Hyperventilation is defined as ventilation in excess of metabolic requirements (CO₂ production) leading to a reduction in PaCO₂. Hyperventilation syndrome (HVS) is a psychological or physiological disorder, involving breathing too deeply and/or too rapidly (hyperventilation) or erratic breathing interspersed with breath-holding or sighing (DB). HVS can result in significant patient morbidity and an array of symptoms including breathlessness, atypical chest tightness, dizziness, tremor and paraesthesia. It has an estimated prevalence of 9.5% in the general adult population. It may be compared with yoshapatantraka mentioned in various ayurvedic textbooks. Nadi shodhana pranayama i.e. psychic network purification is a special yogic breathing technique which brings tranquillity and mental relaxation. The antara kumbhaka part of this pranayama eventually increases carbon dioxide content in the body and not oxygen. If practised daily for a longer duration of time, Nadi shodhana pranayama will be able to slow respiration and increase the capacity to withstand and endure carbon dioxide retention, ultimately leading to the cure of the patients suffering of HVS.

Keywords: HVS, Yoshapatantraka, Nadi shodhana pranayama, Antara kumbhaka.

Introduction

Hyperventilation is defined as ventilation in excess of metabolic requirements (CO₂ production) leading to a reduction in PaCO₂. Common symptoms include lightheadedness, shortness of breath, circumoral numbness and tingling and muscular twitching. Pathophysiologically, hypocapnia produces cerebral vasoconstriction and results in central nervous system hypoperfusion. Patients are usually between 20 and 40 years of age, and women are affected far more frequently than men. The disorder is usually benign, with anxiety a common precipitant, but serious cardiopulmonary causes of hyperventilation or subjective dyspnoea must be excluded. Symptoms commonly occurs in the lying position, which can be diagnostically helpful. Patients often report prolonged unconsciousness, but upon close questioning this rarely proves to be true. Hyperventilation at examiner’s request often reproduces the symptoms.

Hyperventilation syndrome (HVS) is a psychological or physiological disorder, involving breathing too deeply and/or too rapidly (hyperventilation) or erratic breathing interspersed with breath-holding or sighing (DB). It is also called as dysfunctional breathing (DB), chronic hyperventilation syndrome (CHVS) and dysfunctional breathing hyperventilation syndrome (DBHS). HVS can result in significant patient morbidity and an array of symptoms including breathlessness, chest tightness, dizziness, tremor and a tingling sensation in the fingertips and around the mouth (paraesthesia) and may accompany a panic attack. DB/HVS has an estimated prevalence of 9.5% in the general adult population, however, there is little consensus regarding the most effective management of this patient group. The peak incidence is between the ages of 15 and 55 years, but cases have been reported in all age groups except infants. HVS has a strong female preponderance: the female-to-male ratio may be as high as 7:1. People with HVS may feel that they cannot get enough air. In reality, they have about the same oxygenation in the arterial blood (normal values are about 98% for haemoglobin saturation) and too little carbon dioxide (hypocapnia) in their blood and other tissues. While oxygen is abundant in the bloodstream, HVS reduces effective delivery of that oxygen to vital organs due to low-CO₂-induced vasoconstriction and the suppressed Bohr effect. The hyperventilation is self-promulgating as rapid breathing causes carbon dioxide...
levels to fall below healthy levels, and respiratory alkalosis (high blood pH) develops\(^1\). This makes the symptoms worse, which causes the person to try breathing even faster, which further exacerbates the problem. The respiratory alkalosis leads to changes in the way the nervous system fires and leads to the paraesthesia, dizziness, and perceptual changes that often accompany this condition\(^2\).

Hyperventilation syndrome is one of the most common causes of dizziness in the general population, accounting for up to 25 percent of dizziness complaints\(^3\). Hyperventilation syndrome may present a diagnostic challenge to the chiropractic physician because of the diverse symptomatology associated with this disorder. One of the most valuable clues to the diagnosis of hyperventilation syndrome is the simultaneous occurrence of puzzling combinations of diverse symptoms (cardiovascular, neurological, respiratory, gastrointestinal, musculoskeletal, and psychological) in association with ill-defined dizziness. Dizziness attacks are caused by overbreathing which is triggered by anxiety or related emotional disturbance. A better term for this syndrome might be behavioral breathlessness or psychogenic dyspnea, with hyperventilation seen as a consequence rather than a cause of the condition. Symptoms of HVS and panic disorder overlap considerably, though the two conditions remain distinct. Approximately 50% of patients with panic disorder and 60% of patients with agoraphobia manifest hyperventilation as a symptom, whereas 25% of patients with HVS manifest panic disorder.

Predisposition to HVS may also be rooted in childhood. Patients with HVS were shown to be more likely to have had overprotective parents when they were children. A sudden stressful situation later in life can then incite the first episode of HVS\(^4\). Patients with HVS tend to breathe by using the upper thorax rather than the diaphragm, and this results in chronic over inflation of the lungs. When stress induces a need to take a deep breath, the deep breathing is perceived as dyspnoea. The sensation of dyspnoea creates anxiety, which encourages more deep breathing, and a vicious circle is created. The cause of HVS is unknown, but some persons who are affected appear to have an abnormal respiratory response to stress, sodium, lactate, and other chemical and emotional triggers, which results in excess minute ventilation and hypocarbia. In most patients, the mechanics of breathing are disordered in a characteristic way. When stressed, these patients rely on thoracic breathing rather than diaphragmatic breathing, resulting in a hyper expanded chest and high residual lung volume. Because of the high residual volume, they are then unable to take a normal tidal volume with the next breath and consequently experience dyspnoea. Proprioceptors in the lung and chest wall signal the brain with a "suffocation alarm" that triggers release of excitatory neurotransmitters that are responsible for many of the symptoms such as palpitations, tremor, anxiety, and diaphoresis.

A study by D’Alba et al evaluating the prevalence of HVS in adolescents found that the rate of HVS symptoms in adolescents with asthma was 10 times higher than that in adolescents without asthma (25% vs 2.5%, respectively)\(^5\).

Another theory is that patients with panic disorder have a lower threshold for the fight-or-flight response. In susceptible patients, even minor stresses can trigger the syndrome, which then tends to manifest with primarily psychiatric complaints (e.g., fear of death, impending doom, or claustrophobia). In contrast, it is believed that HVS patients tend to focus on somatic complaints related to the physiologic changes produced by hyperventilation. Initiating stimuli and abnormal stress responses may be identical but are expressed differently in each group.

There is insufficient evidence for or against breathing exercises\(^6\). While traditional intervention for an acute episode has been to have the patient breathe into a paper bag, causing rebreathing and restoration of CO\(_2\) levels.
levels, this is not advised. The same benefits can be obtained more safely from deliberately slowing down the breathing rate by counting or looking at the second hand on a watch. This is sometimes referred to as "7-11 breathing", because a gentle inhalation is stretched out to take 7 seconds (or counts), and the exhalation is slowed to take 11 seconds. This in-/exhalation ratio can be safely decreased to 4-12 or even 4-20 and more, as the O₂ content of the blood will easily sustain normal cell function for several minutes at rest when normal blood acidity has been restored.

Diaphragmatic breathing slows the respiratory rate, gives patients a distracting maneuver to perform when attacks occur, and provides patients with a sense of self-control during episodes of hyperventilation. This technique has been shown to be very effective in a high proportion of patients with HVS. Stress reduction therapy, administration of beta blockers, and breathing retraining have all proved effective in reducing the intensity and the frequency of episodes of hyperventilation. Several medications, including benzodiazepines and selective serotonin reuptake inhibitors (SSRIs), have been employed to reduce the frequency and severity of episodes of hyperventilation.

Hyperventilation syndrome (HVS) may be compared with Yoshapatantraka or Yoshapasmara mentioned in various Ayurvedic textbooks because of the similarities in karana, poorvarupa, lakshana and cikitsa as mentioned below:

Karana-
Raktakhyadva bahusho…………………………………………………………..mato hi kalah18.

Poorvarupa-
Hritpidanam jrbhanamangachittayoh…………………..…..….Yoshaptantrakakhye hi gade bhishagbhiih19!

Lakshana-
Sparshotthashakterapi vriddhibhavah shwasasaya krchchhatamathodarachch20!
Vayururdhwam vrajet sthanat..........................................................gyeya esho apatantrakah21.
Smritibhutarthavigyanam…………………………………………………...dhisatwasamplavad24.


20Bhaishjya Ratnawali by Sri Govind Das, Vidiotini hindi vyakhya by Kaviraj Sri Ambika Dutt Shastri, Chaukhamba Prakashan, Varanasi, Reprint 2017, Yoshapatantraka Cikitsa prakaranam 103, verse- 6-11, page- 1226


Role of Pranayama in HVS - Prana means the vitality of life which expresses itself through the various centres of the body. Its simple meaning is energy. Pranayama means the regulation or the control of prana (vital energy) in three stages: inhalation, retention and exhalation of breath. The process of breathing in, breathing out and holding the breath- a sum total of these three processes constitutes the full pranayama. Pranayama is indispensable for getting rid of body toxins, to avoid ailments and to strengthen the corresponding organs. One who practises pranayama becomes immune to such diseases.

Through practising pranayama the lungs become stronger and flexible. In the body, heat is generated which produces beneficial effect on general health. Oxygen is supplied to our body in large quantity. The greater the intake of oxygen, the greater the quantity of carbon dioxide expelled.

Chemical changes brought about by physical exertion result in the break-up of matter within the body and consequent loss of energy. This loss is compensated by an increased supply of oxygen through pranayama. Pranayama also produces a healthy and invigorating effect on the brain and the nerves. It tones up the functioning of the brain, dormant centres in the smaller and greater brain are energized and latent potentialities are awakened. All round development of the pituitary and pineal is brought about by practising pranayama regularly.

While practising vigorous pranayama, the mind becomes inactive and tranquil for some time. This provides some rest and relaxation. By practising retention of breath, the mind becomes relaxed. There is no other way of bringing about relaxation of mind because thoughts always continue to come into it. While practising pranayama the mind becomes stationary and thoughts are exhausted. This is why pranayama is considered to be one of the best practices for concentration.

Through pranayama, we get control over the nerves. As soon as this is brought about, nervous tension is minimized. Extraordinary strength and energy are obtained. Pranayama is sure way to tone up the nervous system. Pranayama is a practise for casting impurities out from the human system. This is a process of purification of pranic channels.

Prana (life force) has a very close relation to the mind. As prana of the subtle pranic body (pranayama kosha) is intrinsically linked to the other koshas, annamaya (food body), manomaya (mental body) etc, prana is influenced by thoughts, feelings, emotions etc, and they are influenced by prana.

Nadi shodhana pranayama i.e. psychic network purification -

There are three stages of pranayama viz. pooraka, rechaka, and kumbhaka. When we breath in or inhale this is called pooraka, and when we breath out or exhale, it is known as rechaka. When we hold the breath, it is said to be kumbhaka. Kumbhaka is of two types. To hold the breath after breathing in is antar kumbhaka, and to hold the breath outside after exhalation is termed bahir kumbhaka.

Pooraka is performed through the same nostril which performs rechaka. Rechaka and then pooraka can be done with one nostril but pooraka and rechaka should not be done with same nostril at one time. If one nostril performs pooraka, the other nostril is to perform rechaka. This will mean automatically that pooraka will be performed by the same nostril which performs rechaka. Through practising this, the intensity of the flow of air through both nostrils is equalized. All the benefits of pranayama is derived through this practice. Those who have congested nostrils while sleeping are freed of this trouble. Those who are susceptible to coughs must practise this daily for at least five to seven minutes.

In nadi shodhana pranayama, the duration of pooraka, kumbhaka and rechaka is is fixed in the ratio of 1:4:2 and breathing is done through alternate nostrils. Nadi shodhana pranayama is of three categories: Uttama (the best), Madhyama (medium), Kanishtha (inferior). All should be learnt slowly and cautiously.

➢ Kanishtha pranayama- Pooraka 12: Kumbhaka 48: Rechaka 24
➢ Madhyama pranayama- Pooraka 16: Kumbhaka 64: Rechaka 32
➢ Uttama pranayama- Pooraka 20: Kumbhaka 80: Rechaka 40

This pranayama improves the pulse and casts off all impurities. By attaining perfection in this pranayama body becomes light and one gains full control of the nerves and body.

Case Report-

A female patient aged around 20 years, studying in the 1st Prof. year of BAMS at Sri Sai Ayurvedic P.G. Medical College & Hospital, Aligarh, brought by her colleagues in emergency at the hospital. She was having complaint of recurrent sneezing & breathlessness, which ultimately turned into shortness of breath, dizziness, headache & severe hyperventilation. On evaluation her vital parameters, lab investigations and other reports are given in the table-
Anyhow she was managed conservatively and symptomatically. But she could not appeared in the sessional examination held next day. She developed similar episode several times in that week. So she was granted permission not to appear in the whole sessional examination. She was reported to have admitted in the ICU of other hospitals for similar complaints 2 times in last 6 months. On enquiring about the past history with her parents, it was come to know that she had similar episode of illness several times in the recent 5-6 years. These symptoms first came to notice of parents when she was about to appear in the 10+2 examination. In consultation with local physicians it was diagnosed as Allergic rhinitis and treated accordingly. Her younger brother who was also preparing for competitive exam had similar problems and he was also in treatment of other doctor. Her mother also had H/o TTH and takes medicine accordingly on & off. These problems remained subsided for almost one year. Later her parents were informed about similar episode when she was studying and preparing for medical entrance at Kota in Rajasthan. On further going through the details of past consultation, she has taken opinion from various Physicians, Cardiologist, Gastroenterologist, Neurologist, Chest Physician, Surgeons, ENT consultant. And she has undergone almost all the basic tests required. In last 3-4 years, as per her chief complaints, she has been diagnosed accordingly from acute coryza to anxiety neurosis, panic disorder, allergic rhinitis, gastritis etc. Presently she was being treated by a chest physician of Agra on the line of Allergy. Presently she had D/H of Tab Loratadine 10mg PO OD, Tab Dexona 4mg PO BD, PPI, multi vitamins and Tab Amitryptiline 10mg BD since last one & half year with poor compliance.

The different investigation performed on her since last 4 year on various occasions of illness is summarised in the following table-

<table>
<thead>
<tr>
<th>Lab investigations- CBC, LFT, KFT, Metabolic profile, Thyroid profile</th>
<th>Almost normal study on every occasion</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEG</td>
<td>Normal EEG Study</td>
</tr>
<tr>
<td>NCCT &amp; CECT of Brain</td>
<td>NAD</td>
</tr>
<tr>
<td>X- RAY Chest PAV &amp; PNS</td>
<td>NAD</td>
</tr>
<tr>
<td>ABG (done once during ICU admission 2 months back)</td>
<td>Features suggestive of respiratory alkalosis</td>
</tr>
</tbody>
</table>

**Diagnosis**

Arterial blood gas (ABG) measurement is indicated if any doubt exists as to the patient’s underlying respiratory status. In chronic HVS, ABG sampling confirms a compensated respiratory alkalosis in a majority of cases. Electrocardiographic changes are common and may include the following:

- ST depression or elevation
- Prolonged QT interval
- T-wave inversion
- Sinus tachycardia

Noninvasive measurements of gas exchange during orthostatic testing are useful in the diagnosis of HVS.

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Treatment-
After going through the sign & symptoms, and the history of present, past, family, drugs and laboratory investigations available till date, the patient was diagnosed as suffering of chronic hyperventilation syndrome. Her course of treatment was left untouched till a clear explanation of the underlying pathophysiology. She was shown her own video during the time of attack and counselled on the role of breathing exercises in overcoming these psychogenic hyperventilation episodes. She was educated and instructed the technique of deflation of the upper chest followed by controlled diaphragmatic breathing.

Instructions in practice of nadi shodhana pranayama-
The patient was advised to sit in sukhasana or padmasana (lotus posture) with a peaceful mind. She was advised to keep the spinal cord straight and vertical. The head and neck was kept erect. The eyes were kept closed throughout the whole pranayama process. The left hand should remain comfortably on or near the knee, or kept in the lap with palm up. The right hand is kept free to manipulate the nostrils. While practising pranayama, when the left nostril is to be closed it should be done with fourth (ring) finger of the right hand, and when the right one is to be closed it should be done with right thumb. Now she was instructed to breath in through the left nostril while counting 1 to 4 mentally. Breath is retained while counting 1 to 16 by closing both the nostrils. The retention should be so timed that it takes 4 times the time taken in inhalation. Then exhale through the right nostril counting mentally from 1 to 8. This practice was repeated by doing pooraka with the right nostril, then kumbhaka, and then rechaka with the left nostril, with the ratio same as before, i.e. 4:16:8. Surya Namaskar asanas before nadi shodhana pranayama and shitali, shitakari and bhramari (humming bee breath) pranayamas were also advised to the patient. After some week of practice, when this ratio has been mastered, this ratio of pooraka, kumbhaka & rechaka was gradually increased in equal proportion.

Result-
After one month of regular practice of pranayama, her drugs like antihistamines, steroids and TCAs were gradually withdrawn. She has not complained of any such symptoms despite the withdrawal of medications. After passage of three months of duration, She has shown improvement in almost all the subjective parameters like dizziness, atypical chest pain, SOB, hyperventilation and headache.

Discussion-
It is very limited and naive view to think of yoga and pranayama purely as a means to improve lung function and oxygenation of the blood. These things do happen; however, yoga provides techniques to both increase and decrease oxygen uptake depending on their relaxing and stimulating nature and the needs of the individual in terms of attaining balance. Indeed, one of the main aims of pranayama practice is eventually to increase carbon dioxide in the body, not oxygen.

Carbon dioxide level is one of the most potent stimulators of the brain’s respiration controlling centres and inspiration and expiration is continually adjusted to maintain this chemical balance in the body. Even a small increase of blood carbon dioxide will stimulate the brain to increase respiration in order to increase its elimination.

The aims of most pranayama, kumbhaka (breath retention), bandha and meditation practices is gradually, over a long period of time, to slow respiration and increase the capacity to withstand and endure carbon dioxide retention. If we can do this, it strengthens the capacity to control other facets of brain and mind also maintains nervous system stability and internal wakefulness during higher states of meditation. Schulte and Abhyankar state,“Yogic breathing produces gradual accumulation of carbon dioxide which stimulates the cerebral circulation and engenders mental tranquillity and the reduction of sympathetic activity in the autonomic nervous system.”

In terms of the respiratory system, these and other studies indicate that asana, pranayama and meditation confer upon us control of the medulla oblongata and pons in the brain stem and the higher more conscious levels, for example in the hypothalamus via the cortical centre.

By controlling the breath, we can control our reactions to emotions and anxiety until such a time as we master the mind through meditation, when the normal stresses and strains of life can no longer affect us.

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negatively. This is the ultimate psychotherapy for the asthmatic patient. This somehow alters the ascending reticular activating system to suppress sensory input to the cortex and thereby brings about steadiness of mind.

David Shannahoff-Khalsa at Salk Institute for Biological Sciences in California have shown that there is a direct relationship between brain activity and the nasal cycle of alteration of congestion and decongestion in the nasal passages. They showed that when airflow is free in one nostril the opposite hemisphere is currently dominant. Forceful breathing through the more congested nostril awakens the less dominant hemisphere. This research shows us that yogis utilized the nose and breath as a means of altering brain activity. This research also proves that yogic breathing and meditation techniques are the doorways to control the total nervous, endocrine and immune system and the whole metabolism of the body. Ultimately this finding has major implications for the developing techniques of self regulation and shows that we can “non-invasively, selectively and predictably alter cerebral activity and associated physiological processes.”

**Conclusion**

It can be concluded from the present study that *nadi shodhana pranayama* slows the respiration and increases the capacity to withstand and endure carbon dioxide retention. If practiced daily for a longer duration of time, *nadi shodhana pranayama* will certainly be able to cure the patients suffering of HVS. However above mentioned results should be further analyzed by conducting such study in large number of patients with a longer period of follow up to justify the effect of therapy. Further, it can be concluded that *nadi shodhana pranayama* should be practised daily, whether people have any physical, mental or emotional problem or not, to strengthen the capacity to control other facets of brain and mind also to maintain nervous system stability and internal wakefulness.

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