Discussion

Physical Parameters

The gastrointestinal tract requires to be rotated in order to be washed thoroughly just as a conch shell. In Laghu Shankha Prakshalana this is achieved by performing five specific exercises (asanas) which increase intestinal motility temporarily, thus causing the large volume of water gulped to move down the intestines and resulting into watery loose motions (Malshe, 2005).

Tadasana, the first asana of Laghu Shankha Prakshalana, opens the pyloric sphincter muscle of stomach through the expansion of oesophagus, stomach and duodenum, causing water to enter into small intestine (Gherand Samhita, 1/17).

The second asana of Laghu Shankha Prakshalana, Tiryaka Tadasana contracts the one side and relaxes the other side of the intestinal layers repeatedly. This causes water to enter from first layer to second layer and from second layer to third layer of intestine with pressure immediately (Gherand Samhita, 1/17). That eliminates the over dated and dried foodstuffs from intestines which remain clung to rugae of stomach and villies of intestines for a long period of time.

The third asana of Laghu Shankha Prakshalana, Katichakrasana twists the whole smooth muscles of stomach and intestine. Due to twisting, water and pressure work together and push the foodstuffs along with water downwards (Gherand Samhita, 1/17).

The fourth asana of Laghu Shankha Prakshalana, Tiryaka Bhujangasana opens the ileocecal sphincter muscle which lies between small intestine and large
intestine, by twisting the small intestine as well as large intestine. At that moment water enters into the large intestine (Gherand Samhita, 1/17).

The fifth asana of Laghu Shankha Prakshalana, Udarakarshan provides the massages and generates the stretching in digestive organs, nerves and muscles. Hence repeated contraction and relaxation occurs in Gastrointestinal Tract (Gherand Samhita, 1/17).

Finally, complete bowel evacuation and elimination of the whole waste materials from gastrointestinal tract occurs. This local cleansing and purification of the digestive tract improves the digestive process and strengthens our whole body.

Laghu Shankha Prakshalana also reduces the bile acid pool. Bile is a complex fluid containing various substances, some of which are merely waste products undergoing excretion (Chatarzee, 2002). Cholesterol, one of the chief constituents of bile, is also reduced; resulting in reduced fat (both triglyceride and cholesterol) absorption for the next several days (Malshe, 2005) and thus it can help to reduce weight, waist and hip circumference.

With regular practice of Agnisar the effects become visibly apparent. Vitality increases as Agnisar has a powerful toning effect on the visceral organs, muscles, nerves and glands. Agnisar increases blood flow to the entire abdominal cavity including pancreas and pressure decreases in the intestine (Tiwari and Roy, 2010). Due to this, the autonomic nerves comprising the solar plexus are strengthened. The process of digestion, assimilation and elimination are directly affected (Muktibodhanand, 2009), thus regulating the hunger and thirst. Improper functioning in the alimentary canal is one of the most basic causes of overweight. Agnisar effects optimal functioning of this region, thereby overcoming many related
diseases. As a result, Agnisar lowers the body weight, hip circumference and waist circumference.

In Sheetali Pranayama, when we breathe through the tongue, the air is cooled by the saliva and this cools the blood vessels in the mouth, throat, and lungs (Niranjananand, 2001). Then the hyperacidity and its associated diseases are controlled (Muktibodhanand, 2009; Gherand Samhita, 5/74-75). It also regulates cholesterol level and appetite, thereby reduces the body weight, hip circumference and waist circumference.

Bhramari Pranayama produces vibrations which induce very soothing effect on neurons of the brain canters and thus on mind (Niranjananand, 2001). This sensation is received by hypothalamus, which regulates thyroid via pituitary. Hence the hormonal secretion of pituitary gland is regulated. In this way it regulates the overall basic metabolic rate of the body. Thereby, Bhramari Pranayama lowers the body weight, hip circumference and waist circumference.

The muscular tensions are related to the body itself, the nervous system and endocrinal imbalances. These are easily removed by the deep physical relaxation attained in the state of Yoga Nidra (Satyanand, 1976). Yoga Nidra is a systematic method of inducing holistic relaxation (Satyanand, 1976) and meditation implies relaxation. Meditation is a most powerful way of controlling physiological processes and also of controlling physiological reactions to psychological events. One of the most profound changes that take place in the body during meditation is the slowing down of the metabolism, the rate of breaking down and building up the body constituents, for there is a sharp reduction in oxygen consumption and carbon dioxide output. The reduced metabolic rate is due to the control over the involuntary nervous system which one develops through meditation (Satyanand, 2007). When
the metabolic rate is brought down, intake of food diminishes. Then the development and deposition of adipose tissue is brought down. Thereby, Yoga Nidra also lowers the body weight, hip circumference and waist circumference.

It is evident from the results that the order of effectiveness of the yogic practices on the physical parameters undertaken are as given below:

**SHATKARMA > PRANAYAMA > YOGANIDRA**

**Physiological parameters**

**Serum Glucose Level**

After completion of Laghu Shankha Prakshalana, the practitioner rests totally for forty five to sixty minutes. This time period is the only opportunity that the digestive system ever gets to really rest, because only then the intestines are completely empty, and the digestive nerve impulses and glandular secretions stop (Shankaradevanand, 2007). In this short time, the internal organs become able to revitalize themselves and, when the rest period is finished, the practitioners eat a simple meal of Khichedi with about 100gms ghee that stops the loose motions because fat delays gastric emptying time and slow peristalsis. Next day, when the stool is passed, one can feel the ghee coming out unabsorbed. Since the bile acid pool has all been washed away, no fat absorption can take place for several days to come (Malshe, 2005). This allows the system to start up again in the easiest and most balanced way. It means that Laghu Shankha Prakshalana rejuvenates the whole gastrointestinal tract as well as pancreas also. Hence it is clear that Laghu Shankha Prakshalana induces the secretion and improves the excretion which reduces the serum glucose level in human body (Tiwari and Roy, 2010).
Cleansing of mucus membranes with salt water is soothing and healing in itself. Laghu Shankha Prakshalana tends to induce parasympathetic dominance and even drowsiness so that the vicious circle of sympathetic activity and the disease is broken and a more relaxed state is instituted in its place (Tiwari, 2007).

Repeated cleansing of the mucus membranes of the intestines may have a reflex action on the cell membranes of other body tissues via the various channels of tissue and cellular communication and thereby tend to improve the action of insulin on the cell membranes (Tiwari, 2007). Practice of L. S. P. improves the excretion which ultimately reduces the serum glucose level (Prajapati and Tiwari, 2006).

In Agnisar, we completely exhale through nose as well as mouth and hold the breath outside. After that abdominal squeeze and massage is going on by repeated expansion and contraction of abdominal muscles. In that condition, a type of special situation, known as brief instants of hypoxia, arise that works as a mock-drill. It means that whatever changes arise during temporary hypoxia in body that changes arise during brief instants of hypoxia also. The hypoxic effects of Agnisar change the bone marrow microenvironment. Hypoxia is one of the conditions which transmit the signals for change of niche of bone marrow to bring about the development of haemopoietic stem cells. Hence this brief instant of hypoxia stimulates the bone marrow for the development of haemopoietic stem cells microenvironment. Thus, Agnisar improves the production of haemopoietic stem cells in human body. Regulatory signals in bone marrow allow the stem cells to thrive, to expand if needed, and to provide varying amounts of descendent daughter cells (Longo et al., 2012). Thus, the niche must also regulate the number of stem cells produced. In this manner, the niche serves both as a site of nurture and also imposes limits on proliferation of stem cells (Guyton and Hall, 2006). Since
Agnisar develops hypoxic condition in our whole body and specifically in abdominal region, therefore, a large quantity of pluripotent haemopoetic stem cells arrive in the abdominal region. Therefore, Agnisar rejuvenates the whole abdominal region, specifically all digestive organs including liver, kidneys, spleen and pancreas simultaneously. That is why all of the cell types in the peripheral blood and some cells in every tissue of the body are derived from haemopoetic stem cells. This mechanism of action of Agnisar is evident enough to be termed as **Yogic Stem Cell Therapy**. It may be applied as antidote for aging and degenerative disorders.

Agnisar reduces the serum glucose level in body by revitalizing the pancreas as well as whole body.

The breathing process is directly connected to brain and central nervous system and it is one of the most vital processes in the body system. It also has some connection with the hypothalamus, the brain center which controls the emotional responses. The hypothalamus is responsible for transforming perception into cognitive experience. Erratic breathing sends erratic impulses to this center and thus creates disturbed responses (**Muktibodhanand, 2009**).

Pranayama, like Sheetali has cooling effects and activates the parasympathetic nervous system. Sheetali Pranayama not only cools the physical body, it also affects the mind in the same way (**Muktibodhanand, 2009**). In this condition, the demand of extra glucose diminishes through the deactivation of adrenal gland. Thereby, Sheetali Pranayama lowers the serum glucose level.

Bhramari provides relief from anger, anxiety and insomnia. It provides relief from mental stress and discomfort by reducing blood pressure (**Gherand Samhita,**)
5/79-84). It also reduces the demand of glucose in the body and thereby lowers the serum glucose level.

In regard to diabetes, meditation practices have been found definitely to help the endocrine glands through relaxation of the sympathetic nervous system. Regulation of the anterior pituitary hormones, which are under the direct control of hypothalamus, is greatly affected by Yoga Nidra. Also, a general increase in mental efficiency is brought about (Shankaradevanand, 2007). Thereby Yoga Nidra lowers the serum glucose level.

It is evident from the result that the order of effectiveness of the yogic practices on serum glucose level is-

SHATKARMA > YOGANIDRA > PRANAYAMA

**Blood pressure and pulse rate**

Laghu Shankha Prakshalana reduces the bile acid pool from the gastrointestinal tract. The body soon regenerates the bile acid pool (Malshe, 2005) that again utilizes some available cholesterol from the body. Thus the blood cholesterol level is brought down. During this time period the circulating cholesterol from the blood vessels eliminates rapidly. In this situation the flow of blood through blood vessels becomes easy. Thus, Laghu Shankha Prakshalana lowers the blood pressure and pulse rate.

In addition, Laghu Shankha Prakshalana induces the parasympathetic dominance (Tiwari, 2007) and thereby blood pressure and pulse rate. Agnisar stimulates the Manipur Chakra (Gherand Samhita, 1/19-20) by repeated abdominal
retraction. Manipur chakra is situated in navel and related with solar plexus physiologically and has endocrinological relationship with adrenal glands and pancreas (Satyanand, 2007). Agnisar provides smooth massage to the lower cardiac muscles. Then the efficiency of heart increases properly. Thereby Agnisar regulates the blood pressure and pulse rate.

The involuntary control of breathing originates in the medulla oblongata of the brain stem, a region known as primitive brain, while voluntary control of breath comes from the more evolved areas of the brain in the cerebral cortex. During conscious control of the breath, the cerebral cortex by-passes the respiratory center in the brain stem. It is thought that impulses from the cortex affect adjoining areas of the brain concerned with emotions. Whatever the mechanism, conscious breathing has an emotionally calming effect (Niranjananand, 2001).

Both Sheetali and Bhramari Pranayama are conscious breathing techniques. Therefore, they provide emotional soothing effect. Thus causes the parasympathetic dominance to enhance, which in turn lowers the pulse rate and blood pressure.

Meditation has a noticeable influence on blood pressure, which drops much lower than normal both during and after meditation. During meditation the activities of the sympathetic system are reduced and therefore constriction of the blood vessels is automatically decreased, resulting in a greater flow of blood (Satyanand, 2007). Thereby, Yoga Nidra lowers the blood pressure and pulse rate.

It is evident from the results that the order of effectiveness of the yogic practices is YOGANIDRA > SHATKARMA > PRANAYAMA.

Haemoglobin
The average daily diet contains 10-20 mg of iron. Its absorption occurs all over the intestine, but mainly in the upper part. Dietary iron is present either as haeme or as inorganic iron. Haeme iron is better absorbed (35%) than inorganic (~5%) but the former is a smaller fraction of the dietary iron. Inorganic iron is mostly in ferric form and needs to be reduced to ferrous form before absorption can take place. Two distinct iron transporters appear to function at the luminal surface and at the basolateral membrane of mucosal cells to regulate iron absorption. Absorption of haeme iron is largely independent of other foods simultaneously ingested, but that of inorganic iron is affected by several factors. The factors that facilitate iron absorption are acids and reducing substances by favouring dissolution and reduction of ferric iron. These agents reduce ferric iron and form absorbable complexes.

The gut has a mechanism to prevent entry of excess iron in the body. Iron reaching inside the mucosal cells is either transported to plasma or oxidised to ferric form, ferritin. This ferritin generally remains stored in the mucosal cells and is lost when they are shed (life span 2-4 days). This is called the `Ferritin Curtain` (Tripathi, 2003). Laghu Shankha Prakshalana eliminates the unuseful foodstuffs, acids, coated layers from gastrointestinal tract. Therefore the available iron in intestines is absorbed at optimum level whenever required. The iron status of the body and erythropoietic activity govern the balance between these two processes, probably through a `hematopoietic transcription factor`, and thus the amount of iron that will enter the body. As a result, larger percentage is absorbed during iron deficiency. When body iron is low or erythropoesis is occurring briskly, ferritin is either not formed or dissociates soon and released iron is transported to the blood (Tripathi, 2003). Thereby Laghu Shankha Prakshalana enhances the level of haemoglobin.
When a person is placed in an atmosphere of low oxygen, erythropoietin begins to be formed within minutes to hours and reaches maximum production within 24 hours. Yet almost no new red blood cells appear in the circulating blood until about 5 days later. From this fact as well as other studies, it has been determined that the important effect of erythropoietin is to stimulate the production of proerythroblasts from haemopoetic stem cells in the bone marrow. And this process speeds up the formation of red blood cells (Guyton and Hall, 2006). Agnisar also generates the pseudo-hypoxic condition in the body that improves the haemoglobin level.

Malse (2005) reported that practice of Sheetali relieves from the infection of anaerobic Helicobacter pylori (which lives in the pyloric region of stomach and causes ulcerative colitis). Hence the digestion of the ingested food becomes proper. Then the absorption of the digested food also enhances. Thereby, Sheetali Pranayama increases the level of haemoglobin in the body indirectly.

The exact mechanism through which yoga nidra works on haemoglobin level of practitioner is still not very much clear but the fact that yoga nidra has a positive effect on physiology and psychology of practitioner is strongly evident. It is thought that yoga nidra increases the level of haemoglobin by reducing stress hormones and catecholamines (Kumar, 2005), and by inducing alpha dominance in brain which is characterized by mental relaxation.

It is evident from the results that the order of effectiveness of the yogic practices under study on haemoglobin is-

SHATKARMA > YOGANIDRA > PRANAYAMA
Dependence on medication

Initially patients were dependent on permanent medication as they were advised by their physicians according to their conditions. Mainly four types of medications were used-

- Oral Hypoglycaemic drugs for diabetes mellitus
- Anti Hypertensive drugs for High Blood Pressure
- Laxative & Antacid for constipation and hyperacidity
- Tranquilizer for insomnia, stress and anxiety

All the patients of Group 1, Group 2 and Group 3 showed decrement in their symptoms and therefore advised to reduce medication after consulting their physicians.

Out of 20 patients of group 1 were taking oral hypoglycaemic drugs, after 30 days of practicing Shatkarma, 12 patients reduced their dependence on drug by 50%. After 60 days, 100% withdrawal was noticed in 7 and 50% withdrawal was noticed in 13 cases. However no patients of this group could reduce his dependence on antihypertensive drugs. On the other hand, dependence of group 1 patients (16) on laxative and antacids reduced by 100% on day 30 itself and continued till the end of study. Similarly all the 6 patients of this group, who were taking tranquilizers, reduced their dependence on this drug by 100% from day 30 onwards.

Out of 20 patients of group 2 were taking oral hypoglycaemic drugs, after 30 days of practicing Pranayama, no patient of this group could reduce his dependence on oral hypoglycaemic drugs, but after 60 days, 100% withdrawal was noticed in 7
cases and 50% withdrawal was noticed in 13 cases. Out of 10 patients of group2, who were taking antihypertensive drugs, after 30 days of practicing Pranayama, 2 patients reduced their dependence by 50% and after 60 days, 2 patients reduced their dependence by 100%. Out of 14 patients of group 2 who were taking laxatives and antacids, after 30 days of practicing Pranayama, 10 patients reduced their dependence on drug by 50% and 4 others reduced their dependence on drug by 100%. After 60 days, 50% and 100% withdrawal of laxatives and antacids were noticed in 6 and 8 patients respectively. Out of 8 patients of group 2 who were taking tranquilizers, after 30 days of practicing Pranayama, 6 patients reduced their dependence on drug by 50% and 2 patients reduced their dependence on drug by 100%. After 60 days, 50% and 100% withdrawal of tranquilizers were noticed in 6 and 2 patients respectively.

Out of 20 patients of group 3 who were taking oral hypoglycaemic drugs, after 30 days of practicing yoga nidra, no patient of this group could reduce his dependence on oral hypoglycaemic drugs but after 60 days, 100% withdrawal was noticed in 7 cases and 50% withdrawal was noticed in 13 cases. Out of 14 patients of group 3 who were taking antihypertensive drugs, after 30 days of practicing yoga nidra, though 5 patients of this group could not reduce their dependence on antihypertensive drugs, but 9 patients reduced their dependence by 50%. After 60 days, 11 patients reduced their dependence by 50%. Out of 15 patients of group 3 who were taking laxative and antacids, after 30 days of practicing yoga nidra, 9 patients reduced their dependence on drug by 50%. After 60 days, 11 patients reduced their dependence on laxatives and antacids by 50%. Out of 10 patients of group 3 who were taking tranquilizers, after 30 days of practicing yoga nidra, 6 patients reduced their dependence on drug by 50% and 4 patients reduced their
dependence by 100%. After 60 days, 50% and 100% withdrawal of tranquilizers was noticed in 8 and 2 patients respectively.

Psychological parameters

Stress and Anxiety

Physical activity may also prevent stress-induced suppression of the immune system (Fleshner, 2005; Richard, 2007). The cleansing and maintenance of the physical body has an immediate positive effect on our wellbeing. In the process, the mind is also cleansed because the Shat karma has a direct effect on activating and eliminating unconscious negative material, and so purifies the mind (Rishivivekanand, 2006). Postures probably have general balancing effects on the hormones and peptides of the body; they certainly increase endorphins, the ‘Feel Good’ peptides (Rishivivekanand, 2006). Exercise activates beta-endorphins, which may stimulate Natural Killer Cell activity. Therefore exercise may be an important buffer against stress related immune changes (Shelley, 2006). Flexibility of the body produces flexibility of the mind, so we are able to assess our negative attitudes and change them. Thereby it is clear that Laghu Shankha Prakshalana and Agnisar decrease the stress and anxiety.

Controlled and relaxed breathing also calms the mind. One of the mechanisms by which this may occur is through the release of endorphins. Deep breathing has been observed to release endorphins into the blood stream. The endorphins are potent brain chemicals, neuromodulators, which help us, cope with pain, and which are the part of the mechanism for dealing with and eliminating fear and anxiety (Niranjananand, 2001). From the above facts it is obvious that Sheetali and Bhramari lower the stress and anxiety.
Relaxation produced by a yoga session lasts way beyond the session and becomes an ongoing state as we continue overtime with our practices. It breaks the vicious circles such as Stress and Anxiety (Rishivivekanand, 2006). Relaxation may mute the effects of stress on immune system. In a study with elderly adults, participants were assigned to relaxation training, social contact, or no intervention (Kiecolt-Glaser et al., 1985).

Participants in the relaxed condition had significantly higher levels of Natural Killer cell activity after the intervention than at baseline and significantly lower antibody titres to herpes simplex virus I, suggesting some enhancement of cellular immunity associated with the relaxation intervention (Shelley, 2006). The immune system stands as a potential mediator of a variety of psycho-physiological effects (Adler, 1983). Modulators of neurotransmitters also influence behaviour, perhaps when effects are exerted early in the course of Central Nervous System development (Adler, 1983).

The immune status of an organism has consequences on his behaviour. The new research indicates that the nervous and immune system, the two most complex systems are involved in the maintenance of homeostasis (Cohen and Ader, 1993).

The immunologic correlates of emotional states and personality traits are modulators of immune function and the effects of stress on immune function (Cohen and Ader, 1993). Immune responses, like other physiological processes, can be modified by classical conditioning (Cohen and Ader, 1993). People’s emotions—both positive and negative – play a critical role in the balance of immune functions. But positive emotions can also affect immune function, giving it a boost (Sarafino, 1998).
Yoga Nidra probably reduces stress hormones. It has also been reported to reduce anxiety level and level of catecholamines for long term (Bali 1979; Bhushan and Sinha, 2001). Yoga Nidra is probably the best-known technique to induce complete physical, mental and emotional relaxation. Yoga nidra also brings alpha dominance in the brain, which is characterized by mental relaxation (Kumar, 2005; Mangalteertham, 1998). These statements verify that Yoga Nidra diminishes the stress and anxiety and enhances the `Psychoneuroimmunity`.

Communication between mind and the body is carried out by peptides called neurotransmitters. Three neurotransmitters - norepinephrine, serotonin, and dopamine, are essential for neurocommunication. In addition to these neurotransmitters, the hypothalamus, a key structure in the nervous system, plays a significant role in Psychoneuroimmunology. The hypothalamus is affected strongly by the emotional and cognitive states. It is surrounded by and interconnected with the limbic system, a part of nervous system that controls the emotional state of an individual. It is also adjacent to cerebral cortex, which provides cognitive and interpretive processes (Bloom and Lazerson, 2000). The Sympatho-Adreno-Medullary (SAM) and Hypothalamic-Pituitary- Adrenocortical (HPA) systems are thought to be primary pathways by which psychosocial processes and health behaviors impact the immune mechanisms (Lutgendorf et al., 2003). For example, certain hormones, such as cortisol and epinephrine are released in higher amounts when an individual is under great stress. These hormones are known to depress T – cell activity, and thus depress one’s immune system.

From the above mentioned facts and evidences, it is inferred that the immune system is similar to the proverbial two-edged sword; immunodeficiency states render easy prey to infections and hyperactive immune system may cause fatal disease. In addition, yogic practices enhance the immunity at bio as well as psycho stratum.
Various psychological approaches, such as relaxation, and stress management training can actually boost immune system functioning (Coon, 2003). Thereby it is clear that yoga establishes self control in life also, hence Diabetes Mellitus cures rapidly through yogic practices.

It is evident from above table that order of effectiveness of the yogic practices is YOGANIDRA > SHATKARMA > PRANAYAMA