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EVALUATION OF THE EFFECT OF *PRANAYAMA* AND *AGASTYA HARITAKI RASAYANA* ON *PRANVAHA SROTAS*: A COMPARATIVE CLINICAL STUDY

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Abstract- Ayurveda is the ancient medicinal system of India which has been being practiced over thousands of years. It emphasizes on the prevention from disease and to maintain the health of an individual. Worldwide approximately 30 % of population is suffering from various Cardio vascular and respiratory disorders. Ayurveda consider cardiovascular system and respiratory system as *Pranvaha Srotas* (System for conduction of vital force or life). Proper functioning of *Pranvaha Srotas* can be helpful in the prevention of cardio-respiratory disorders. *Pranayam* is *Yogik* technique which is mentioned for good health and *Agastya Haritaki Rasayana* is an *Ayurvedic* formulation used for various diseases of *Pranvaha Srotas*. Present paper presents the clinical effects of both measures on *Pranvaha Srotas* in terms of various cardio-respiratory parameters.

Key words: *Ayurveda*, *Pranayama*, *Pranvaha Srotas*,

I. INTRODUCTION

Ayurveda is an ancient science of life which basically deals with the focus on quality of life of an individual. As the term *Ayurveda* is a combination of two words; "*Ayu*" which means life and "*Veda*" which indicates knowledge. So basically it aims towards the longevity of life in means of being healthy in all aspects i.e., physically, mentally and socially. Here the term "*Ayu*" is a fine integration of four essential parts, *Satva* (*Manas*), *Atma* (soul) *Indriya* (the senses) and *Sharir* (the body)[1]. And the fine combination of all these are said to be the medium to conquer the *Purusharth* (goal of life) i.e. *Dharm* (moral duty), *Artha* (economic prosperity), *Kama* (Pleasure) and *Moksha* (spiritual liberation) [2]. *Ayurveda* emphasize the preventive aspect of treatment and for this purpose lots of concepts are there for the prevention of disease and to maintain the healthy status of an individual.

The concept of *Srotas* is amongst the fundamental concepts of *Ayurveda*. *Srotas* constitute the internal transport system of the body & are specially related to the fine channels of circulation & pathways, carrying out all the vital functions of the body. The health & disease depends on the proper structure & function of these channels of the body. Therefore *Srotas* have great importance to maintain the equilibrium, development of the body & in application of treatment to the patients. Among total thirteen *Srotas*[3], *Pranvaha Srotas* is of immense importance because this *Srotas* conducts the flow of *Prana* (Vital energy). Any derangement in the normal physiological values of the *Pranvaha Srotas* may lead to several cardiac and respiratory disorders. As *Acharya Charaka* has mentioned *Hridaya* (Heart) and *Mahasrotas* (G.I.T) are the *Moola* (Origin) of *Pranvaha Srotas*[4] and *Acharya Sushruta* stated *Hridya* and *Rasa* (*Prana*) *Vahi Dhamni* as *Pranvaha Srotas Moola*[5]. So the view of both *Acharya* pointed out a relevant link between *Pranvayu Samvahan* (Respiration) and *Rasa Samvahan* (Blood circulation) and in combined form they maintain the flow of *Prana* (Vital energy essential for life). Physiologically *Pranvaha Srotas* can be understood as a fine functional association between cardiovascular system and the respiratory system which includes all the anatomical structure majorly; heart, associated blood vessels, lungs and the respiratory tract and those are collectively termed as Cardio-respiratory system.

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Our ancient science is enriched with so many concepts and ways to improve the quality of life and feeling of well being. *Yogika* technique like *Pranayama* is among one of them. *Pranayama* simply means Extension of *Prana* (force of life) by gaining control over the breath. It is included under the *Asthanga Yoga* and it is a very effective *Yogika* Technique which has a profound physiological effect on cardio-respiratory system. There are various *Rasayana Yogas* described in different *Ayurvedic* literature which are used to improve vital measures in both healthy and diseased condition. One of them, a famous *Yoga* is *Agastya Haritaki Rasayana* mentioned by *Acharya Charaka*, in the context of *Kasa Roga* [6]. As it is a *Rasayana*, so it can be used in healthy individuals to improve the physiological functions of various body systems including cardio-respiratory system. In the present study an attempt has been made to analyze and compare the effect of *Pranayama* and *Agastya Haritaki Rasayan* on *Pranvaha Srotas* in terms of cardiovascular and respiratory parameters. This study will also help to assess the better measure (preventive or curative) for the maintenance of health.

II. MATERIAL AND METHODS:

A. Ethical clearance:

This study has been approved by IEC, National Institute of Ayurveda, Jaipur under No. IEC/ACA/2016/32.

B. Study type: Interventional, pre and post type clinical trial

C. Selection of the subjects:
For this study apparently healthy individuals were selected from National Institute of Ayurveda, Jaipur and nearby area after applying the following inclusion and exclusion criteria.

D. Inclusion criteria:
- Apparently healthy individuals
- Individuals of either sex

E. Exclusion criteria
- Individuals of less than 16 years and more than 50 years of age.
- Any acute or chronic systemic illness.
- Individuals on any form of respiratory or cardiac medication.
- Individuals of not involved in any kind of athletic activity.

F. Randomization:
Selected subjects were randomized by lottery method and then were distributed in two groups; Group A and group B.

G. Intervention protocol:
Group A was treated as *Pranayama* group, the subjects of group A were given a demo for *Nadi Shodhan Pranayama* (*Anuloma -Viloma*) and were directed to practice regularly for 20 minutes after 10 minutes of warm up/ *Sookshma Vyayama* (warm up exercise) daily in the morning between 6-7 a.m. Subjects of group B were administered *Agastya Haritaki Rasayan*, in a dose of 12 gram before meal once a day.

H. Study Duration: total study duration was of one month.

I. Parameters:
- **Heart Rate:**
  Heart rate was measured by counting radial pulse for a minute. Three readings were taken and their average was recorded.
- **Blood pressure:**
  Both systolic and diastolic blood pressures were measured with the auscultatory method by using sphygmomanometer and stethoscope. Three readings were taken and their average was recorded.
- **ECG:**
  Electro cardiogram recording of each subject was taken with standard ECG machine.
- **Chest expansion:**
  Maximum chest expansion was measured manually by using measuring tape.
- **Respiratory rate:**
  Respiratory rate was measured in the subject in supine position by the movement of the abdominal wall per minute.
- **Respiratory blast test:**
  It was conducted by using mercury sphygmomanometer by removing its bladder (pump) part and then subject was asked to inhale deeply and then blow up to the maximum capacity. Three reading were taken and then the average value was recorded.
- **Spirometry:** Lung capacity parameters like FVC, FEV1 and PEFR were measured by using medspiror spirometer (computerized).

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III. RESULTS

Collected data was analyzed statistically by using graph pad prism 7.04 and it is as below:

Table 1: Results on Cardio vascular Parameters

S.No.	parameter	Group	Mean score			S.D±	SE±	P value	Result
			B.T	A.T	Diff.				
1.	Chest expansion	A	87.58	87.60	-0.026	0.09649	0.01365	0.0626	**N.Q.S**
		B	84.06	84.14	0.074	0.3089	0.04369	0.0966	**N.S**
2.	Respiratory rate	A	18.3	17.12	10.78	1.055	0.1493	<.0001	**E.S**
		B	17.96	17.88	0.08	1.027	0.1452	0.5843	**N.S**
3.	Respiratory blast test	A	80.62	81.84	1.22	2.401	0.3396	0.0008	**H.S**
		B	83.5	83.54	0.04	1.106	0.1564	0.7992	**N.S**
4.	FVC	A	3.154	3.336	-0.1820	0.1734	0.02453	<.00001	**E.S**
		B	3.044	3.062	-0.0180	0.1747	0.02470	0.0598	**N.Q.S**
5.	FEV1	A	2.364	2.404	-0.04000	0.04949	0.006999	<.00001	**E.S**
		B	2.488	2.482	0.006	0.04669	0.006646	0.3710	**N.S**
6.	PEFR	A	6.672	6.740	-0.06800	0.08533	0.02184	0.0031	**V.S**
		B	6.672	6.664	0.008000	0.04669	0.01207	0.5105	**N.S**

Table 2: Results on Respiratory parameters

S.No.	parameter	Group	Mean score			S.D±	SE±	P value	Result
			B.T	A.T	Diff.				
1.	Heart rate	A	80.040	78.240	1.800	4.882	0.6905	0.0060	**V.S.**
		B	79.300	78.820	0.4800	3.808	0.5385	0.1885	**N.S**
2.	Blood pressure (systolic)	A	123.96	122.88	1.080	2.834	0.4009	0.0048	**V.S.**
		B	125.82	126.20	0.3800	2.514	0.3556	0.1452	**N.S**
3.	Blood pressure (diastolic)	A	82.20	81.48	0.72	2.935	0.4151	0.0445	**S.**
		B	81.71	82.13	-.4167	2.575	0.3717	0.2680	**N.S**
4.	P-R intervel	A	0.1571	0.15722	0.00012	0.001304	0.0001844	0.5182	**N.S**
		B	0.1603	0.162055	0.001755	0.01309	0.00187	0.3526	**N.S**
5.	R-R interval	A	0.8664	0.848	-0.0184	0.04405	0.00622.9	0.0048	**V.S**
		B	0.8652	0.8628	-0.0024	0.3467	0.004904	0.6267	**N.S**
6.	QRS duration	A	0.448	0.4472	-0.0008	0.005657	0.0008	0.3222	**N.S**
		B	0.44	0.4407	-0.000078	0.005601	0.0007843	0.3221	**N.S**

IV. DISCUSSION

As mentioned above in group A which was *Pranayama* conducted, cardiac parameters like Heart rate, Systolic blood pressure, diastolic blood pressure significant changes were found, a significant reduction in these parameters was obtained. This can be attributed to modulation of autonomic activity with parasympathetic predominance and relatively reduced sympathetic tone. Systolic blood pressure depends upon cardiac output which further basically depends upon stroke volume and heart rate. When there is significant reduction in heart rate cardiac output decreases as well as the systolic blood pressure also decreases. In Various *Yogik* practices like *Pranayama* there is well controlled and regulated pattern of breathing which alters the autonomic regulation of cardiovascular system. Modification of

breathing patterns triggers various central and autonomic mechanism as well as mechanical and hemodynamic adjustments causing both tonic and phasic changes in cardiovascular functioning.

Slow deep breathing as in *Pranayama* resets the autonomic nervous system through stretch induced inhibitory signals and hyper polarization currents propagated through both neural and non neural tissue which synchronized neural elements in heart, lungs, limbic system and cortex. During deep inspiration lungs are stretched and stretching of lung tissue produce inhibitory signals by action of slowly adapting receptors (SARs) and hyper polarization current is generated by fibroblast surrounding the lungs [7]. These inhibitory impulses in cooperation with hyper polarization current initiates the synchronization of neural elements in the central nervous system, peripheral nervous system and surrounding tissues ultimately causing shifts in the autonomic balance towards parasympathetic dominance and there is marked reduction in heart rate and systolic blood pressure. The another probable reason in reduction of systolic blood pressure and heart rate may be due to the relaxation of mind through *Pranayama* which probably made parasympathetic system to override sympathetic system in another word we can say better parasympathetic control over heart.

Diastolic blood pressure totally depends on peripheral resistance and heart rate. In *Pranayama* group it was found just significant probably due to reduction in heart rate and decrease in peripheral resistance due to parasympathetic dominance as discussed earlier. In a previous study it is reported that the *Praṇayama* practices increase the frequency and duration of inhibitory neural impulses by activating pulmonary stretch receptors during above tidal volume inhalation as in Hering Bruer reflex, which bring about withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing decrease in peripheral resistance and decrease in the Blood Pressure[8]. Joseph CN et al. have reported that by slow breathing like in *Pranayama*, there is an increase in baroreflex sensitivity; reduce sympathetic activity and chemo reflex activation in healthy subjects[9]. Also the strongest cardioventilatory coupling is seen when there is decreased breathing frequency like slow *Pranayamic* breathing [10].

In ECG a significant decrease in R-R interval was found in *Pranayama* Group that might be due the decrease in Heart rate. Group B in which *Agastya Haritaki Rasayana* was given, all the cardiac parameters were found non-significant statistically. Most probably it was due the effect of herbs used in *Agastya Haritaki Rasayan*, because most of the drugs are having *Katu Rasa*, *Laghu* and *Rooksha Guna* and *Ushna Virya* and *Katu Vipka* under which influence the preparation was not found effective to reduce the heart rate, systolic and diastolic blood pressure significantly.

Regular practice of *Pranayama*, includes various exercises which involve forceful inspiration to total lung capacity (TLC) and forceful exhalation to residual volume, and all maneuvers are done through nostrils, which offer resistance by the means of decreased cross sectional area and turbulence. Breathing through one nostril in *Anulom-Vilom Pranayama* further increases the resistance. Higher peak expiratory flow rates and FEV1 could be explained due to better strengthening of respiratory muscles by regular practicing as muscles get little hypertrophy by being continue utilized in a systemic and organized way. By the effect of *Pranayama* practice respiratory apparatus is emptied and filled more completely and efficiently which is recorded in terms of increased forced vital capacity (FVC). Breathing pattern in *Pranayama* creates more negative pressures in both abdominal and thoracic cavity during inspiration and moves the diaphragm more than its normal excursions and helps in efficient movement of diaphragm, intercostal and abdominal muscles.

Thus the improvement in vital capacity is due in part to increased development of respiratory musculature incidental to regular practice of *Pranayama*. Skeletal muscles control many crucial elements of aerobic conditioning including lung ventilation. Repeated inspirations to total lung capacity and breath holdings as done during *Pranayama* can lead to increase in the maximal shortening of the inspiratory muscles by which probably the significant improvement has been shown in the lung function parameters. Apart of this the point is also important that *Yoga* postures involve isometric contraction which is known to increase skeletal muscle strength. In addition to improved respiratory muscle performance, increased FEV1 in yogic practitioners may be because of improved patency of airways. As *Pranayama* with its calming effect on the mind can reduce and release emotional stresses, hereby withdrawing the broncho-constrictor effect. Lung inflation near to total lung capacity is a major physiological stimulus for the release of lung surfactant and prostaglandins into alveolar space, which increases lung compliance and decreases bronchiolar smooth muscle tone, respectively.

In group B reportedly there were no such significant results on various respiratory parameters except of forced vital capacity which was found not quite significant statistically. This may be due to some bronchodilator effect of the drugs used in *Agastya Haritaki Rasayana.*

Previous study has reported the changes in cardiovascular autonomic activity by breathing exercises on the basis of known anatomical asymmetries in the respiratory, cardiovascular, and nervous system and that the coupling mechanisms between each of these systems: Lung-heart, heart-brain and lungs-brain, are also asymmetrical. These asymmetrical vector forces resulting from the mechanical activity of the lungs, heart and blood moving throughout the circulatory system, will also produce a lateralization effect in the autonomic balance. There are negative feedback loops between brain autonomic controls and mechanical functions in the body as a fundamental part of the body's homeostatic mechanisms. A long-term improvement in autonomic balance as well as in respiratory, cardiovascular and brain function can be achieved if mechanical forces are applied to the body with the aim of reducing existing imbalances of mechanical force vectors. This technique implies continually controlling the body functions for precise timings like in *Pranayamic* breathing techniques [11].

In the yogic system of breathing, the right nostril dominance corresponds to activation of '*Pingala'* subtle energy channel; related to sympathetic arousal and left nostril to '*Ida'* subtle energy channel, corresponding to parasympathetic activation. *Pranayama* effects the proper balance between '*Ida'* and '*Pingala'* i.e. Sympathetic and parasympathetic activity and gain spiritual upliftment and enlightment through *Sushumna*, the third *Nadi*. The '*Sushumna' Nadi* is supposed to exist at centre where the flow of '*Prana'* (subtle life force) through the two *Nadis*: '*Ida'* and '*Pingala'* meet in the body. *Nadisuddhi* means 'purification of subtle energy path'. Thus this *Nadisudhi Pranayama* purifies all three *Nadis* and various other *Nadis* throughout the body and helps in to improve health measures. So over all we can say the significant changes in cardio respiratory parameters in *Pranayama* group are due to the alteration in the autonomic activity of the nervous system with parasympathetic dominance over sympathetic system. And in this whole phenomenon there are lots of factors involved like response of stretch receptors on lungs, increase in baroreflex activity, cardioventilatory coupling etc and significant changes in respiratory parameters like lung capacity were due to strengthening of respiratory muscles, increase in lung compliance due to effective release of surfactants and prostaglandins.

V. CONCLUSION

For the better functioning of cardiovascular and respiratory systems *Pranayama* proved as a better intervention compared to *Agastya Haritaki Rasayana*. Though *Agastya Haritaki Rasayana* has been used for various pathological conditions viz *Kasa* (cough), *Swasa* (*Dyspnea*) of respiratory system still it could not produced any significant effect on cardio vascular parameters.

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