YOGA BASED ISOMETRIC RELAXATION VERSUS SUPINE REST: A STUDY OF OXYGEN CONSUMPTION, BREATH RATE AND VOLUME AND AUTONOMIC MEASURES R.P.

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Forty male volunteers with ages ranging from 16 to 46 yrs ware studied in two sessions, yoga based isometric relaxation technique (IRT) and supine rest (SR). Assessments of autonomic parameters were made in 15 subjects, before and after the practices, whereas oxygen consumption, breath rate and breath volume were recorded in 25 subjects, before and after IRT and SR. A significant decrease in breath rate after IRT and in linger Plethysmogram was recorded after SR. The results suggest possibilities for IRT in reducing some physiological signs of anxiety.

INTRODUCTION

Various conventional as well as non-pharmacological methods of relaxation, including autogenic muscle relaxation are becoming popular for reduction of stress (De Berry, Davis & Reinhard, 1939). Traditional yoga texts say that it may also sometimes be desirable to activate the mind (Chinmayananda, 1984): "In a state of oblivion awaken the mind again; when agitated, pacify it; in between understand that the mind is full of potency. If the mind has reached the state of perfect equilibrium then do not disturb it again" (p. 275). For most persons routinely, the mental state is neither in a "state of oblivion" nor is it "agitated", but is somewhere between these extremes, and hence a combination of "awakening" and "pacifying" measures may be better suited, to reach a state of equilibrium. Once the mind is out of vikshipta (a state of unsteadiness), then the equanimity will set in. To shatter the "Laya" (a state of oblivion) and pacify the vikshipta, a combination of stimulation and relaxation may be a better measure.

Isometric squeeze relaxation (a variant of progressive relaxation) may be more appropriate for individuals who have difficulty focusing, while meditation may be better suited to those who already possess well-developed relaxation skills at the trait level (Weinstein & Smith, 1992). It is important that the appropriate relaxation technique is used, as people with mental illness may experience an exacerbation of their symptoms with the injudicious use of relaxation techniques that use imagery (Harding, 1996). There are some relaxation methods, which can be carried out as a simple technique "on the spot" like the intervention in the present study (Payne, 1 995).

The objective of the present investigation was to evaluate the efficacy of yoga based isometric relaxation technique (a variant of conventional technique), with external instructions to reduce psychophysiological arousal. This is basically a combination of isometric contractions of all Muscle groups followed by relaxation with breath awareness (Isometric relaxation technique, IRT). For comparison. assessments were also made following supine rest (SR).

METHOD

Subjects

The subjects were 40 male volunteers, with ages ranging from 16- 46 years and with an average of 23.9 months of experience of yoga practice. The autonomic parameters were assessed in 15 subjects (group"s average age was 30.2, SD = 6.1 yr.). In 25 subjects the oxygen consumption, breath rate and volume were measured before and after the two practices (group"s average age was 28.2, SD = 6.6 yr,).

Design

Subjects were studied in two separate relaxation sessions, viz., isometric relaxation technique (IRT), and supine rest (SR) with instructions as a control. The two sessions were on different days, at the same time of the day. For half the subjects, alternately, the IRT session was on the

first day with the SR session the next time. The order was reversed for the remaining subjects. Each recording session was of 10 minutes and consisted of 2 periods, viz., before (5 minutes) and after (5 minutes The subjects were sitting at case before and after the practice periods, and supine during the relaxation periods. Both techniques were of 10 minutes duration under the same standard conditions.

Assessment

The oxygen consumption was recorded with a closed circuit, Benedict-Roth apparatus (INCO, Ambala, India) using the standard method (Mountcastle, 1980). The subject breathed into an oxygen tank, from which exhaled carbon dioxide was excluded by absorption in sodium hydroxide. The subjects were asked to breathe into the mask, which covered their nose and mouth. Recordings were made before and after, but not during test periods.

A 4-channel polygraph (Medicaid Systems, Chandigarh, India) was used to record the electrocardiogram (EKG), respiration, and finger plethysmogram amplitude EKG was recorded using standard Limb lead 1 configuration. The EKG was digitized using a 12 bit analog-todigital convertor (ADC) at a sampling rate of 500 Hz. The data recorded were visually inspected off-line and only noise free data were included for analysis (Raghuraj, Ramakrishnan, Nagendra & Telles, 1998). The R waves were detected to obtain a point event series of successive R-R intervals, from which the beat to beat heart rate series was computed.

Respiration was recorded from using a nasal thermistor attached to the more patent nostril. Finger plethysmogram amplitude was recorded placing the photoplethysmograph on the volar surface of the distal phalanx of the index finger of the right hand.

Isometric relaxation technique (IRT)

The isometric relaxation technique lasts for 10 minutes and is done in 5 phases of step-wise relaxation, detailed below (Nagendra & Nagarathna, 1988). (i) Isometric contractions of all the muscle groups from the toes to the facial muscles, mentioning each part of the body specifically, (ii) letting the body collapse" on the ground with a feeling of "letting go", till the changes revert back to normal, (iii) Watching the abdominal movements, (iv) synchronizing the abdominal movements with breath, (v) developing the breath awareness followed by invoking the positive emotions with the breath "This is practiced slowly and with instructions about relaxation and awareness of breath and mental sensations. Throughout the practice the eyes are closed.

Supine rest (SR)

During SA, the subject lies supine with the legs apart, arms away from the sides of the body, and eyes closed. This session lasts 1 0 minutes, as for IRT.

Data extraction

The end expiratory points of the respirogram obtained using the Benedict-Roth apparatus were joined as a slanting line, the slope of which gave the difference between initial and final volumes of oxygen in the tank in a given period, which was approximately 3-4 minutes in most cases. The breath rate and respiratory (tidal breathing) volume were also obtained from the record.

The following data were extracted from the polygraph records: The respiratory rate (in cycles per minute) was calculated by counting the breath cycles in 60 second epochs, continuously. Finger plethysmogram amplitude (in mm) was sampled at 20-second intervals. Values averaged across each of the periods (before, after) of a session, were used for analysis.

Frequency domain analysis of heart rate variability (HRV) data was carried out for the 5- minute recordings before and after the sessions. The mean heart rate was obtained from this record. The mean values were removed from the heart rate series to obtain the HRV values. The HRV power spectrum was obtained using Fast Fourier Transform (FFT). The power in HRV series in the following specific frequency bands was studied, Viz., the very low frequency (VLF) band (0- 0.05 HZ), low frequency (LF) band (0.05- 0.15 HZ), and high frequency (HF) band (0.15- 0.50 Hz). The low frequency and high frequency values were expressed as normalized units, which represent the relative value of each power component in proportion to the total power minus VLF component (LF) norm = LF/ (total power-VLF) X 100; HF norm = HF/(total power-VLF) X 100)" (Task force of the European Society of Cardiology the North American Society of Pacing and Electrophysiology, 1996).

Data analysis

A two factor analysis of variance (ANOVA) was used to check for significant differences between the categories of subjects, i.e., factor A, and for differences between recordings before and after, i. e., factor B. The Tukey test for the least significant difference between means was used for multiple comparisons. The "t" test for paired data was used to assess the significance between, after, and before values of each group, separately, to detect changes which were not significant with the Tukey test.

Oxygen consumption, breath rate and breath volume

There was a significant difference between values recorded before and after the session of isometric relaxation technique and of supine rest (i.e., Factor B) for breath rate $F = 5.22$, for $df = 1,96$, $p<.05(2)$, values for oxygen consumption, breath amplitude were not significant. The difference between two categories of subjects was not significant (Factor A), with no significant interaction between Factors (A X B).

RESULTS

The group means + SEMs obtained in the two sessions are given in Tables 1 & 2

Table 1: Means and Standard Error of the Means (SEMs) of Oxygen Consumption, Breath Rate and Breath Volume (n = 25)

Parameters		**IRT**		**SR**	
		Pre	**Post**	**Pre**	**Post**
Oxygen Consumption (Ml/min)	**Mean**	846.1	694.8	720.6	670.1
	SEM	84.1	61.4	54.8	68.1
Breath Rate (cpm,)	**Mean**	11.8	9.4**	11.5	10.2
	SEM	1.0	0.6	1.0	0.7
Breath Volume (ml)	**Mean**	1079.2	1188.3	986	1052.6
	SEM	68.0	75.1	84.0	75.9

* p<.01 paired t-test. “Post” compared to “Pre”

Table 2
Means and Standard Error of the Means (SEMs) of Autonomic Variables (n=15)
Before and After Isometric Relaxation and Supine Rest

Parameters		IRT		SR	
		Pre	**Post**	**Pre**	**Post**
Heart Rate (bmp)	**Mean**	76.1	74.8	76.3	75.8
	SEM	2.6	3.0	2.3	2.7
Respiratory Rate (cpm,)	**Mean**	19.1	17.0*	19.1	18.0
	SEM	0.9	1.2	1.3	1.2
Finger Plethysmogram amplitude(mm)	**Mean**	3.73	4.05	7.43@	5.27***
	SEM	0.3	0.5	0.8	0.7
Low frequency(in nU)	**Mean**	35.9	37.4	37.9	40.3
	SEM	2.1	3.9	4.3	3.6
High frequency(in nU)	**Mean**	64.1	62.6	62.0	59.6
	SEM	2.1	3.9	4.3	3.6
LF/HF ratio	**Mean**	0.59	0.84	0.76	0.79
	SEM	0.1	0.3	0.2	0.1

* p<0.05 ***p<.001, paired t test. “Post” compared to “Pre” @p<.001, Tukey test

The paired t test showed significant reduction in breath rate (20.6%, p<.01) after IRT, values for oxygen consumption and breath amplitude after both IRT and SR sessions were not significant

Autonomic measures

There was no significant difference between values recorded before and after the session of isometric relaxation techniques and of supine rest (i.e., Factor B) for finger plethysmogram amplitude, heart rate, high frequency in power spectrum low frequency, ratio of low frequency to high frequency (LF/HF). The differences between the two categories of subjects (Factor A) was significant for finger plethysmogram amplitude (F=15.90, df =1.56, p<. 001 (2), with a significant interaction between Factors (A X B) for finger plethysmogram amplitude (F=4.04, for df =1.56, p<. 05(1)).

Tukey multiple comparison test shows that the average finger plethysmogram amplitude recorded before SR as a baseline was significantly more than the average value recorded before IRT (q = 6.0, p<. 001).

The paired t test showed a significant reduction in respiratory rate (10.4%, p<. 05) after IRT and in finger plethysmogram amplitude (29.0%, p<. 01) post SR, compared to the respective "before" value for these parameters.

DISCUSSION

In the present study there was a significant decrease in breath frequency following IRT, and a decrease in finger plethysmogram amplitude after SR. There were no changes in measures of autonomic activity. The rate of respiration is highly sensitive to phasic changes in the psychological state (Lorig & Schwartz, 1990). The increase in breath rate has been correlated with experimentally evoked fear and anxiety (Ax, 1953), as well as before situations such as parachute jumping (Fenz & Jones, 1972). The reduction in breath rate after yoga based IRT is consistent with other reports of reduced breath rate related to the practice of yoga, both as an immediate effect (Wallace, Benson & Wilson, 1971) and after three months (Joseph et al., 1981). This suggests that IRT may help to reduce some aspects of physiological arousal, without modifying autonomic activity.

Similarly, the non-significant trend of decrease in oxygen consumption and increase in breath amplitude after IRT, also suggest a reduction of arousal. A decrease in finger plethysmogram amplitude is suggestive of increased peripheral vasoconstriction related to increased sympathetic vasomotor tone (Delius & Kellerova, 1971), which occurred after SR. This change may be due to the postural readjustment as the "post" recording was made while seated erect, compared to the supine position, during the test period.

In conclusion, yoga based IRT produced better physiological rest than SR, supporting the idea that a combination of stimulation (through isometric contractions) and relaxation may reduce arousal better than relaxation alone.

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