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Original Article

Physiology Section

A Study on Effects of Meditation on Sympathetic Nervous System Functional Status in Meditators

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ABSTRACT

Objective: Meditation has long been known to affect human physiology through autonomic nervous system. This study was designed to assess sympathetic autonomic functional status of meditators of various age groups.

Material and Methods: Three clinical tests, Isometric handgrip test,Cold pressor test and Valsalva Meneuver were studied in 25 meditators of age ranging from 25 to 75 years. The results were compared with those observed in 25 non-meditators of matching age and socio economic status.

Observation and Results: The basal cardiac parameters viz heart rate and blood pressure were uniformly lower in meditators than non meditators in all age groups, more so in senior meditators. On performing isometric handgrip test, non-meditators developed significant increase in blood pressure and heart rate during gripping than that seen in meditators. In cold pressor test, as compared to non-meditators, mediators showed blunted increase in blood pressure along with returning of blood pressure to basal level earlier, which indicated presence of controlled sympathetic drive in meditators. In Valsalva maneuver the overshoot of BP was lower in meditators than in non meditators.

Conclusion: It can be concluded that the regular practice of meditation initially blunted the sympathetic drive and later on developed control over sympathetic function of meditators. .

Key Words: Meditation Cold Pressor test, Isometric Handgrip Dynamometry, Valsalva maneuver Meditators

INTRODUCTION

A common essential feature of various spiritual traditions is the intuitive knowledge of close connection between mind and the body, which may possibly be achieved by the techniques like Meditation, Yoga etc. Meditation is basically a family of many techniques, each of which is involved in the conscious and voluntary efforts, to focus the attention of the meditator. It is an activity that keeps the attention pleasantly anchored in the present moment. Meditation has always been a subject of intense exploration amongst scientists. The physiology of meditation differs from that of ordinary rest with eyes closed and from that of most hypnotic states. Further, during meditation, deep physiological relaxation, somewhat similar to that occurring in the "deepest" Non-Rapid-Eye-Movement (NREM) sleep phase occurs in a context of wakefulness [1,2].

A vast complexity of biological organization indicates that the physiological responses to meditation probably occurs on a multidimensional, interactive basis. Further, meditation produces specific neural activation patterns involving decreased limbic arousal in the brain, which in turn results in reduced stress and increased autonomic stability [3,4].Different clinical reflexes are practiced to assess autonomic functions in clinical conditions like borderline hypertension and diabetes mellitus [5,6]. Some scientists have demonstrated the effects of meditation on parameters like Galvanic Skin Resistance (GSR) and EDR only [2] but attempt to assess functioning of autonomic nervous system in meditators by using different clinical reflexes are still lacking. So the present study was aimed to assess the autonomic functional status in mediators by using such techniques.

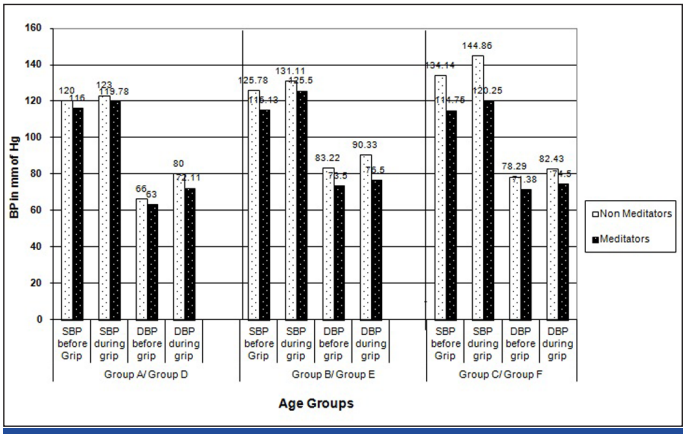
MATERIALS AND METHODS

Present study was carried out in the department of Physiology, Himalayan Institute of Medical Sciences, Swami Ram Nagar, Dehra Dun, Uttaranchal, India. Out of fifty male subjects, 25-75 years of age, who volunteered, twenty five were asymptomatic meditators (from Yogoda Satsanga Dhyana Mandali Dehradun) and rest twenty five were non–meditators of similar age, and physical activity.

From each meditator a detailed history of meditation practices was recorded with special reference to duration, numbers of meditation sessions per day, and the age at which the meditation practice was started.

Following clinical reflexes were performed to assess autonomic functional status:

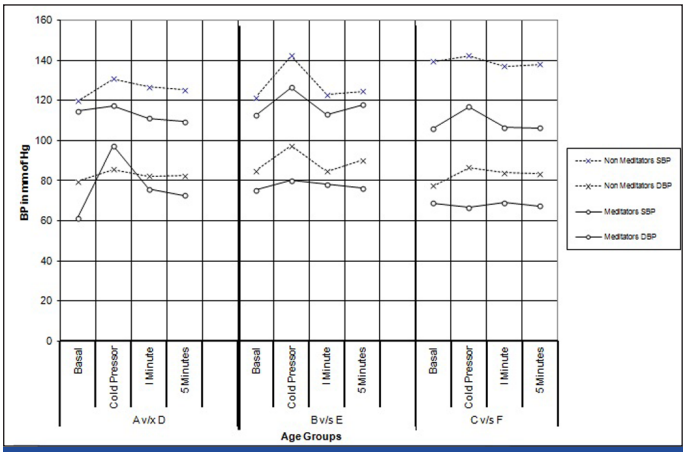
1. **Isometric hand grip Dynamometry [5]:** On a sustained hand grip at 30% of maximum voluntary capacity for 15 sec, parameters i.e. Heart Rate (HR) and Blood Pressure (BP), were recorded just before the release of hand grip, after 1 min



[Table/Fig-1]: Relative Rise in Blood Pressure on sustained Grip in Non Meditators and Meditators

and 5 minutes of grip release.

2. **Cold Pressor test [7]:** It was performed in sitting posture, while left hand (upto first crease at wrist) was immersed in cold water at 8 degree Celsius for 2 min. Parameters were recorded during immersion and after 1and 5 minutes of removing hand from cold water.
3. **Valsalva maneuver [7]:** With nostrils closed and after forceful blow into the tube of aneroid manometer, subject held it at 40 mmHg for 15 sec. RR intervals were observed to determine Valsalva Ratio. (Valsalva Ratio being the ratio of longest RR interval during 1 minute after the strain and shortest RR interval during the strain.)
   - Each test was performed after a resting period of 10 minutes, in supine or sitting position.
   - The heart rate (HR) was measured from the R-R interval of ECG using Lead II of Electrocardiograph machine (BPL Cardiart 108). Blood Pressure was recorded by using an electronic BP apparatus (National, Japan). Handgrip strength was measured by using a handgrip Dynamometer.
   - The data obtained were subjected to appropriate statistical analysis using Microsoft Excel software. The one tail student 't' test was applied for the analysis.



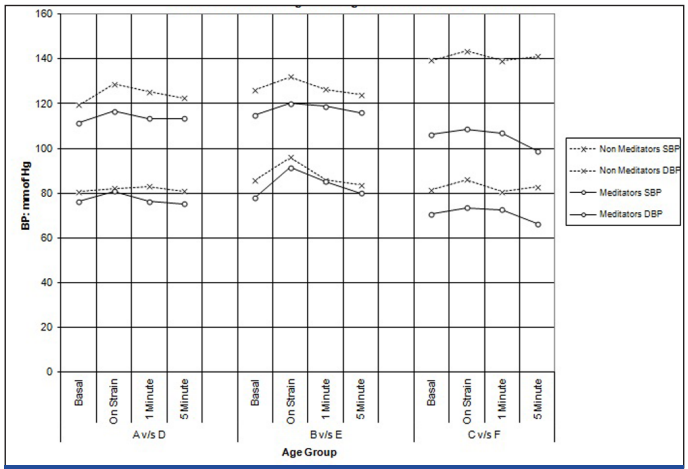
[Table/Fig-2]: Blood Pressure Changes during and after Cold Pressor Test

OBSERVATIONS AND RESULTS

All the subjects of both groups were divided into 3 groups of (25-40 years), (41-55 years) and (56 years onwards). Accordingly the non meditators were groped as A,B,C and meditators as group D,E,F.

The duration of meditation in years as well as in the hours per day was in direct proportion to the increasing age of meditators.

Basal Blood Pressure and Heart Rate: [Table/Fig-1]



[Table/Fig-3]: Blood Pressure Changes during and after Valsalva Maneuver

		N	Mean Age ± S D	Mean SBP ± S D	Mean DBP ± S D	Mean H R ± S D
Non-Meditators	(A+B+C)	25				
	A	9	34.56 ± 4.42	118.33 ± 6.20	71.33 ± 3.43	69.77 ± 6.36
	B	9	47.33 ± 5.00	128 ± 10.55	84 ± 5.68	75.88 ± 12.92
	C	7	63.00 ± 7.21	135.42±10.06	79.85 ± 3.07	75 ± 9.20
Meditators	(D+E+F)	25				
	D	9	36.67± 3.28	114.33 ± 6.20	68.33 ± 3.43	70.33 ± 9.49
	E	8	48.5 ± 5.88	115.9 ± 3.87	75.12 ± 5.59	70.75 ± 9.13
	F	8	67.5 ± 5.04	114.75 ± 4.09	71.88 ± 4.12	69.87 ± 8.90
Statistically Significant P values						
Intra Group Non Meditators	A vs B		0.006	0.073		0.080
	B vs C		0.001	0.087	0.043	
	A vs C		0.001	0.002	0.001	
Intra Group Meditators	D vs E		0.001		0.006	
	E vs F		0.001			
	D vs F		0.001		0.038	
Inter Group compariso	A vs D			0.064	0.025	
	B vs E			0.014	0.003	
	C vs F			0.001	0.001	

[Table/Fig-4]: Age distri bution and basal cardiac parameters of subjects

			Basal			During Isometric Handgrip			On release		
			SBP	DBP	HR	SBP	DBP	HR	SBP	DBP	HR
Age Group 25-40 Years	Group A	Mean	120.0	66.0	69.1	123.0	79.6	74.4	121.2	75.9	68.4
		SD	2.96	5.77	7.79	6.00	6.53	13.00	7.01	7.57	9.36
	Group D	Mean	116.0	62.8	66.9	119.8	72.1	80.0	115.8	67.4	72.4
		SD	1.67	2.17	11.08	4.53	4.10	20.29	4.60	9.77	11.41
Unpaired 't' test: A vs D			0.003	0.068			0.005		0.035	0.029	
Age Group 41-55 Years	Group B	Mean	125.8	83.2	76.8	131.1	90.3	71.8	122.3	82.9	77.7
		SD	9.04	5.14	13.26	16.01	6.80	22.73	15.72	6.51	16.09
	Group E	Mean	115.1	73.5	68.8	125.5	76.5	78.1	109.0	64.3	68.8
		SD	10.59	6.91	8.12	9.71	8.45	15.67	12.14	25.18	8.10
Unpaired 't' test: B vs E			0.022	0.003	0.075		0.001		0.034	0.039	0.084
Age Group 56 Years Onwards	Group C	Mean	134.1	78.3	77.3	144.9	82.4	80.6	131.0	87.4	76.9
		SD	10.02	4.46	10.87	13.35	11.37	10.24	11.09	7.48	11.13
	Group F	Mean	114.8	71.4	68.6	120.3	74.5	70.9	108.0	68.4	71.1
		SD	4.10	4.21	6.65	6.16	5.35	4.02	4.17	4.50	7.86
Unpaired 't' test: C vs F			0.001	0.005	0.049	0.001	0.064	0.024	0.001	0.001	

[Table/Fig-5]: Isometric Handgrip Dynamometry, P <.0.1 significant (Only significant values shown)

			Basal		BP during strain		1 Minute later	
			SBP	DBP	SBP	DBP	SBP	DBP
Age Group 25-40 Years	Group A	Mean	119.56	80.56	128.89	82.22	125.22	83.11
		SD	3.68	5.81	4.43	3.63	3.67	4.73
	Group D	Mean	111.4	76.3	116.6	80.8	113.4	76.3
		SD	7.89	5.81	12.92	11.86	9.36	4.27
Unpaired 't' test: A vs D			0.006	0.071	0.008		0.001	0.003
Age Group 41-55 Years	Group B	Mean	126.22	85.89	132.00	96.00	126.44	85.78
		SD	11.40	5.84	8.87	12.16	11.53	7.97
	Group E	Mean	115.0	78.0	120.0	91.5	118.8	85.3
		SD	8.50	8.47	12.84	11.59	11.91	8.99
Unpaired 't' test: B vs E			0.018	0.023	0.023		0.099	
Age Group 56 Years Onwards	Group C	Mean	139.43	81.57	143.57	86.00	139.14	80.57
		SD	15.36	8.44	21.17	22.62	17.36	18.47
	Group F	Mean	106.3	70.6	108.6	73.5	106.9	72.5
		SD	4.43	4.10	4.03	6.50	5.17	4.72
Unpaired 't' test: C vs F			0.001	0.007	0.002		0.001	

[Table/Fig-6]: Valsalva Maneuver, P <0.1 significant (Only significant values shown)

In non-meditators basal Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were lowest in group A and higher in older subjects (group B and group C). While in meditators SBP was similar in all the three groups (group D, E, F), while DBP was higher in group E and group F than in group D. Heart rate (HR) increased gradually in non meditators with age, while in meditators it was lower in group E and group F.

Inter group comparison showed that basal SBP, DBP and HR were statistically significantly (p=.025) lower in meditators than in non-meditators of corresponding age groups especially in group F than in group C. However this difference was statistically more signifiThe duration of meditation in years as well as in the hours per day was in direct proportion to the increasing age of meditators.

Basal Blood Pressure and Heart Rate: [Table/Fig-1].

In non-meditators basal Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were lowest in group A and higher in older subjects (group B and group C). While in meditators SBP was similar in all the three groups (group D, E, F), while DBP was higher in group E and group F than in group D. Heart rate (HR) increased gradually in non meditators with age, while in meditators it was lower in group E and group F.

			Basal			Cold Pressor for 90 secs			1 Minute later			5 Minutes later			
			SBP	DBP	HR	SBP	DBP	HR	SBP	DBP	HR	SBP		DBP	HR
Age Group 25-40 Years	Group A	**Mean**	119.9	79.6	71.3	130.9	85.7	75.3	126.8	82.2	69.2	125.2	4.3	82.4	71.8
		SD	5.17	6.06	7.23	5.59	12.33	15.94	13.33	5.90	14.77	10.12		7.04	8.09
	Group D	**Mean**	114.8	61.3	68.6	117.3	77.4	69.0	111.0	75.9	61.3	109.4	6.7	72.5	64.3
		SD	5.17	6.06	11.61	5.59	12.34	9.45	13.33	5.90	12.86	10.12		7.04	9.75
Unpaired 't' test: A vs D			0.016	0.033					0.021	0.011		0.006		0.044	0.048
Age Group 41-55 Years	Group B	**Mean**	121.6	84.9	77.1	142.3	97.4	83.1	123.0	84.7	76.7	124.6	12.5	90.2	75.3
		SD	13.85	4.81	12.22	7.02	7.54	13.41	12.04	6.30	11.86	20.90		9.23	5.81
	group E	**Mean**	112.5	75.4	71.9	126.5	80.1	74.9	113.1	78.1	72.0	117.8	6.9	76.4	72.4
		SD	10.03	3.89	6.03	13.32	16.89	8.87	15.54	7.86	7.41	11.30		5.93	7.19
Unpaired 't' test: B vs E			0.071	0.001		0.006	0.012	0.077	0.085	0.041				0.001	
Age Group 56 Years	Group C	**Mean**	139.6	77.4	75.7	142.3	86.6	77.9	137.0	84.0	75.3	138.0	3.0	83.6	76.4
		SD	15.08	5.94	7.87	19.34	9.20	8.97	18.18	7.30	8.36	18.27		7.02	7.89
	Group F	**Mean**	106.0	68.8	69.3	117.0	66.6	69.4	106.5	69.0	70.3	106.4	9.1	67.4	69.0
		SD	5.21	4.89	6.86	4.00	6.86	4.03	7.11	4.63	7.23	5.01		3.78	4.66
Unpaired 't' test: C vs F			0.001	0.005	0.059	0.007	0.001	0.025	0.002	0.001		0.002		0.000	0.028

[Table/Fig-7]: P <.01 significant (Only significant values shown)

Inter group comparison showed that basal SBP, DBP and HR were statistically significantly (p=.025) lower in meditators than in non-meditators of corresponding age groups especially in group F than in group C. However this difference was statistically more significant (p=.001) in senior meditators.

Study of basal parameters was followed by different test mentioned above [Table/Fig 2 to 7].

DISCUSSION

Bodily responses following meditation may vary, depending upon the age, sex and duration of meditation [8].

In initial phase of meditation, a regular practice of the relaxation response is believed to establish a hypometabolic state of parasympathetic dominance in meditators, which continually resets the level of metabolic functioning to a lower rate. It has been seen that people who have been meditating for years/decades, show marked differences in both their physiological response and their ability to control their own physiology compared with meditators who have only been practicing meditation for a short time. Hence it has been stressed that physiological effects of meditation are mediated through autonomic nervous system [9,10].In present study, both SBP and DBP increased with advancing of age in non-meditators. Such changes are attributed to the effect of ageing as reported earlier on non-hypertensive patients [11,12].

On the other hand in meditators SBP, DBP and HR showed almost similar values in all the three groups, and statistically significant (p=.001) lower BP and HR was observed in Group F than in corresponding age group C of non-meditators. The probable cause of lowest HR in Group F may be improved vagal tone, as a result of meditative practices of a longer duration.The present study points out significant lower basal SBP and DBP and HR in meditators than non-meditators.

However the rise in SBP and DBP and HR on sustained handgrip was highly significantly higher (p=.005) in all groups of non-meditators which may be due to greater sympathetic drive in non-meditators as reported by Mark et al [13] in normal subjects.

Variations in DBP is a more sensitive and specific to diagnose autonomic disorders [14]. The rise of DBP was found to be statistically significantly lower (p.064) during the period of sustained grip in meditators than in non-meditators with more significant in senior meditators of group F [Table/Fig-5]. In addition, the rise of SBP and Heart Rate also showed a more statistically significant (p.001) lower values in all groups of meditators and their levels were observed even lower that pretest valus after release of handgrip [Table/Fig-1]. The comparatively smaller rise of SBP, DBP and HR on sustained grip in meditators indicates the presence of lower sympathetic drive in them supporting the hypothesis of enhanced control on sympathetic drive by meditative techniques.

The cold pressor test is a measure of sympathetic activity.In resting state both SBP and DBP were statistically significantly lower (p=.001) in meditators than non-meditators . In addition heart rate was also found to be statistically significant lower (p.05), especially in meditators in group F. However, in non-meditators the rise in SBP and DBP was increased statistically significant following cold pressor test in all groups and returned to normal in 5 minutes.

In meditators, there was statistically significant increase in DBP in group D only; indicating pronounced sympathetic response similar to that seen in non-meditators. On the other hand, in group F meditators, there was no significant increase in DBP and HR, depicting reduced sympathetic response in senior meditators [Table/Fig -2].

These findings along with other findings of this study with different autonomic tests, indicate a decline in sympathetic drive in the senior meditators . Further it was seen that in meditators the SBP, DBP and HR returned to normal earlier than that seen in non-meditators suggesting less sympathetic drive in meditators more so with increase in meditating duration as seen in senior meditators.

On straining during valsalva maneuver, the overshoot of SBP was significantly (p) lower in meditators in comparison to non-meditators. This was still lower in senior meditators of subjects in group F. All parameters returned to near normal within 5 minutes in all groups but in group F, it reached to a lower value than the pretest levels [Table/Fig -3]. It suggests that the sympathetic activity was

lower in meditators than non-meditators and especially so with long duration practitioners.

It can be concluded that meditative techniques may affect the autonomic activity significantly creating a balance in favour of parasympathetic nervous system but the effects requires a long term continuation of the technique. Changes in autonomic activity might help in reducing psychosomatic disorders and general well being of an individual.

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