, we have taken an attempt to see the effect of head tilt (headstand using tilt table) on heart rate variabilityHRV in normal persons.

Subjects and Methods

This was the cross-sectional study that was done in the Department of Physiology in collaboration with Ayush department of AIIMS, (17th March 2020) Bhopal. Twenty-six healthy volunteers in the age group of 25–50 years would be included in the study. Healthy volunteers were faculties from various departments of AIIMS, Bhopal. Exclusion criteria for the subjects were as follows:

- History suggestive of acute infection
- Diabetes mellitus
- Hypertension
- Examination finding suggestive of acute or chronic disease
- Patient taking the drug which modulates the autonomic response
- Patients having musculoskeletal problem disorder acute or chronic due to any cause.
- History suggestive of glaucoma.

After written informed consent, volunteers were asked about relevant history followed by a general and systemic examination. All the subjects were made familiar with the instrument and the procedure for performing the test. They were made comfortable with the instrument as well as the environment.

The subject was made to lie on the tilt table (Medica Podium, New Delhi, HLT-200) for around 10 min. HRV recording was done for 5 min. Then the patient was strapped to the tilt table. The patient was tilted through 30°. This was done through a remotely operated tilt table. The patient was kept in this position and HRV recoding was taken in this position for 5 min.

The study was undertaken after due approval from the Institutional Human Ethics Committee (IHEC) of AIIMS, Bhopal, and after the approval obtained, 17th march 2020 from the Research Review Board (RRB) of AIIMS, Bhopal.

Heart rate variability procedure

HRV recording and assessment were done on the power lab (AD Instruments P Ltd, Castle Hill Australia). ECG sampling was done at 1000 Hz for 5 min with the Power Lab acquisition system. The recording was started once the patient becomes stable in a quiet room with a comfortable temperature. Before recording, patients were instructed to abstain from any type of exercise, eating, and drinking anything having caffeine, 2 h before the scheduled time for the test. HRV recording was analyzed with both frequency-domain and time-domain analysis.

All testing and analysis would be done as recommended by Task Force on HRV.[10]

Statistical analysis

Statistical analysis was done using statistical software. A paired *t*-test was used to compare the mean values of various parameters. A *P* value of less than 0.05 was considered to be statistically significant.

Results

The study was done on 30 healthy volunteers (20 males and 6 females) of age 34 years ± 6.98 (mean ± S.D). The subject's characteristics are shown in Table 1. HRV parameters (time and frequency domain) are shown in Table 2. All the parameters showed non-significant change except low-frequency parameters which showed significant change during head tilt.

Discussion

In the present study, we had attempted to see the effect of head tilt (headstand using tilt table) on HRV parameters. We expected that there may be less sympathetic activity since the anxiety of doing this skillful asana similar to that of sirshasan would not be there. Further physiological mechanisms activated by head

Table 1: Subject characteristics

Age (Yrs)	34.23±6.98
Height (cm)	170.22±19.23
Weight (Kg)	66±8.98
BMI	27.22±3.76

Table 2: Heart rate variability - Time and frequency domain parameters in subjects

Parameters	Rest (*n*=26)	During head tilt (*n*=26)	*P*
Mean RR interval (ms)	892.29±114.98	837.07±66.33	0.165
RMSSD	31.8±26.5	32.8±22.1	0.77
HF	518.4±696.5	497.5±559.4	0.88
LF	518.2±293.0	421.9±280.8	0.03*
VLF	509.4±319.3	471.0±308.0	0.59
Total Power (msec^2)	1638.7±1162.3	1465.7±910.5	0.38
HF power (nu%)	42.5±20.3	41.2±17.5	0.75
LF power (nu%)	56.62±22.0	53.1±21.9	0.38
LF/HF ratio	2.57±2.9	2.0±2.8	0.18

*P<0.05- significant. All values are mean±S.D. RMSSD - The root mean square of the mean of the sum of the squares of differences between adjacent RR intervals. HF - high frequency, LF - low frequency, VLF- very low frequency

tilt may also decrease sympathetic stimulation. We got an only significant decrease in the low-frequency power spectrum (LF). No significant difference was seen in other parameters.

LF is considered a too strong indicator of sympathetic activity. In the present study, LF had significantly increased. Other findings in favor of this were decreased mean RR interval and decrease in LF/HF ratio, however, these changes were not significant. The mean RR interval decrease may be explained by a decrease in sympathetic stimulation. Balance between the sympathetic and parasympathetic systems is indicated by LF/HF ratio. A decrease in ratio could be mainly because of a decrease in sympathetic stimulation. However, if we see the overall result, all values including total power have decreased during head tilt, thus not only sympathetic but also parasympathetic activity decreased during the head tilt. Overall autonomic activity which is mainly contributed by sympathetic activity is denoted by total power. Total power had decreased. Thus, in the present study, overall autonomic activity showed a decrease and this decrease was mainly because of decrease sympathetic activity.[10,11]

This was a unique study where headstand was done using a tilt table and tilt was kept to 30°. We had come across a study by Rao S. *et al.*[12] where a decrease in heart rate was reported in headstand posture. Manjunath *et al.* had also compared the effect of two types of headstand, that is, one with support and one without support. However, he had compared recording 5 min each before and after a headstand posture of 2 min. He has not compared during the headstand posture. He got similar findings, whether the headstand was done with support or without support.[9]

What could be the physiological mechanism for this? The inverted posture in 30° has resulted in increased venous return, thereby increasing left ventricular filling and ultimately cardiac output has increased. This increased cardiac output has stimulated baroreceptor, as a result of which sympathetic discharge had decreased.[13,14] Another reason may be a person's anxiety level was less as this procedure was done using a tilt table.

We had come across a study where head down tilt was kept for 30 min. This has caused increased inspiratory time, decreased respiratory rate, inspiratory and expiratory flow rate and increased the airway resistance.[15] One of the important factors affecting HRV is respiration. The changes in respiration parameters could have affected HRV. Slow breathing was responsible decreased LF and Decreased LF/HF ratio. It was because of alteration in baroreflex sensitivity in patients of essential hypertension.[16] In the present study, these interaction may be responsible for the findings. However, respiratory rate was not measured in the present study.

We also compared our result with some study where the head-up tilt test is done. This test has been used in the diagnosis of syncope.[17,18] An increase in LF was seen in their studies which were a result mechanism reverse of above.[19]

Thus, with this study, sympathetic activity had decreased, however we should have done 5 min reading again in supine position post tilt because it could have given a better idea about the physiological response of the body. An increase in heart rate after headstand was seen in a study.[9] The sample size was also less. Also in the present study respiratory rate was not measured. These were the limitations of the study.

Recommendation for future studies

Such a study should be done with a large sample size. What is the long term effect over a certain minimum duration? This effect has to be studied. Headstand is considered to be beneficial, however, it is a skillful procedure. It could not be attempted by all. For such a patient, whether the tilt table would be useful needs to be studied.

Thus, to conclude key point and key message of this study are-

Key Points

- Practicing headstand in 30° using head tilt may cause decrease in autonomic activity.
- Further studies should be encouraged to evaluate the beneficial effect of headstand using tilt table.

Key Message

- Headstand to a 30° using tilt table cause a decrease in the autonomic activity which is mainly because of decrease sympathetic activity.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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