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Influence of kapalabhati pranayama on oxygen saturation and blood pressure

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Abstract
Kapalabhati is one of the rapid breathing techniques, known as automatic inhalation technique. Kapal is the cranium. Bhati means light, splendour, perception or knowledge. This pranayama invigorates the entire brain and the centres responsible for subtle perception and insight. Kapalabhati is one of the six cleansing processes described in Hathayoga. Since it is a breathing exercise, therefore, it has found its place also in the book describing pranayamic exercises. Kapalabhati has a profound effect on various systems of the body making it suitable for modern day needs. This study was conducted to study the influence of kapalabhati pranayama on oxygen saturation and blood pressure.

Materials &Methods: 60 subjects satisfying the inclusion and exclusion criteria were recruited randomly to both the groups i.e. Kapalabhati (study group) and Normal breathing (control group).Subjects practiced respective practices for ten minutes. The assessment was done just before and immediately after the practices in both the groups.

Results: Our study showed that there was a significant increase in Diastolic Blood pressure [$F_{(1,56)}$=10.15, p=0.02], SpO_2 [$F_{(1,56)}$ =27.00,p≤0.001]suggesting sympathetic stimulation and a significant reduction in pulse rate[$F_{(1,56)}$=5.573,p=0.022] in the yoga group following kapalabhati after adjusting for their baseline values, age and gender. There was no significant change observed in these parameters among the control group. [Systolic BP (p=0.089), Diastolic BP (p=.069), SpO_2(p=0.097), pulse rate(p=0.87)]

Interpretation & Conclusion: Practice of kapalabhati pranayama increases diastolic BP and Oxygen saturation immediately in novices. Thus the practice exercises the diaphragm vigorously and enhances the better oxygenation. Further studies are required to understand the physiological changes followed by the practice of kapalbhati pranayama among Hypertensive patients.

Keywords: Kapalabhati Pranayama, oxygen saturation, blood pressure, pulse

Introduction

Yoga is an integrated individual life style [1]. According to Swami Kuvalayananda yoga has multiple physical, mental and spiritual benefits and the influence of the mind on body is far more powerful than the influence of the body on mind [2].Though yoga is often considered in the West to be only physical, it is also a physio-psychological and psycho-spiritual subject. It is a science which liberates one's mind from the bondage of the body and leads it towards the soul [3]. Pranayama is an essential ingredient of yogic discipline [4]. The breath is the most vital process of the body. It influences the activities of each and every cell and most importantly, is intimately linked with the performance of the brain. Human beings breathe about 15times per minute and 21,600 times per day. Respiration fuels the burning of oxygen and glucose, producing energy to power every muscular contraction, glandular secretion and mental process. The breath is intimately linked to all aspects of human experience. Although breathing is mainly an unconscious process conscious control of it may be taken at any time. Consequently it forms a bridge between the conscious and the unconscious areas of the mind [5].

Although the lung volume is not increased more than deep breathing, the lung ventilation – lung circulation ratio improves. This has led to increased output by about 20%. Improvement of respiratory efficiency is now a well-documented fact [6].

Pranayama encompasses two types of breathing techniques; one is slow and the other is rapid. Kapalabhati is one of the rapid breathing techniques, known as automatic inhalation technique, the other one being forced inhalation or Bhastrika. Though Kapalabhati is the common term used for both automatic and forced inhalation, some practitioners use Bhastrika for a more advanced technique that includes breath holding [7]. This technique as described by Swami Kuvalayanandaji is known as 'practice of active exhalation and passive inhalation'. Exhalation is active because one has to make effort for sudden expulsion of breath through the nostrils. Inhalation is passive because nothing is done for taking the air in. Air automatically rushes in simply because of going down of diaphragm with the relaxation of abdominal muscles. This technique i.e. going down of diaphragm and relaxation of abdominal muscles, results into inhalation [8].

Aims and objective

To study the influence of kapalbhati Pranayama on

- Oxygen saturation
- Systolic blood pressure
- Diastolic blood pressure

Materials and Methods

Study design: Randomized Controlled study

A total of 100 subjects were screened and assessed for eligibility criteria out of those 60 were selected who fulfilled the requirement of the study and randomly divided into two groups, study group (n=30) and control group (n=30).Pre assessment was recorded for both the groups, study group underwent kapalbhati pranayama 120 strokes per minute for 10 minutes and the control group observed for normal breathing for 10 minutes, post assessment was made for both the groups immediately after the intervention.

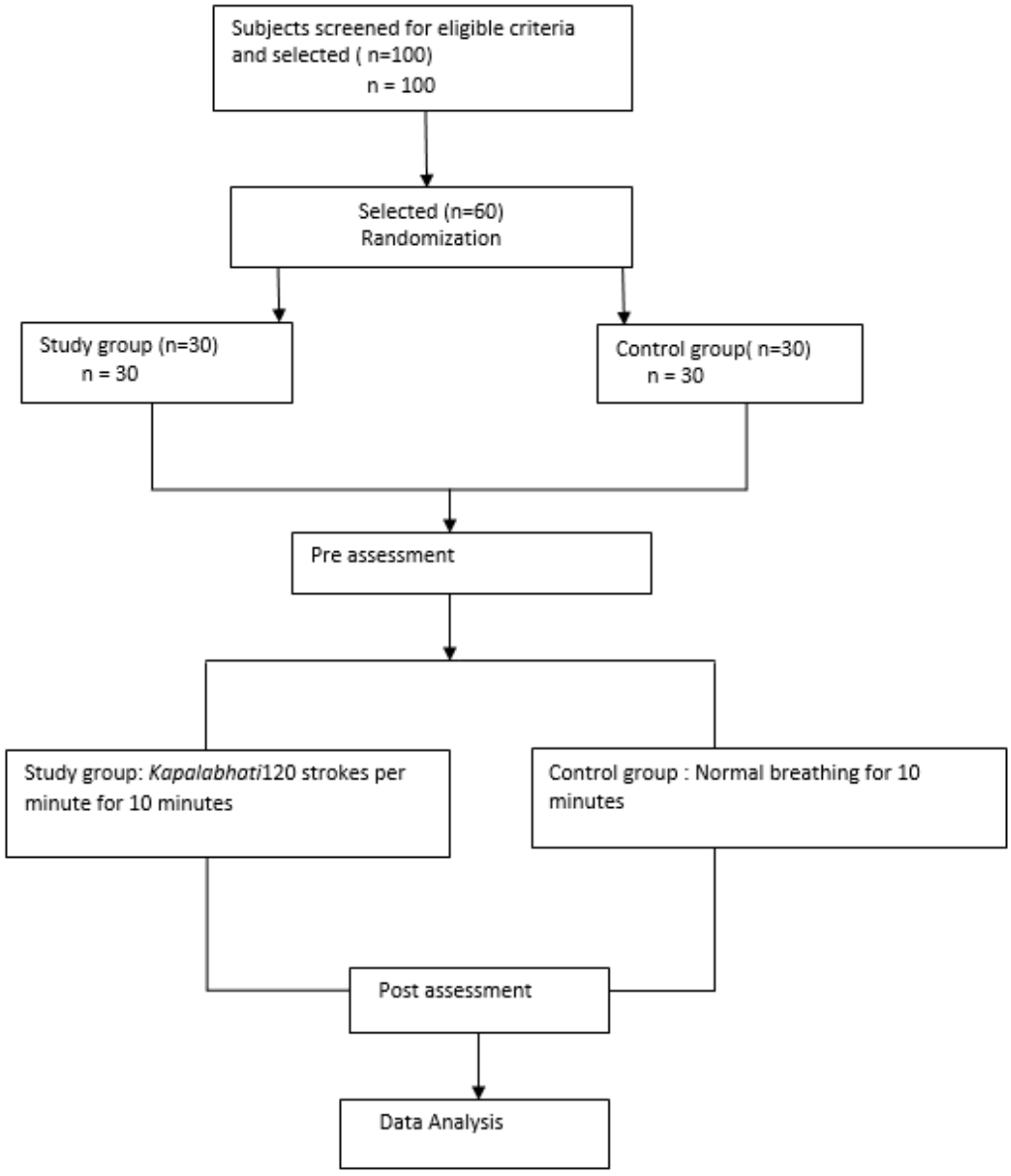
Table 1: Method of kapalbhati practice

KB	NB	KB	NB	KB	NB	KB	NB	KB	NB
1Min	1Min	1Min	1Min	1Min	1Min	1Min	1Min	1Min	1Min

10minutes

KB: Kapalabhati Pranayama **NB:** Normal breathing

All the details of the study was explained to the subjects and an informed consent was obtained from them before starting the study. Ethical clearance was obtained from the Institutional ethical committee.



***Source*:** Alva's college of Naturopathy and Yogic sciences, Moodbidri. Alva's Homeopathy Medical College, Moodbidri

Fig 1: Illustration of study plan

Inclusion criteria
- Age group: 18-24 years
- Gender: Both male and female (15 males and 15 females in each group)

Exclusion criteria
- Those who are taking alcohol
- Tobacco chewing
- Smoking
- Narcotic drugs intake

Study sample size: 60 subjects (30 in each group)
Grouping: Two groups
- Study group (n=30)
- Control group (n=30)

Intervention
Kapalabhatipranayama: The subjects were made to sit in Vajrasana and instructed to forcefully expel all of the air from the lungs, while pushing the abdominal diaphragm upwards. The expulsion is active, but the inhalation is passive. Subjects rapidly breathed out actively and inhaled passively through both nostrils. One hundred and twenty strokes per round. It is considered an excellent rejuvenator of the respiratory system as all muscles of expiration are exercised [9].

Laboratory investigations
Pulse Oximetry: The index finger of the subject is plugged into silicone hole of the fingertip pulse oximeter [operon iO_2] which is not too tight (which would constrict the circulation) or too loose (may fall off or let other light in) [10]
Blood Pressure: Both systolic and diastolic blood pressure is measured in sitting position with the digital BP apparatus (Omron Automatic Blood Pressure Monitor HEM-7130-L). The digital manometer was tied in the left arm over the brachial artery and was inflated to record the blood pressure immediately before the start and after the completion of the intervention [11]. Pulse rate was also recorded from the same monitor which was displayed along with blood pressure.

Fig 2: Recording the Blood pressure

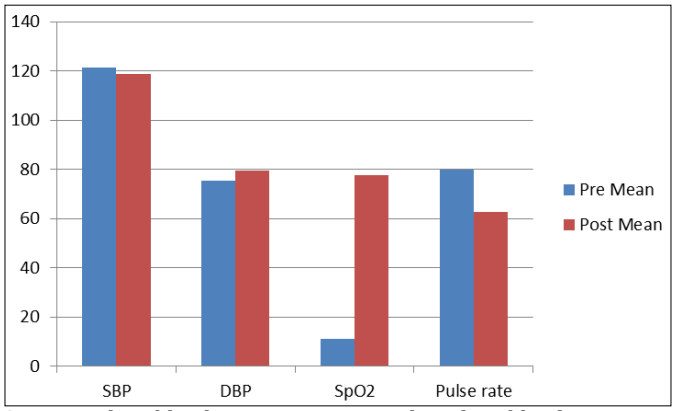
Fig 3: Recording Oxygen Saturation

Fig 4: Practice of Kapalabhati by healthy subjects

Results
The data was collected at two time points: baseline and immediately following intervention. The mean difference between each of the respective variable: Blood Pressure, Pulse rate and Oxygen saturation were used to test for normality. Normality was assessed using Shapiro-Wilk's test. Results suggested that the variables, Diastolic blood pressure and pulse rate were normally distributed.
Sixty subjects of age [19.8±1.29] were recruited for the study. They were allocated into either of the two groups: Yoga or Control group. The Yoga group was administered with Kapalabhati and the control group was administered normal breathing for the same duration as described in the intervention [9]. The age of Yoga and control groups were19.16±1.01 and 21±0.78 respectively. Both the groups had 15 males and 15 females in each group.
We performed Analysis of covariance to assess the effect of the 10-minute intervention between the groups, adjusting for the respective baseline values, age and gender. The results suggest that there was a significant increase in Diastolic Blood pressure [$F_{(1,56)}$=10.15, p=0.02], SpO2 [$F_{(1,56)}$ =27.00,p≤0.001] and a significant reduction in pulse rate [$F_{(1,56)}$=5.573,p=0.002] in the Yoga group (Table 2) following kapalabhati after adjusting for their baseline values, age and gender. There was no significant change observed in these parameters among the control group.(Table 3)

Table 2: changes in systolic and diastolic blood pressure, oxygen saturation and pulse rate in study group. Values are group mean±S.D.

Variable	Study Group(n=30)		ANCOVA
	Pre (Mean SD)	Post (Mean SD)	p value
SBP	121.23±11.542	118.63±11.51	0.089
DBP	75.27±7.534	77.63±7.237	0.002
SpO_2	11.112±1.432	98.87±2.339	0.001
Pulse rate	79.83±8.913	62.53±9.031	0.002

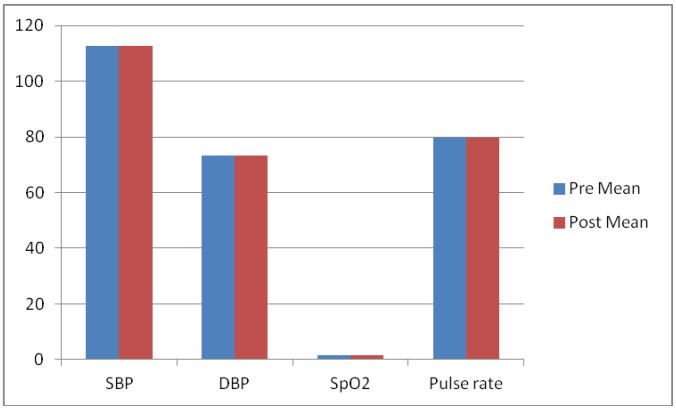


SBP=systolic blood pressure, DBP=diastolic blood pressure, SpO2=oxygen saturation

Fig 5: comparison of mean graph for study group before and after practice of kapalabhati Pranayama

Table 2: Changes in Systolic and Diastolic Blood Pressure, oxygen saturation and pulse rate in Control group. Values are group mean±S.D. group

Variable	Control group (n =30)		ANCOVA
	Pre (Mean SD)	Post (Mean SD)	p value
SBP	112.80±16.098	112.80±16.098	0
DBP	73.17±6.320	73.17±6.320	0
SpO_2	1.432±2.424	1.432±2.424	0
Pulse rate	79.60±6.924	79.60±6.924	0



SBP=systolic blood pressure, DBP=diastolic blood pressure, SpO2=oxygen saturation

Fig 6: Comparison of mean graph for control group before and after normal breathing

Discussion

This study was conducted on Novice medical students who are not exposed to yoga practices. Our study showed that there was a significant increase in Diastolic Blood pressure [$F_{(1,56)}$=10.15, p=0.02], SpO2 [$F_{(1,56)}$ =27.00,p≤0.001] suggesting sympathetic stimulation and a significant reduction in pulse rate [$F_{(1,56)}$=5.573, p=.022] in the yoga group following kapalabhati after adjusting for their baseline values, age and gender. There was no significant change observed in these parameters among the control group. [Systolic BP (p=.089), Diastolic BP (p=.069), Spo_2 (p=.097), pulse rate (p=0.87)]

The earlier study showed significant increase in the sympathetic nervous system activity with the increase of Systolic and Diastolic BP immediately following kapalabhati practice. Findings of the present study are partially in accordance with the earlier study [12]. The present study showed significant increase in diastolic BP but with the no change in systolic BP. The changes might be because of the 10min practice of kapalabhati in the present study compared to that of 3min practice in the earlier study.

Last of the six shatkarma is kapalabhati. Kapalabhati is a pranayama technique which invigorates the entire brain and awakens the dormant centres which are responsible for subtle perception [13].

Earlier studies on kapalabhati have concluded that Kapalabhatipranayama improves cardiovascular endurance [14]. A study on the effect of Kapalabhati on Blood Pressure in Naive subjects showed considerable increase in before and after values suggestive of sympathetic activity and considerable reduction immediately after and 3 minutes after the practice results of which are suggestive of parasympathetic activity [15]. A similar study on Kapalabhati changes cardiovascular parameters showed sympathetic dominance during kapalabhati with the increase in Heart rate, Systolic and Diastolic Blood pressure. Whereas during and after values reduced considerably suggestive of modulation of the autonomic nervous system. No considerable difference between before and after values were noted in this study [12]. In the study which compared kapalabhati and bhastrika with autonomic functions also showed stimulation of the sympathetic activity immediately after these practices among which kapalabhati was more stimulating. Oxygen saturation remained the same as before in both the groups [11]. Kapalabhati purifies the whole body by blowing off carbon dioxide in the blood and tissues. At the same time, there is an increase in oxygenation of the blood stream [16].

However, there are no studies conducted to understand the influence of Kapalabhati on oxygen saturation and blood pressure for the duration of 10min in novice yoga practitioners. In any tissue of the body, a rapid increase in arterial pressure causes an immediate rise in blood flow. However within less than a minute, the blood flow in most tissues returns to the normal level, even though the arterial pressure is kept elevated. This return of flow toward normal is called autoregulation [17]. With this mechanism the increase in the diastolic blood pressure as observed in the study group might have resulted in enhanced blood flow and oxygenation of the tissues. This is in coordination with the vitalising effect of kapalabhati as mentioned in the scriptures: The exercise enables us to eliminate a large quantity of the toxins contained in the body, by filling the body with oxygen and purifying the tissues and nerves [18].

Future research

- Study on larger sample size
- Advanced equipment can be used for data collection.
- Further, understanding is mandatory to ascertain the cardiac hemodynamics and autonomic regulation during and immediately following kapalabhati practices in novices.

Conclusion

Practice of Kapalabhatipranayama increases diastolic BP and Oxygen saturation immediately in novices. Thus the practice exercises the diaphragm vigorously and enhances the better oxygenation. Further studies are required to understand the physiological changes followed by the practice of kapalabhati pranayama among Hypertensive patients.

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