

Editorial

Physical Health through Yoga - Unexplored Areas

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Editorial

Research in physical effects of Yoga began in 1929 by the efforts of Swami Kuvalayanandji who established a research centre at Lonavala near Pune in Maharashtra state of India, and started publishing the results in the journal 'Yoga Mimansa'. Swami Kuvalayanandhad his own insight about the possible effects of different yogic techniques and researchers under his guidance followed those lines. That pranayama provides 'extra oxygen' to the tissues, inverted postures increase the blood supply to the brain and the pituitary gland and different asanas put stretch on muscles and ligaments to produce beneficial effects are some of his concepts that have been investigated and published.

However, now it is time that we do some out-of-the-box thinking on this subject. Fresh insights and new additions to the medical knowledge now prompt us to take up research in areas that so far have remained unexplored. I shall discuss some of them in this editorial.

Effect of inverted postures on air contained in the gut

Swami Kuvalayananda figured out the effects of inverted posture on the movement of body fluids such as the blood, lymph etc. That inverted postures increase the venous return to the heart, improve lymphatic flow in the lymphatic vessels of the lower limbs and the thoracic duct are well-known facts. However, little attention has been given to the movement of air in inverted postures. In normal human beings, the fundus of the stomach is often seen to contain some air when X-ray films of the abdomen are taken in the upright posture. As anyone can visualize, in inverted posture the air contained in the fundus of the stomach would move to the pyloric region. We have verified this fact by getting X-ray picture in inverted posture, and confirmed that the air does reach the pyloric region. A possible effect of this could be inhibition of the organism *Helicobacter pylori* which is responsible for a number of gastrointestinal disorders including peptic ulcers and some gastric cancers. *H. Pylori* is microaerophilic, i.e. it prefers very small amount of oxygen and is inhibited by the oxygen present in the air. Possibly that is the reason why it does not colonise the fundus region of the stomach. We have demonstrated that the fundus air moves to the pylorus and then further; across the pylorus. Once it crosses the pylorus, it must pass down the intestines by peristaltic waves. When it reaches the colon it can inhibit the vegetative forms of *Entamoeba Histolytica*, another anaerobic pathogen of the gut. Studies detecting stool antigen for *H. Pylori* before and after a 3-week regime of aeration of the pylorus by yogic techniques are underway.

Re-inventing the ancient technique of cleansing the intestine with air, 'Vata-saradhauti'

Intestinal air has been a topic of discussion because of the symptoms of bloating. However, the intensity of symptoms is not at all proportionate with the quantity of air present in the gut. Indeed, the symptom of fullness/bloating result more from the chemical content of the gut, which modifies its motility. In the gut, air, water and food all travel at different speeds, with fatty meal being the slowest. If a normal individual swallows, sucks in his stomach or drinks air in fasting state, one passes voluminous flatus after a short time- about 1-3 hours. Indeed, the cleansing technique in yoga known as the *Vata-saradhauti* is claimed to have the power to cure 'all diseases' and increase the body fire (Digestive power). Several *yogacharyas* believe this technique to have become extinct, while it is not so. Malshe has figured it out and described it for the welfare of people at large. It requires one to drink air and manoeuvre it down the pylorus by inverting the trunk; ultimately to be passed down as flatus.

Kaki-mudra is the technique described in yoga to drink air in upright posture. This technique involves a knack and becomes easy once learnt. We have shown that the size of gastric air bubble increases tremendously after successful *kaki-mudra*. However, some individuals find *kaki-mudra* difficult to learn; therefore for research purpose we recommend the use of a pierced straw, a device with which anyone can easily drink air [1]. The air so drunk has to be manoeuvred to the pylorus by inverting the trunk. Understanding the way air can be made to move in the different parts of the gut, it is possible to design a series of postures which can facilitate movement of air from the rostral to the caudal end. I am sure if someone today attempts this one will land up with a series of postures very similar to the present-day *Suryanamaskara*. It has been very well illustrated with diagrams in a booklet which is in the public domain [2].

We have proposed an interesting hypothesis that air-distension of the gut releases 'Glucagon-Like-Peptide-1' (GLP-1) This offers a great field for researchers due to the beneficial effects of GLP-1 especially on appetite regulation, obesity and the beta cells of the pancreas. A video demonstration of drinking air through a pierced straw can be seen on the internet [3].

Brief Intermittent Hypoxia (BIH), its benefits and yogic techniques to produce BIH

In the erstwhile USSR, 60 years have been spent on research in medical effects of BIH. The Russians have used several techniques including rapid ascent to high altitudes, sitting in hypobaric chambers and inhalation of hypoxic gas mixtures. Typically such a Hypoxic Gas Mixture (HGM) contains 10% Oxygen and is known as HGM-10. The machines delivering such gas mixtures are known as 'hypoxicators'. Intermittent-Hypoxia-Training (IHT) was given to pilots of open-cockpit fighter jets, athletes, mountaineers, shallow-water divers and swimmers. Later the hypoxia techniques were applied to disease states and developed into a specialty 'Hypoxia therapy' [4,5]. Today an internet search for this term yields about 52,50,000 results. Malshe,

for the first time has discussed the possible role of BIH as a mechanism mediating multiple beneficial effects of *Nisshesharechaka* pranayama [6]. It seems that whatever is achievable by the use of hypoxicators should be achievable by *Nisshesharechaka* pranayama as well.

Pulmonary effects of negative pressure inside the thorax

It is a well-known fact that the yogic technique 'Nauli' creates a great negative pressure in the different parts of the gastrointestinal tract. Swami Kuvalayanand demonstrated that water can be sucked into the colon in what he termed as the 'Madhavdas vacuum' and that the stomach also has a negative pressure during the practice of *Nauli*.

We can now extend our imagination and see that during *Nauli* as also during '*UddiyanBandha*', a negative pressure is created inside the thorax. Understandably it reduces the intra-alveolar pressure and there is bound to be a proportionate reduction in the alveolar pO_2 . In short, the effect of *Uddiyanbandha* should be similar to climbing up a hill station. We have measured the intrathoracic pressure during *UddiyanBandha* and found it to be 70 mm below the prevalent atmospheric pressure. There is a proportionate decrease in the alveolar pO_2 . That means that at sea-level the alveolar pO_2 can be brought down from the normal 148 mm Hg to about 134 mm Hg. Extending the logic further, if one is stationed at an altitude where the atmospheric pressure is already about 570 mm Hg and the normal respiration keeps the hemoglobin saturation at or above 98%; *Uddiyanabandha* can reduce the alveolar pO_2 to below normal and may lead to hypoxia.

A brief, intermittent hypoxia is known to stimulate several physiological pathways. It raises the erythropoietin levels even in patients of chronic renal failure and may obviate the need for erythropoietin injections. In ischaemic tissues it leads to formation of Vascular Endothelial Growth Factor (VEGF) and can be used in patients of coronary artery disease for generation of coronary collaterals. Brief intermittent hypoxia induces endothelial Nitric Oxide Synthase (eNOS) making it useful in erectile dysfunction. In addition, it facilitates trafficking of stem cells from the bone marrows to where they are needed for tissue repair; this may help patients of osteoarthritis in regeneration of cartilage. The author has suggested that *Nisshesharechaka* pranayama, which is defined as breath-holding at Residual Volume (RV), breath-after-breath, can be effective in several disease conditions through this mechanism [6].

Pilot studies on several other techniques including *Asanas* such as *Pawanmuktasana*, *Yoga-mudra*, *Shudhhikriyas* such as *Nauli*, and *Agni-sarahave* shown that all of these are capable of producing brief hypoxia. On-by-one we have discovered several yogic techniques that lead to BIH. Research on this aspect of Yoga has to begin now that the concept has been developed.

Effect of *Nadi-shodhanapranayama* on inhalation of sinus-generated Nitric Oxide (NO)

Knowledge about the physiological role of NO is relatively recent and still far from complete. It is now known that among several tissues NO is generated in the paranasal sinuses and is inhaled with the inspired air and exerts a bronchodilator effect in the distal airways. Also, it helps keeping the pulmonary arterioles dilated in ventilated areas while allowing vasoconstriction in poorly ventilated ones. This way it helps maintaining a normal 1:1 Ventilation: Perfusion ratio.

Effect of deprivation of sinus-generated nitric oxide has been studied in constant mouth breathers. However, several yogic techniques produce a brief intermittent deprivation of this sinus-generated nitric oxide to the lungs. It needs to be pointed out that *Anulom-Vilom Pranayama*, *Omkarjapa* and *Shitali Pranayama* are the techniques that can prevent the sinus-derived nitric oxide from reaching the lungs.

Let us focus on the mechanics of *Anulom-Vilom Pranayama*. One closes the left nostril and breathes in through the right one. Closing one nostril cuts off the NO generated in sinuses of that side from entering the lungs. In this duration the NO that is synthesized accumulates in the left sinuses. Then after holding the breath for a while when one exhales through the left nostril, all the accumulated NO is exhaled out. Then one is supposed to breathe in through the left nostril, closing the right one. Now that the left sided sinus is devoid of accumulated NO, the breath that enters the lungs is poor in NO. The recommended time ratio of inhalation: holding: exhalation is 1:4:2; in this way the nitric oxide inhalation is cut down to one seventh.

While chanting Ommmm in *omkarjapa*, one takes in a deep inhalation for about 2 seconds and exhales while chanting Ommmm for 15-30 seconds. In this way *Omkarjapa* reduces intake of NO by about one seventh. *Shitali pranayama* involves breathing in through a tube formed by rolling the tongue and thus completely cuts off the inhalation of nitric oxide.

A research study can be designed regarding intermittent deprivation of the lungs of the sinus-derived NO. The results can be astonishing.

***Suryabhedana pranayama*: The key to switch on non-shivering thermogenesis**

In yoga texts, *suryabhedana* is described as breathing in through the right nostril and before exhaling through the left nostril holding the breath to the utmost; with great effort breath-after-breath till 'sweat appears from tip of toes to the top of the head'. Presently the full potential of this technique has not been realized. In our small pilot experiments we have found out that repeated, forceful breath holding beyond the comfort zone- with great effort- raises the body temperature by 1°F. In our experiments, two individuals developed eruption of herpes simplex, a viral eruption which is known to commonly occur with fever. There is no doubt that the body is heated up within a matter of few minutes without shivering. We do not know the source tissue of this heat. It needs to be studied using thermal imagery. As the heat is produced in the tissues themselves, it may be more effective than the passive heating techniques like the short-wave diathermy of physiotherapy and the *swedana* of Ayurved, where the heat is applied from outside. Further studies only can improve our understanding.

What purpose can elevation of body temperature serve? In biology temperature has a great effect on growth, multiplication and differentiation of cells. Bacteria can grow optimally only in a very narrow range of temperature. A hen's eggs need to be incubated at a definite temperature. Tortoise eggs become differentiated in males and females depending upon the incubation temperature. In humans, testicular cancer develops if testicles remain undescended and get incubated in the abdominal cavity at the normal body temperature.

The body temperature is elevated in early pregnancy, which may relate with the high multiplication and rapid differentiation of the zygote cells.

It is now known for several years that in infections, the body itself produces chemicals known as endogenous pyrogens that elevate the setting of hypothalamic thermoregulatory centre to the fever range. All other mechanisms like cutaneous vasoconstriction and shivering then follow to maintain the body temperature at the higher set-level. Fever sometimes directly kills the offending organism, for example the malarial parasite is killed at 105°F. It has been speculated for long that fever somehow provides an atmosphere conducive to development of better immunity. My hypothesis is that the differentiation of lymphocytes into Th1 or Th2 may be temperature driven. There is no doubt that fever is a component of the body's defence mechanism against infections. For this reason, reducing fever with the use of antipyretics is madness.

It is in this connection that it is important to know that the yogic techniques which briefly elevate the body temperature may enhance immunity. Can a brief elevation of body temperature everyday protect us from common viral infections? Can this technique be used

for protection during epidemics such as common flu? Immune cells eliminate not only infecting organisms but also cancer cells. It is not without reason that yogis live long and healthy lives. It needs carefully designed studies to understand the effects of daily, controlled elevation of body temperature.

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