Stress Reactions: Its Management

by

Preksha Meditation & Yoga

Chapter-5

Discussion
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1. Blood Pressure

The findings of the present study indicated a significant decrease in blood pressure in the subjects practicing swas Preksha after three months and this decline persists even after six months of the practice. After further analysis it was observed that both the systolic and diastolic components of blood pressure have shown the similar trend. Several studies have reported a similar beneficial effect of yoga based programs in terms of decreased blood pressure. These include the studies of Bhargava et.al. (1988) and Roopakala et.al.(2002) who reported significant reduction in the systolic blood pressure after pranayamic breathing. Mishra (1995) has stated that a short term practice of Deergha swas Preksha and anuloma viloma pranayama have played a significant role in obtaining integrated health state along with individual performance. Most of these studies were small including Raichur et al (2001) who observed significant reduction in the systolic blood pressure following pranayama. Udupa et al (2003) have also studied short term effect of pranayama training on cardiac function in normal young volunteers and observed that pranayama training modulates ventricular performance by increasing parasympathetic activities and decreasing sympathetic ones. Udupa et al (1975) have also reported a decrease in pulse rate but no change in blood pressure after short duration pranayama training. Patel et al (1975) conduct a scientific study on 34 hypertensive patients for six weeks of yoga methods with biofeedback or to general relaxation and showed a reduction in blood-pressure.

Pranayama and/or swas Preksha thus shows a strong tendency to improve the autonomic nervous system through enhanced activation of the parasympathetic system leading to withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing decrease in peripheral resistance and thereby decreasing the blood pressure.
In a study of ninety five female Japanese university students, Cusumano et al (1992) demonstrated comparable and significant reductions in blood pressure over time among women receiving three weekly training sessions in either Hatha yoga or progressive muscle relaxation. Overall, these studies demonstrated a 4.9% to 24.2% decline in diastolic blood pressure and a 2.6% to 21.3% decline in systolic blood pressure with yoga, with the magnitude of change varying with the study design and sample population. Yoga-based programs used in the twenty eight other studies reporting positive findings ranged in duration from thirty days to six months (Sundar et al, 1984) in the uncontrolled studies, from three weeks (Selvamurthy et al, 1998) to six months (Stone et al, 1976) in the controlled nonrandomized studies, and from eight days to twelve months (Fields et al, 2002) in the RCTs. Interventions associated with blood pressure improvement included yoga routines in both alone (N = 20) and in combination with other therapies (N = 8). Of those studies using yoga alone, ten incorporated active yoga asanas and ten relaxation postures alone (Sundar et al, 1984) or in combination with meditation (Patel et al, 1975). Collectively, the findings of both controlled and uncontrolled studies suggested that even the relatively short-term practice of yoga, meditation or other yoga-based programs may reduce blood pressure. Our findings are also in the same line.

Recently a randomized control study reported that device guided slow breathing (mechanized modulation of breathing) with prolong expiration performed daily for two months resulted in a sustained blood pressure reduction of 16.2/10.6 mmHg from a baseline blood pressure of 158/97 mmHg (Schein et al, 2000)

Another study was conducted by Barnes et al, (2004) to assess the impact of meditation on resting and ambulatory blood pressure and heart functions of youths. They observed significant decrease in resting blood pressure, day time ambulatory blood pressure after school, and day time ambulatory heart rate after school. These finding demonstrated the potential beneficial impact of meditation on blood pressure and heart rate in the natural environment in healthy normotensive youth. Our results are also in conformity of the findings of this study.
Numerous other longitudinal studies on effect of yoga on cardiovascular system in various age groups have shown a significant and positive coefficient of correlation of systolic and diastolic blood pressure with age, where mean values of pulse rate, systolic blood pressure and valsalva ratio were less in the group of subjects practicing yoga in comparison to control group of subjects. The author (Gopal et al, 1973) stated that variety of behavioural factors such as stress and anxiety related to daily life activities and affective and attitudinal dispositions of the individual influence the cardiovascular responses. Yogic exercises involving physical, mental and spiritual task bring in several behavioural changes. Yoga affects hypothalamus and brings about decrease in the systolic and diastolic blood pressure through its influence on vasomotor center, which leads to reduction in sympathetic tone and peripheral resistance (Khanam et al, 1996)

Mishra and Shekhawat (2007) have conducted a scientific study to determine if meditation training modulates the cardiovascular response and autonomic functions, after short term yoga and meditation intervention program which combined daily practice of Kayotsarga (Relaxation with self awareness), Antaryatra (Internal Trip) and AnuPreksha (Contemplation) all being the components of Preksha Meditation. They observed that such short term meditational intervention has reduced systolic and diastolic blood pressure, which they attributed to reduction in sympathetic activity. Their findings not only support our results but also very clearly provide physiological base for making out an inference that such changes may be because of reduction of sympathetic activity.

By far, the most important part of autonomic nervous system for regulation of the cardiovascular responses in the sympathetic nervous system, sympathetic vasomotor nerve fibers leave the spinal cord and pass into the sympathetic chain and then by two roots to the circulation: (1) through specific sympathetic nerves that innervate mainly the vasculature of the internal viscera and the heart and (2) through the spinal nerves that innervate mainly the vasculature of the peripheral areas. The innervations of the smaller arteries and arterioles allow sympathetic stimulation to increase the resistance and thereby to change the rate of blood flow and blood
pressure. The parasympathetic nervous system, although play a minor role in regulation of circulation, its most important circulatory effect is its control of heart rate by way of parasympathetic fibers carried to the heart in the vagous nerve. Principally parasympathetic stimulation causes a marked decrease in heart rate, blood flow and blood pressure (Guyton, 1991).

Swas Preksha practice stimulates the autonomic nervous system by enhancing and strengthening the functioning of parasympathetic component and simultaneously modulating the sympathetic components (Acharya Mahaprajna, 1994). Thus it may be inferred that our findings are in conformity with the pathway of mechanism of action of yoga and meditation, derived by exponent scientific investigators.

2. Pulse Rate

A statistically significant reduction in the pulse rate of the experimental group of subjects practicing Preksha meditation module has been recorded in the findings of the present study. Such significant changes were noticed at both follow-up schedules i.e. three months & six months. These findings depict the positive effects of Preksha meditation practice and are in accordance with the remarkable findings of few other studies.

In a scientific study, yoga based guided relaxation and supine rest, conducted by Vempati et al (2002) on 25 male volunteers with age ranged from 20 to 40 years; comparable reductions in heart were noticed during both types of relaxation. While studying the effect of yoga on cardiovascular system in subjects above forty years, a significant reduction in the heart rate in subjects practicing yoga was observed by Jyotsana et al (2003). They concluded that cardiovascular parameters alter with age but these alterations are not shown in persons aging with yoga. Their observations were in conformity with our findings but in the subjects of higher age groups, whereas our findings belong to adult group of subjects.

Raghuraj (1998) studied the effect of two selected yogic breathing techniques of heart rate virility (HRV). This study was conducted to evaluate the HRV in two yoga practices
which have been previously reported to have opposite effects, viz, sympathetic stimulation (kapalabhati, breathing at high frequency, i.e., 2.0 Hz) and reduced sympathetic activity (nadi-suddhi, alternate nostril breathing). The results showed a significant increase in low frequency (LF) power and LF/HF ratio while high frequency (HF) power was significantly lower following kapalabhati. There were no significant changes following nadi-suddhi. The results suggested that kapalabhati modifies the autonomic status by increasing sympathetic activity with reduced vagal activity. The study also suggests that HRV is a more useful psychophysiological measure than heart rate alone.

Bhargava et al. (1988) have shown that baseline heart rate and blood pressure (Systolic and Diastolic) exhibited a tendency to decrease and both these autonomic parameters were significantly decreased at breaking point after pranayamic breathing. Although the GSR was recorded in all subjects the observations made were not conclusive. Thus pranayamic breathing exercises appear to alter autonomic responses to breath holding probably by increasing vagal tone and decreasing sympathetic discharges.

Telles et al. (2004) determined whether yoga reduced heart rate and whether the reduction will be more after thirty days of yoga training? Two groups (yoga and control) were assessed on day one & day thirty during the intervening thirty days. The yoga group received training in yoga technique while the control group carried out with their routine. Post follow-up heart rate was significantly lower in the yoga group on day thirty compared to day one. Our findings have also got support as we also recorded the similar trend of changes in the pulse rate following Preksha meditation intervention.

Delmonte (1984) found that heart rates were slightly lower during meditation than rest for fifty-two subjects. Holmes et al. (1983), however, found that while meditators had lower heart rates while practicing TM, they did not experience lower arousal than control subjects who were simply resting. These findings were also supported by Dillbeck and Orme-Johnson (1987), Morrell (1986), and Holmes (1984). It has also been reported by Madanmohan et al. (1983), Rai et al. (1982), and Gopal et al. (1973) that pranayama improves cardiorespiratory functions
Evaluating physiological responses to *Hath yoga* intervention in terms of cardiovascular functions, Funderburk (1977) observed significant reduction in heart rate and blood pressure. Madanmohan et al (2004) assessed the impact of *Hath yoga* on heart rate & blood pressure and reported that even after short practice of *Hath yoga* heart rate came down significantly. Meditation practice brings down serum cortisol and total protein level along with systolic & diastolic blood pressure and heart rate. The percentage decrease in these parameters were up to 22% (Sudsunh et al, 1991)

Cuthbert et al (1981) had results demonstrating clear superiority for meditators using Benson's relaxation response versus heart rate biofeedback, especially when the subject experimenter relationship was supportive. Lang et al (1979) placed the heart rate decrease for advanced TM meditators with more than four years of practice at 9%. Bauhofer (1978) found that the heart rates of experienced TM meditators were lowered by TM more than those of less experienced TM meditators. Corey (1977) and Routt (1977) reported that TM appeared to decrease heart rate under non stress conditions. Glueck and Stroebel (1975), Wallace and Benson (1972), Wallace et al (1971), and Wallace (1971) found that the heart rate decreased from three to five beats per minute during TM. Reports of reduced heart rates during meditation extend back to Paul (1969), Karambelkar et al (1968), Anand and Chhina (1961), Wenger and Bagchi (1961), Bagchi and Wenger (1957), and Das and Gastaut (1955). Udupa et al (1975) have also reported a decrease in pulse rate but no change in blood pressure after short duration pranayama training.

Mishra and Shekhawat (2007) evaluated effect of a different practice module of Preksha meditation on cardiovascular response and lipid profile. Four weeks of Preksha meditation practice results in significant decrease in heart rate, blood pressure, total cholesterol, triglyceride, rate pulse pressure, mean pressure and increase in high density lipoprotein – total cholesterol ratio. Since rate pulse pressure is an index of myocardial oxygen consumption and load on the heart (Gobel et al, 1978), the authors concluded that Preksha Meditation training
decreases load on heart. A decrease in diastolic blood pressure along with heart rate has indicated reduction in sympathetic activity as also reported by Ray at el (2001). Significant variation in spectral measurement of heart rate in experimental group of subjects practicing yoga could possibly due to variation in cardiac responsiveness to the change in vagal nerve traffic to the heart through parasympathetic channel (Singh at el, 1999). Goldberger at el (2003) have also postulated that heart rate variation increases with increasing vagal nerve traffic to the heart and then decreases with further increase in vagal tone. The findings of our study and another important scientific study conducted by Bijlani al el (2005) are in accordance with the results of Eradman at el (2002) who have concluded that a life style modification and stress management through yoga meditation leads to favorable cardiovascular response.

Strong sympathetic stimulation increases the heart rate four to five times and also the force with which heart muscle contracts there by increasing the cardiac output as much as two fold to three fold (Guyton, 1982). Inhibition of the sympathetic nervous system can be used to bring down the heart rate and strength of ventricular contraction. Strong parasympathetic vagal stimulation of the heart decreases the strength of heart contraction by as much 20-30%. In addition to that certain chemical compounds also influence the heart rate. Though the parasympathetic nervous system is exceedingly important for many other autonomic functions of the body, it plays only a minor role in regulation of the circulation. Its only really important effect is its control of heart rate through vagal nerve. (Guyton, 1982; Tartora, 2006; Guyton, 1991).

Our results are in conformity with the findings of several studies of the same field. This may be due to improved vagal tone after selected slow breathing in swas Preksha. Changes in heart rate and respiration accompanying a swas Preksha practice are intended to alter the state of mind alone (Wallace and Benson, 1972). It has been seen that certain yogies can alter the patterns of their cardiovascular functions, voluntarily create arterial fibrillation or stop their heart at their will (Kuvalyananada, 1968). Other type of voluntary alteration of heart rate such as
tachycardia, bradycardia, reduction of P-wave amplitude, achieving T-wave amplitude more than that of R-wave and arterial flutters have also been recorded (Talukdar, 1996). These observations suggest that our practice module causes a shift in the autonomic equilibrium to the parasympathetic side. This inference is again supported by Dang et al (1999), by reporting similar observations in their findings, which they have stated in reference to certain other yogic practices.

3. Respiratory Variables

It may be concluded, from the results obtained, that the long term and regular practice of Preksha meditation module manifests in overall improvement in respiratory functions. The pathway of mechanism of Preksha meditation module involves the higher neural centers in the brain. The particular remedial action generated in the cerebral cortex, in terms of thought modulation and pranic balance, is being communicated to the concerned system/organ through the relative center in the brain. The changes observed in the present study might be attributed to such mechanism of action. It may be inferred that whatever changes has been observed following the practice of Preksha meditation module, an integral component of Preksha Meditation, may be the sum total of various neuromuscular control efforts over the respiratory functions of the subject, because practice of Preksha meditation module includes modulation in both muscular and neural performances.

Fibers from medulla oblongata (I neurons and E neurons) travel down the spinal cord and synapse with lower motor neurons in the cervical to thoracic regions. From here, nerve fibers travel in the phrenic nerve to the diaphragm and intercostal nerve endings to the intercostal muscles. During quiet breathing impulses transmit to the external intercostal muscles via intercostal nerves and to the diaphragm via the phrenic nerve (Tortora, 2006). The improvement in the ventilatory functions may be due to neural changes that send impulses, after getting a stimulus from breathing modulation by Preksha meditation module, to the inspiratory area in the medulla oblongata. The stimulus for these changes in respiratory centers may also be from input from proprioceptors, which monitor the movements of related joints and
muscles. Through these routes after getting impulses form brain centers to neuromuscular centers, the respiratory muscles expands and give space to the lungs for their maximum expansion which may cause an improvement in the pulmonary ventilation capacities (Seeley RR et al., 2003).

4. Stress hormone, anxiety and frustration

The anxiety related components individually influence the net level of anxiety and frustration favorably after relaxation practice because it can check sympathetic over activity (Vempati, et al., 2002). The objective manifestations of anxiety – a racing heart, palpitations, tremors, sweating, increased blood pressure, dry mouth, avoidance behavior, signs of restlessness and heightened responsiveness decrease and slowly disappear following the practice of meditation. Prior studies have also reported a significant reduction in the scores of trait anxiety following meditation (Eppley, et al., 1989) and breathing exercises as the relaxation techniques and in the state anxiety following muscle relaxation techniques and listening to music (Stoudemire, 1975). A similar lifestyle intervention had favorably changed the biochemical parameters too – the serum lipid and fasting plasma glucose in ninety-eight subjects who followed the practice of meditation (Bijlani, et al., 2005). The improvement in anxiety scores along with biochemical indices is clinically relevant in spite of the heterogeneous patient profile. Psychological stress being the risk factor for many diseases (Bruce, et al., 1992; Bijlani, et al., 1981; Paul, et al., 2002) makes this improvement valuable in terms of primary prevention. Maximum improvement was seen in patients with psychiatric disorders having higher anxiety scores possibly because the scope for reduction was greater. But the improvement remained statistically significant even after the results on patients were pooled with those on the subjects who had attended the program as a part of general preventive measure and had lower initial anxiety scores. This further adds to the physiological and clinical relevance of the observations of the present study in the context of meditation practice.
Although Bhattacharyya and Krishna Swami (1960) concluded that yoga training does not produce any significant effect on the physiological parameters of the normal and healthy volunteers, there are several other reports of yoga meditation-training on physiological functions critically contradicting their observation. Bera and Rajapurkar (1993) have reported that yoga and meditation training results in significant improvement in cardiovascular endurance and anaerobic threshold. This is consistent with the findings of Murlidhara and Ranganathan (1982) that yoga training improves physical efficiency as indicated by significant increase in cardiac recovery index measured by Harvard Step Test. Our findings of significant decrease in blood pressure, heart rate and rate pulse pressure after meditation practice are consistent with the findings of those studies. Assessment of subjective well being and anxiety levels after a brief lifestyle modification educational program based on the principles of yoga showed improvement of both the parameters in two separate studies (Sharma, et al., 2004, Gupta, et al., 2006). Another study has revealed that meditation intervention was effective in reducing the state anxiety in both males and females (Singh, et al., 2003). These studies suggest that short duration meditation and lifestyle intervention program positively modifies the people’s subjective well being and anxiety levels. Psychological stress is an important risk factor for many diseases and thus these improvements appear to be valuable in terms of basic prevention.

Early work by Lazarus and his colleagues (reviewed in Lazarus, Averill, & Opton, 1974) suggested that there are individual differences in physiological reactions to stress. They investigated the effect of stress on end organs, or the outward manifestations of sympathetic arousal. These include heart rate, respiratory rate, and galvanic skin response (GSR), which reflects the amount of perspiration on the skin. They found individual differences in the patterning of responses. For example, some individuals’ heart rates increased in response to stress, whereas other individuals’ heart rates decreased though they perspired more. While sympathetic arousal did occur, the manifestation of this arousal varied across individuals. Thus, there may be individual differences in the patterns of physiological reactions to stress.
Further, there was early evidence that different types of stressors may evoke different physiological reactions. Mason (1971) subjected rats and monkeys to different types of stress, including hunger, inadequate nutrition, and cold. He found that there were “stressor profiles,” such as specific neuroendocrine reactions that varied depending on types of stress, and concluded that reactions to stress were specific, not general.

It is now well established that there are both individual differences in as well as situation-specific responses to stress, and that the physiology of stress is much more complicated than originally thought. For example, within the sympathetic nervous systems (SNS), there are different subsystems that can be activated independently (Jänig & McLachlan, 1992). Further, we know much more about the timing of and interaction between different stress-regulating systems in the body.

The SNS constitutes the immediate reaction to stressors, and consists of two major subsystems (Gevirtz, 2000), both of which result in the release of catecholamines (epinephrine and norepinephrine, also called adrenaline and noradrenaline). In the first system, the SNS neurons use norepinephrine to stimulate target organs and to immediately increase the heart and respiratory rates and decrease gastrointestinal activity, which allow more circulating blood to reach the muscles more quickly, giving them more nutrients and taking away toxins such as lactic acid generated by motor activity. Norepinephrine also serves to increase muscle strength and mental activity. The second system also results in the release of catecholamines, but indirectly via the adrenal medulla. In the sympathetic–adrenomedullary (SAM) system, the sympathetic nerves directly stimulate the adrenal medulla to release both epinephrine and norepinephrine into the bloodstream, which then also affect the target organs (see Figure 4.2). The pathways are, in fact, redundant, which signals the importance of being able to respond immediately to stress for adaptation.
**Figure 4.2** Two pathways in the stress activation of the sympathetic nervous system.

**Hypothalamic–Pituitary–Adrenocortical Axis and the Anabolic/Catabolic Balance**

Catecholamines are toxic, and too prolonged an exposure damages the organs that are being activated (Sapolsky, 1998). Thus, activation of the hypothalamic–pituitary–adrenocortical (HPA) axis occurs not simply as a stress response, but is a way in which the body tries to reduce the toxic effects of SNS exposure. For example, SNS stimulates the inflammatory response of the immune system (see below), which, if prolonged, can damage various organ systems. HPA activation suppresses the immune system in an attempt to prevent this damage.

The HPA axis is presented in **Figure 4.3**. The stressor, which includes chemical toxins, mechanical stress (such as physical exertion or exposure to heat or cold), and psychosocial problems (more precisely, the perception of threat or harm), stimulates the hypothalamus to secrete corticotropin-releasing hormone (CRH). In turn, CRH stimulates the anterior lobe of the pituitary to release adrenocorticotropic hormone
(ACTH) into the bloodstream. The adrenal cortex or outer part of the adrenal gland, releases corticosteroids, which are fat-soluble molecules that use cholesterol as a component. Cell walls are also made up in part by cholesterol. This allows them to cross cell membranes and enter every cell in the body. This is why stress can affect nearly every organ system. Corticosteroids include both glucocorticoids and mineral corticoids. Glucocorticoids have a wide range of effects. They can suppress immune function, raise metabolic rates, and stimulate the release of glucose into the body. They can also affect sex hormones and thus influence fertility. Depending upon the duration of the stressor, they can either stimulate or suppress growth hormone (Sapolsky, 1998). Mineral corticoids regulate systems such as calcium metabolism.

**Figure 4.3** Stress activation of the hypothalamic–pituitary–adrenocortical axis (HPA).

In the present study we have observed significant reduction in the quantitative profile of the stress hormone cortisol. With this finding it may be inferred that regular practice of Preksha Meditation has influenced the above mentioned stress producing mechanisms there by causing the reversal of stress states. The possible pathway of mechanism may involve hypothalamic-autonomic route and also crucial
role of neurotransmitters and endocrine glands. The findings of the present study related to various physiological parameters applied in the study have been further supported by the enhanced level of psychological well being in terms of reduced level of anxiety and frustration.

5. Preksha Meditation: Pathway of Mechanism

Preksha Meditation module applied in the present study comprises swas Preksha as its main component along with its other supporting components. It is a module where the practice of swas Preksha is at the core. It may be presumed that whatever changes have been recorded during the whole duration of study appeared to be psychobiological efficacy of swas Preksha. It is relevant to mention here that relaxation with self awareness (kayotsarga) and perception of breathing (swas Preksha) are the core and integral components of Preksha meditation.

Relaxation is practiced to counteract the ill effects of stress. Stress would mean deformation of our comforts. It can display itself as tightness, an anxiety or an irrational fear. Under stress we feel irritable, getting easily upset or angry and as stress increases we may begin to feel that we simply cannot cope with the situation any more, and finally that leads to several diseases or disorders, respiratory and cardiovascular being one of them. Whenever one encounters a psychological stressful situation, an elaborate innate mechanism is automatically put into action. This mechanism involves (1) hypothalamus – the remarkable portion of the brain which integrates all functions of the body which are not normally controlled by the conscious mind, (2) pituitary gland, which is called master of the endocrine system because it regulates the other glands, (3) adrenal gland, which secretes adrenalin and other hormones to keep the body tense and alert, and (4) sympathetic component of the autonomic nervous system which is responsible for ultimately preparing the body for “fight or flight” response. There is plenty of evidence now to show that tension may play a significant part in promoting or triggering off a great many illness including coronary heart disease and diabetes (Mahaprajna, 1992). There is an innate mechanism which produces physiological conditions, which are diametrically
opposite to fight or flight response. Nobel Laureate, Swiss Physiologist Dr. Walter described his response as a protective mechanism against overstress, promoting restorative processes and called it “trophotropic response”. Dr. Herbert Benson (1975) has termed this reaction as “relaxation response”. Kayotsarga component of Preksha meditation enable the practitioner to activate the healing mechanism and to influence our reaction to stress. It normalizes the metabolic rate and secretion of stimulating hormones and the sympathetic dominance is being counter-balanced by increased parasympathetic activity (Muni Mahendra Kumar, 1991 and Mishra, 1996). Autosuggestion, associated with relaxation, works as a special kind of self-hypnosis which modulates the functioning of self-healing mechanism, thereby correcting the abnormal functions of various organs.

Perception of breathing (swas Preksha) promotes the means of disposing the waste carbon dioxide and provides a continual replenishment of the oxygen, which thereby maintains the optimal level of metabolism. Balanced metabolism helps innate correction mechanism to operate in full swing. As per philosophical basis of Preksha meditation constituent organs of nervous system and endocrine gland system constitute the psychic centers (chaitanya kendras in this study Jyotikendra Preksha). These two are the major controlling and coordinating systems of our body. They coordinate the physiological functions of other systems and through them control the functions of the body as a whole. The functional interlocking between them qualifies them to be regarded as constituting a single integrated system called “neuro-endocrine system”. Perception of the constituent endocrine glands and neuronal junctions may probably modify the hormonal and neurotransmitter profile which in turn regulates the total metabolism. This may be one of the possible beneficial mechanisms operating in Preksha Meditation practice module.