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Immediate effect of Chandra and Suryanadi Pranayamas on Cardiovascular Parameters and Reaction Time in a Geriatric Population

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ABSTRACT

Previous studies have reported differential physiological and psychological effects of exclusive right and left nostril breathing. Though potential health benefits have been postulated, further clinical research is required to prove immediate and sustained efficacy of these techniques. This study evaluated immediate effects of exclusive right (SNP) and left (CNP) nostril breathing on cardiovascular (CV) parameters and reaction time (RT) in a geriatric population. 26 subjects attending regular yoga sessions at a senior citizen hospice, were recruited for this self-controlled study. They were instructed to sit in any comfortable posture and relax for 5 min before taking the pre-intervention recordings of Heart rate (HR), blood pressure (BP), auditory and visual RT (ART and VRT respectively). They then performed the selected technique and parameters were recorded immediately after performance of 9 rounds of either SNP or CNP. The entire sequence of recordings was randomised to avoid any bias. Intra and inter group statistical analysis was carried out using Student's paired t test for data that passed normality testing and Wilcoxon matched-pairs signed-ranks test applied for the others. Overall intra-group comparison of pre-post data and inter-group Δ % comparisons showed statistically significant ($p < 0.05$) differences for all parameters. There was an overall reduction in HR and BP-based parameters following both SNP and CNP. However, inter-group Δ % comparisons revealed a significantly greater reduction after CNP for all parameters. Inter-group comparisons revealed highly significant decreases ($p < 0.001$) in VRT and ART after SNP. In conclusion, our study sheds new light on the physiological changes occurring after SNP and CNP in a geriatric population. While both techniques reduce HR and BP, CNP does it more significantly. There is shortening of RT following SNP and this may be attributed to enhance sensory motor function that is of great significance in the elderly. We suggest that Yoga should be part of the heath care facilities for the elderly as it can enhance their quality of life and improve their overall health status.

Keywords: *Cardiovascular, Geriatrics, Pranayama, Reaction Time, Yoga*

INTRODUCTION

Ageing is a progressive, generalised impairment of function, resulting in a loss of adaptive response to stress and in a growing risk of age-related disease. (1) It is a natural process characterised by declining physical performance, slower speed of reaction, inadequate working of various systems with poor motor and sensory conduction. The process of aging is characterised by progressive and generalised impairment of homeostasis resulting in declining ability to respond to external or internal stresses and increased risk of diseases. (2)

Yoga is a conventional long-established and time-tested art and therapeutic science that has positive contribution to make in maintenance of general wellbeing and happiness. According to the Hathapradipika, one of the traditional Yoga texts, it is a safe and reliable practice that can be done at any age *(Yuva vrddho'thivrddho va vyadhito durbalo'pi va abhyasat siddimapnoti sarvayogeshvatandritah.* Whether young,

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old or very old, sick or debilitated, one who is vigilant attains success in all yoga, by means of practice, provided they abide to the rules and regulations properly- Hathapradipika I:64). [3] Yoga has preventive, curative as well as rehabilitative potential and this may be explained on the basis of its ability to modulate autonomic functions, relieve stress, improve physiological functions including cardio-respiratory fitness and improve quality of life. [4,5,6]

Swarodaya vigyan, the science of understanding the ultradian nasal cycle has been traditionally codified in Shiva Swarodaya wherein differential effects of different phases of the nasal cycle are given in great detail [7] It is traditionally taught that breathing exclusively through the left nostril or chandra nadi pranayama (CNP) potentiates ida nadi, the "lunar channel" while breathing exclusively through the right in surya nadi pranayama (SNP), activates the pingala nadi, the "solar channel".

There is some evidence that the practice of Pranayama (the fourth limb of Ashtanga Yoga) can significantly lower dangerous free radicals while increasing the body's intrinsic potential to produce protective antioxidants. [8] This may be one of the intrinsic mechanisms by which it helps improve psycho-physiological wellbeing in patients suffering from chronic degenerative diseases that are more common in the elderly.

Previous studies have reported differential physiological and psychological effects of exclusive right and left nostril breathing. [9,10,11] Though potential health benefits have been postulated, further clinical research is required to prove immediate and sustained efficacy of these techniques especially in a geriatric population.

With the above in mind, this study planned to evaluate immediate effects of SNP and CNP on cardiovascular (CV) parameters and reaction time (RT) in a geriatric population. We selected heart rate (HR) and blood pressure (BP) as these indicate changes in cardiac autonomic regulation while RT is an index of processing ability of central nervous system and a simple, non invasive means of determining sensorimotor co-ordination and performance. [12, 13]

MATERIALS AND METHOD

Twenty six subjects (21 females, 5 males) attending regular yoga sessions at a senior citizen hospice, twice weekly for more than 3 months were recruited for this self-controlled study by convenience sampling. Their mean age and body mass index (BMI) were 61.38 ± 3.61 (SD) years and 25.26 ± 6.33 units respectively. All of them were right handed. Three of them reported normal health status, whereas others reported that they were on regular treatment for one or more medical conditions like hypertension (14), hypothyroidism (3), type 2 diabetes mellitus (15), knee pain (4), low back pain (3), arthritis (1), asthma (2), dyslipidemia (4) and insomnia (2). None were receiving autonomic modifying agents like α- or β-blocking drugs.

The study was conducted on four different days between 4pm and 5.30 pm. To avoid any confounding effects of recording on different days, subjects were randomly assigned to do one of the techniques on two days of their recording. One half of the subjects performed CNP, while the others performed SNP and this was reversed on the next day. The subjects were instructed to sit in any comfortable posture and relax for 5 min before taking the pre-intervention recordings of HR, systolic pressure (SP), diastolic pressure (DP), auditory and visual RT (ART and VRT respectively). They then performed the selected technique and the parameters were recorded immediately after the performance of 9 rounds of either the SNP or CNP. The entire sequence of recordings was randomised to avoid any bias.

SNP was performed using nasika mudra wherein the ring finger of the right hand was used to occlude the left nostril by pressing on the outside of the nostril. CNP was performed using nasika mudra wherein the thumb was used to occlude right nostril by pressing on the outside of the nostril. The left hand was held in Jnana Mudra on both the occasions. Participants were instructed to focus their mind on their breath and ensure it was slow, deep, and regular while attempting to utilize all sections of their lungs. Respiratory rate for all techniques was maintained at 5-6 breaths per min (BPM) and this was regulated by providing an audible count of six for both inspiration and expiration. As they were all attending regular Yoga sessions, none reported any difficulty in doing the techniques.

HR, SP and DP were recorded using non-invasive semi-automatic BP apparatus (CH – 432, Citizen Systems, Tokyo, Japan) having range from 40 to 180 beats/min and accuracy ± 5%. Mean pressure (MP), pulse pressure (PP), rate-pressure product (RPP) and double product (Do P) were calculated by respective formulae.

RT apparatus (Anand Agencies, Pune) with a built in 4 digit chronoscope and display accuracy of 1 ms was used for the study. Simple ART was recorded for auditory beep sound stimulus and simple VRT for red

light stimulus. The subjects were instructed to release response key as soon as they perceived stimulus. Signals were given from the front to avoid effect of lateralized stimulus and they used dominant hand while responding to signals.[10,11] All subjects were given adequate exposure to the equipment on two different occasions to familiarize them with the procedure as RT is more consistent when subjects have had adequate practice. [14] More than ten trials were recorded and the mean of three similar observations was taken as a single value for purpose of statistical analysis. [15, 16]

Data were assessed for normality using GraphPad InStat version 3.06 for Windows 95, (GraphPad Software, San Diego California USA). Intra and inter group statistical analysis was carried out using Student's paired t test for data that passed normality testing by Kolmogorov-Smirnov Test. Wilcoxon matched-pairs signed-ranks test was applied for other data. P values less than 0.05 were accepted as indicating significant differences for pre-post and intergroup comparisons.

RESULTS

The results are given in Table 1. Overall intra-group comparison of pre-post data and inter-group Δ % comparisons showed statistically significant ($p < 0.05$) differences for all parameters. There was an overall reduction in HR and BP-based parameters following both SNP and CNP. However, inter-group Δ % comparisons revealed a significantly greater reduction after CNP for all parameters except DP and HR (that just missed statistical significance). Inter-group comparisons revealed highly significant decreases ($p < 0.001$) in VRT and ART after SNP.

Table 1: Immediate effect of chandra nadi pranayama (CNP) and surya nadi pranayama (SNP) on heart rate (HR), systolic pressure (SP), diastolic pressure (DP), mean arterial pressure (MAP), pulse pressure (PP), rate pressure product (RPP), double product (DoP), auditory reaction time (ART) and visual reaction time (VRT) in a geriatric population before (B) and immediately after (A) nine rounds of the technique.

Parameters	CNP (n = 26)			SNP (n = 26)			Comparison (p value)		
	B	A	Δ %	B	A	Δ%	B	A	Δ%
HR	79.19	74.46	-4.64	79.81	77.65	-1.69	0.408	0.047	0.0889
(beats/min)	± 12.52	± 7.54**	± 11.13	± 12.75	± 8.59	± 9.26			
SP	142.42	132.85	-6.31	142.12	138.65	-2.17	0.7593	0.0097	0.0032
(mmHg)	± 18.61	± 13.7***	± 6.05	± 18.51	± 15.28*	± 4.27			
DP	83.46	79.73	-3.77	83.85	80.35	-3.56	0.4836	0.5779	0.7222
(mmHg)	± 11.09	± 7.25**	± 7.58	± 11.19	± 8.24**	± 7.21			
MP	103.12	97.44	-5.05	103.27	99.78	-3.05	0.7531	0.0313	0.0182
(mmHg)	± 11.81	± 7.77***	± 5.78	± 11.89	± 9.21**	± 4.63			
PP	58.96	53.12	-7.91	58.27	58.31	2.03	0.5113	0.0248	0.0254
(mmHg)	± 16.13	± 12.94**	± 17.71	± 15.91	± 13.13	± 14.66			
RPP	112.99	99	-10.44	113.79	107.83	-3.76	0.6476	0.0057	0.0101
(units)	± 23.86	± 5.34**	± 13.78	± 25.12	± 17.64*	± 10.62			
DoP	81.81	72.58	-9.24	82.66	77.48	-4.63	0.2999	0.007	0.029
(Units)	±16.28	± 9.70**	±13.90	± 17.17	± 11.01**	± 10.63			
ART	297.83	292.03	-1.12	293.28	279.73	-4.59	0.0215	0.0003	0.0038
(ms)	± 56.21	± 37.48	±5.67	± 52.9	± 50.18***	± 2.81			
VRT	315.05	316.89	0.82	307.65	296.21	-3.68	0.0132	<0.0001	<0.0001
(ms)	± 68.7	± 64.82	±2.7	± 54.06	± 51.38***	± 2.12			

Values are given as mean ± SD for 26 subjects. * $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$ by paired t test for intra group comparisons of HR, SP (SNP), DP, MP, PP, RPP and DoP and Wilcoxon matched-pairs signed-ranks test for SP (CNP), ART and VRT. Actual p values are given for paired t test (HR, DP, MP, PP, RPP and DoP) and Wilcoxon matched-pairs signed-ranks test (SP, ART and VRT.) are given for the intergroup comparisons. Δ % comparisons were done by paired t test for PP and RPP and by Wilcoxon matched-pairs signed-ranks test for the rest.

DISCUSSION

In the present study we have found a reduction in all CV parameters following 9 rounds of both CNP and SNP, but these changes were more significant following CNP. This may be due to the fact that slow and deep breathing at the rate of 5-6 BPM has been reported to enhance cardiac autonomic regulation. [17] A normalization of autonomic CV rhythms as a result of increased vagal modulation and/ or decreased sympathetic activity and improved baroreflex sensitivity have been suggested in an earlier report on CNP in hypertensive patients [18] It has been however reported that yogic breathing through right, left, or through both nostrils in normal subjects produces distinct autonomic changes and that SNP increased SP and DP, whereas CNP resulted in significant reduction in SP and MP. [11] Jain et al suggested that sympathetic activation produced by right nostril breathing may be masked by vagally mediated lung baroreceptor activity enhanced by voluntary breathing efforts. [19] Hence changes following CNP may be attributed to a parasympatho-mimetic effect as the nasal cycle is dependent upon tonic activity of limbic autonomic nervous system with hypothalamus as control centre, as well as levels of circulating catecholamines and other neuro-hormones. [20, 21]

Interestingly in our geriatric population, even right nostril breathing decreased CV parameters. This seems to be a contradiction to concepts of swara yoga but a recent report has found that SNP is safe in hypertensives and attributed this to in-built safety mechanisms of yoga that enhances homeostatic normalcy. [22] The goal of Yoga is to restore homeostasis, hence, if sympathetic reactivity of a subject is already higher than normal, it is suggested that yogic techniques will not further increase such a hyper reactivity but rather bring it back to normal. Hence, we suggest that SNP may be practiced safely by the geriatric population though CNP has greater benefits. Changes in the RPP and DoP signify a reduced work load on the heart with reduced O_2 consumption, and this is indeed a positive finding in the geriatric population.

The RT changes following CNP and SNP were however very divergent with significant reduction being seen in SNP and no such changes in CNP. The activation following SNP may be attributed to an improved central neuronal processing ability due to greater arousal and faster rate of information processing. [15] This is usually attributed to an alert state produced by sympathetic activation, but in the present study, as CV parameters haven't shown such a change, it must be due to other mechanisms. Earlier studies by the authors have reported shortened RT following mukha bhastrika in both normal and mentally challenged children and also after surya namaskar. [16, 23] It has been previously suggested that right nostril dominance in the nasal cycle as well as right uninostril forced breathing, may be correlated with the "activity phase" of the basic rest-activity cycle, the time during which sympathetic activity in general exceeds parasympathetic activity throughout the body.[24] Werntz et al have also reported relatively greater integrated electro encephalogram (EEG) value in one hemisphere correlating with predominant airflow in contralateral nostril, defining the inter-relationship between cerebral dominance and peripheral autonomic nervous function.[25] In this study, the wider variation in RT values may be attributed to reduced sensory awareness and attention span in the elderly. This may also be why there were significant differences in pre-test values too.

In conclusion, our study sheds new light on physiological changes occurring after SNP and CNP in a geriatric population. While both techniques reduce HR and BP, CNP does it more significantly. There is shortening of RT following SNP and this may be attributed to enhanced sensory motor function of great significance in the elderly. We suggest that Yoga should be part of heath care facilities for elderly as it can enhance quality of life and improve overall health status.

Conflict of Interest: None

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