Review

UNILATERAL FORCED NOSTRIL BREATHING:

Basic Science, Clinical Trials, and Selected Advanced Techniques

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ABSTRACT

This article reviews the published basic science and clinical studies on unilateral forced nostril breathing (UFNB), a subset of yogic breathing (pranayam) techniques that were discovered/devised more than 5000 years ago. The relationship of UFNB to the ultradian physiological phenomenon called the nasal cycle, a marker of mind-body states is also reviewed. Basic science studies show how UFNB can affect the autonomic nervous system, central nervous system (including cognition), and general metabolic activities. Clinical trials on the application to angina pectoris and obsessive compulsive disorder are described. In addition, three selected advanced UFNB techniques are described; one for stimulating the immune system; one for developing a comprehensive, comparative, and intuitive mind; and a third for developing an enlightened-transcendent mind. These three techniques are part of the ancient science of Kundalini Yoga as taught by Yogi Bhajan.

KEYWORDS: Unilateral forced nostril breathing, pranayam, nasal cycle, ultradian rhythms, yoga, subtle energies, yin and yang, ida and pingala, meditation, immune system, angina pectoris, obsessive compulsive disorder, transcendental realities

INTRODUCTION

The science of yoga evolved over countless generations, during the ancient times of the rishis, in an era before the advent of the formal religions. This article reviews recent scientific studies that help give some credibility to this ancient knowledge as a science. The focus here is on a subset of yogic "pranayams" or breathing techniques, those designated as unilateral forced nostril breathing (UFNB) techniques. These techniques include specific time-tested variations of selective left or right nostril breathing patterns, or combinations in sequence. A review is provided for the basic science studies, clinical trials, and a few examples are included of the more advanced UFNB techniques so that the unfamiliar reader may appreciate the vastness and depth of this ancient and powerful knowledge.

BASIC SCIENCE

The Nasal Cycle and UFNB

One may ask why is breathing through one nostril any different than using two? The answer to this question is based in part on first understanding the mind-body relationships correlated with the phenomenon called the "nasal cycle" (NC). The NC is a marker of a rhythmic and alternating shift of lateralized autonomic function that co-regulates lateralized rhythms of the central nervous system (CNS).[1] Although the NC is not widely known, it has been studied at length and is defined as an alternating congestion and decongestion of opposite nostrils where there is a vasoconstriction (decongestion) in one nostril paralleled by vasodilation (congestion) in the other. The nasal mucosa are highly innervated with fibers from the autonomic nervous system (ANS) and the dominance of sympathetic activity on one side produces vasoconstriction, while the contralateral nostril exhibits a simultaneous parasympathetic dominance causing partial occlusion. While yogis had been acutely aware of this phenomenon and its correlates, Kayser was the first western scientist to document the NC. In 1895, he described it as reflecting the "alternation of vasomotor tone throughout the periphery on the two sides of the body."[2] Yogis called this subtle physiological phenomenon a marker of the balance of "ida and pingala" and in Chinese medicine it is described as the balance of "yin and yang."

The NC is only now gaining significance in the West. Studies of the NC with reviews have been made in 1968 by Keuning and in 1986 by Haight and Cole.[3,4] In 1951, Beickert looked at other structures in relationship to the NC and published a study on "Half-sided rhythms of Vegetative Innervation."[5] In 1983, Werntz, Bickford, Bloom and Shannahoff-Khalsa demonstrated that the NC was also a marker for CNS function.[6] They showed how the NC was tightly coupled to ultradian rhythms of alternating cerebral hemispheric activity during waking in humans.[6] This was the first study to demonstrate how the NC was in fact a marker of mind-body activity and was based on the teachings of Yogi Bhajan, a master of Kundalini Yoga that came to the west in 1968. Later, Shannahoff-Khalsa, Kennedy, Yates and Ziegler showed how the NC was also a marker for the tightly coupled "hourly" ultradian rhythmic changes in the cardiovascular, neuroendocrine, and fuel regulatory hormone (insulin) systems during waking.[7,8] Shannahoff-Khalsa and Yates showed how the NC was tightly coupled to cerebral rhythms of alternating cerebral hemispheric activity during sleep and Shannahoff-Khalsa, Gillin, Yates, Schlosser and Zawadzki showed how these cerebral rhythms were also coupled to sleep stages of rapid eye movement (REM) and non rapid eye movement (NREM) sleep.[9,10] These studies have helped to further define Kleitman's hypothesis of the "Basic Rest-Activity Cycle (BRAC)."[11] And in addition, this work now presents a comprehensive and multi-variate view of how the major bodily systems change in concert, thus helping to define physiological states in a new temporal-spatial context.[1,6-10] Yogis knew these rhythms of "ida and pingala" were essential for understanding mind-body states, health, disease, and daily/nightly activities.[12]

This work on physiological states helps give credence to the yogic perspectives on state changes (alternations in the balance of "ida and pingula") that alternate with nostril dominance, and how UFNB techniques may alter mind-body states, at least in the grossest context. While the mechanism for how UFNB affects the ANS, CNS and multiple bodily systems, is not clearly understood, it is likely that mechanical receptors in the nasal mucosa register the flow of air across the membranes (unilaterally) and transmit this signal ipsilaterally to the hypothalamus—the brain's brain, or what is conceived to be the highest center for autonomic regulation. (For a model of hypothalamic regulation of the ANS-CNS BRAC cycle see reference 7.) The use of local anesthesia in the mucosa has been shown to eliminate the selective effects of UFNB on electroencephalographic (EEG) activity.[13]

Keuning reviewed numerous studies of the NC during waking and concluded that the average cycle length is about three to four hours and ranges anywhere from two to eight hours.[3] Hasagawa and Kern studied 50 human subjects during waking rest and found a mean duration of 2.9 hours, ranging from one to six hours.[14] These studies were all done under laboratory conditions during the day and only with intermittent measures. Cole and Haight report results from two subjects which showed the NC was continuous throughout the 24 hour period.[15] Laboratory conditions, which help impose resting states, may skew the cycle towards longer than normal periods. The frequency of sampling and what defines a cycle has confounded the discussion of cycles in the ultradian literature. There are wide variations in the reported length and the early waking studies failed to employ spectral analysis for determination of NC "periodicity." One subject exhibited a transition in dominance every twenty minutes for four consecutive cycles during a 90 minute recording period and a much longer cycle on another day.[6] This was observed when a continuous recording was made of nasal dominance. Time series analysis detected periods for the NC and co-regulated systems at 280-300, 215-275, 165-210, 145-160, 105-140, 70-100, and 40-65 min bins with the greatest spectral power in longer periods during a waking multivariate study.[7,8] The NC has also been demonstrated in rats and rabbits, in anesthetized pigs, and cats, and no doubt occurs in all mammals.[16-18]

Peripheral Effects of UFNB

Perhaps the earliest western scientific study to demonstrate a normal half-sided reaction in autonomic function was with the relationship of the nose and lung.[19-22] There is a unilateral nasal-pulmonary reflex mechanism which is clearly elicited when there is a forced inhalation through one nostril producing a significant increase in inflation of the homolateral lung compared to the contralateral lung. In 1939 Samzelius-Lejdstrom studied 182 individuals and showed that the movements of one thoracal half were much more inflated compared to the contralateral lung in 94% of the subjects.[19] She also observed that "variations in width of one half of the nasal cavity caused variations in the amplitude of the movements of the homolateral thoracal half." While it is not clear if she was aware of the NC, she observed how differences in nasal congestion could affect the lung. Her work did not pursue possible effects of continuous UFNB. However, she did report that in cases of tuberculosis where

there is primarily a lateralized deficit, there is a simultaneous pathological phenomenon of the homolateral nasal and thoracal halves.[19] Wotzilka and Schramek studied rabbits under experimental conditions and showed that if coal dust was inhaled through one nasal opening, it was deposited in much larger quantities in the homolateral lung.[23] These studies all indicate that lateralized rhythms of lung inflation are likely to parallel the NC since a neural reflex exists between the nose and lung. This does not discount the central autonomic mediation of a rhythm of lateralized predominance in lung inflation. A dominant nostril on one side has greater sympathetic tone, as would the homolateral lung. However, while sympathetic activity produces vasoconstriction in the nose, it produces vasodilation in the vessels of the lung, thereby producing an ipsilateral relationship of predominance in activities between the nose and lung.

Papers by Backon,[24] Backon and Kullock,[25] and Backon, Matamoros and Ticho,[26] all demonstrate the effects of UFNB on other autonomic related phenomena. As proposed, right nostril dominance correlates with the "activity phase" of the BRAC, the time during which sympathetic activity in general exceeds parasympathetic activity throughout the body.[6-10,12] Backon showed how right UFNB significantly increases blood glucose levels and how left UFNB lowers it, thus supporting this thesis.[24] Backon and Kullock also showed how UFNB can affect involuntary eyeblink rates.[25] They found that right UFNB reduced blink rates and that left UFNB increased involuntary blink rates. Backon et al. also showed how intraocular pressure can be selectively altered by UFNB patterns.[26] In their paper they cite references that suggest that vagal tone is increased in glaucoma simplex, reflecting high intraocular pressure. They find that right UFNB leads to an average decrease of 23% in intraocular pressure and that left UFNB increases it by an average of 4.5%. This is further evidence that right UFNB increases the generalized sympathetic tone of the body, thus correlating with the "active phase" of the BRAC.

The sympathetic and parasympathetic branches of the ANS each have separate trunks on the two sides of the body and thus affect bilateral structures and organs differentially where one side or organ is dominant and the other resting in a relative sense.[1] Even alternating left-right levels of catecholamines are found in the peripheral circulation of resting humans, and their rhythms are coupled to the NC.[27] Beickert made an early review of how some bilateral structures (e.g. kidneys) are regulated with resting and active patterns.[5]

However, this differential ANS pattern of organ innervation can also have interesting effects on organs that are not represented as bilateral structures, for example with the heart. Levy and Martin review studies on the neural innervation and control of the heart and discuss the lateral differences.[28] There is considerable right-left asymmetry in the distribution of the sympathetic fibers to the heart.[29,30]

In studies of the dog Levy et al. found that stimulation of the right stellate ganglion can increase heart rate (HR) by 85 beats/min while the effects of left-sided stimulation produce a much smaller increase, and that right-sided stimulation can increase left ventricular systolic pressure (LVSP) by 50 mm Hg while left-sided stimulation increases LVSP >> 50 mm Hg.[29] They conclude that right-sided stellate ganglion stimulation has greater chronotropic effects while the left produces greater inotropic effects; right stellate ganglion stimulation decreases systolic duration and left-sided increases mean arterial pressure. Thus the right sympathetic trunk via the right stellate ganglion has relatively greater effect on HR while the left has relatively greater effect on left ventricular function. There are also right and left vagal differences; the right vagus has a greater cardiac deceleratory effect compared to the left vagus, and right vagal transection causes a greater cardiac acceleration then left transection, suggesting the right vagus exerts greater restraint on the sino-atrial (SA) node than the left vagus.[31,32] And the heart period is more prolonged when a stimulus is given to the right vagus compared to the left.[31]

Yogis knew that UFNB had differential effects on HR. And HR has an ultradian periodicity in the 1-4 hour range, and ultradian rhythms of blood pressure are coupled to HR.[33-36] Shimada and Marsh conclude that the sympathetic nervous system drives the ultradian rhythms of the heart.[35] Shannahoff-Khalsa and Kennedy suggested that the ultradian rhythms of HR are also governed by the alternating rhythmic influences of the right and left branches of the ANS with increased HR resulting from right sympathetic with left parasympathetic dominance.[37]

Shannahoff-Khalsa and Kennedy conducted three experiments that employed impedance cardiography to monitor the beat-to-beat effects of UFNB on the heart.[37] Two experiments employing a respiratory rate of 6 breaths/min and one experiment with a rapid rate (2-3 breaths/sec) of shallow respiration, employing a yogic technique called "breath of fire" or "kapalabhatti," showed

that right UFNB increases heart rate compared to left UFNB which lowers HR (at a rate of 6 breaths/min). They also showed that stroke volume is higher with left UFNB and that left UFNB also increases end diastolic volume. These results and the relevant understanding of ANS innervation of the heart help explain the clinical results of Friedell in 1948 discussed below using alternate nostril breathing for the treatment of angina pectoris.[38]

In addition, right UFNB, left UFNB, and alternate nostril breathing have been compared for their possible effects on metabolism as measured by oxygen consumption.[39] Telles, Nagarathna, and Nagendra studied the effects of having "27 respiratory cycles, repeated 4 times a day for one month."[39] They found that right UFNB produced a 37% increase in baseline oxygen consumption, and that left UFNB produced a 24% increase and alternate nostril breathing increased baseline values by 18%. They also found that the left UFNB group showed an increase in volar galvanic skin resistance, interpreted as a reduction in sympathetic activity supplying the sweat glands. In another study, Telles, Nagarathna, and Nagendra found that a one time 45 min practice of right UFNB increased oxygen consumption by 17%, increased systolic blood pressure by 9.4 mm Hg, and decreased digital pulse volume by 45.7%.[40] They did not compare against left UFNB in this study, only against normal breathing.

The CNS-Cognitive Effects of UFNB

The selective global hemispheric effects of UFNB on the brain were first documented in 1983 as a preliminary result and with more rigor in 1987 by Werntz, Bickford and Shannahoff-Khalsa using EEG.[6,41] They demonstrated how UFNB could selectively stimulate the contralateral hemisphere producing relatively greater EEG power. In a 1987 pilot study, Srinivasan and Shannahoff-Khalsa (unpublished) found similar contralateral EEG power effects.

Work by Kristof, Servit, and Manas suggests that the electrographic activity generated by nasal (versus oral) breathing is produced by a neural mechanism in the superior nasal meatus.[13] This activating effect could also be produced by air insufflation into the upper nasal cavity without inflating the lung. Local anesthesia of the mucosal membrane suppressed the cortical effects of airflow stimulation. Servit, Kristof, and Strejckova showed how deep breathing through

one side of the nose could activate abnormalities in epileptic patients with unilateral focal or lateralized paroxysmal abnormalities in the fronto- or occipito-temporal regions.[42] "The abnormalities of this type were significantly more activated from the ipsilateral nasal cavity."[42] However, these paroxysmal abnormalities were also generated with contralateral breathing to the foci in 60% of the patients. These paroxysmal abnormalities are not equivalent to the sustained contralateral increases in global EEG power observed in the Werntz et al. studies, since this paroxysmal activity manifests as only intermittent spikes in a small fraction of the record with epileptic patients.[6,41] However, it is one example of how lateralized EEG activity can be affected by unilateral nasal airflow.

The relationship of greater EEG power reflecting either mental activity or inactivity was an important and controversial consideration. Yogis believe that UFNB activates the contralateral hemisphere. In 1986, a study by Klein, Pilon, Prossner and Shannahoff-Khalsa showed under resting conditions that right nasal dominance is coupled to relatively greater verbal performance, or left brain activity, and left nasal dominance with spatial or right hemispheric skills.[43] They were not able, however, to demonstrate the effects of UFNB on cognition in this study, possibly due to the experimental design. Their comparison cognitive task testing was post-UFNB rather than during. However, in 1991, Shannahoff-Khalsa, Boyle, and Buebel and again in 1993 Jella and Shannahoff-Khalsa used longer periods (30 min) of UFNB and showed that right UFNB increased left hemispheric cognition and that left UFNB increased right hemispheric cognition as predicted by yogis.[44,45] Both of these studies employed UFNB prior to and during task assessment. The study by Klein et al. also used tasks that may not have been as well lateralized.[43] The cognitive tests used, breathing times, and keeping the nostril blocked during testing all appear critical. While UFNB stimulates the contralateral hemisphere, it frequently does not alter the natural phase of the endogenous cerebral dominance rhythm, and the concordant state of nasal dominance in the post exercise period.

The interpretation of the expected functional relationships based on the lack of crossover by autonomic fibers coincides with the yogic interpretations. It appears that nasal airflow may stimulate sympathetic dominance on the homolateral (ipsilateral) body-brain half. Therefore, it is possible that direct stimulation of one half of the cortex may occur by sympathetic stimulation

and thus result in vasoconstriction. It is also likely that increased parasympathetic activation may occur simultaneously in the contralateral hemisphere to compensate for the contralateral sympathetic activation, thus helping to maintain adequate but altered cerebral perfusion.

In 1989, Block, Arnott, Quigley and Lynch studied the influence of UFNB on cognitive performance.[46] There results showed a mixed pattern. In males UFNB appeared to have an ipsilateral increase in performance, but "unilateral breathing influences female performance contralaterally, but only on the spatial task." These results were obtained after only 5 minutes of forced breathing exercise. In contrast to the results of past studies they state "These differences within and between sexes may exist because unilateral nostril breathing differently activates the two hemispheres and thereby facilitates performance, or because attempts of the brain to control the NC unilaterally interfere with performance." However, in 1994, the work of Sanders, Lattimore, Smith and Dierker attempted exactly the same experimental design as Block et al. and they found no nostril-to-condition related performance for either males or females.[46,47] The Klein et al. study found similar nostril dominance and hemisphere (contralateral) relations between the two sexes during rest.[43] It is not likely that ANS circuitry differs between sexes.

EEG work by Velikonja, Weiss, and Corning also failed to find a nostril-hemisphere effect.[48] Their study, however, only captured four 1-min samples of EEG under a variety of conditions, including sitting erect interchanged with lateral recumbent postures to help alter nasal airflow. They only analyzed high alpha (10-12 Hz) and low beta (12-18 Hz) EEG frequency bands This study also differs from that of Werntz et al. in that it did not analyze a continuous sample of EEG activity over all the entire recording period.[42] One minute samples of data, compared to a continuous recording of relative left/right power, can easily lead to mis-sampling due to the Mayer Wave (0.1 Hz to 0.01 Hz) activity that produces substantial intermittent increases in power. Longer, continuous, and filtered recordings are less affected by this normal ANS-related event when relative hemisphere powers are compared.

In 1991, Stancak, Honig, Wackermann, Lepicovska and Dostalek compared UFNB to bilateral breathing and report that the peak power of beta 2 activity in the frontal leads was lower during UFNB than in bilateral breathing.[49] They also report that they found a homolateral relationship between nostril activity

and EEG theta activity, but attribute this result to "increased upper airway resistance and to lateralized modulation of the subcortical generators of EEG theta rhythm during unilateral nostril breathing." They also found that inspiration and expiration time were longer, the amplitude of respiration was higher and respiratory sinus arrhythmia was greater during UFNB compared to bilateral breathing.

In a 1997 cognitive study by Naveen, Nagarathna, Nagendra, and Telles an attempt was made to detect the hemisphere specific effects of UFNB on memory skills.[50] They compared right UFNB, left UFNB, alternate nostril breathing, breath awareness, and a control group of no breathing practices after 10 days of practice. All four breathing groups showed only increases in spatial skills, rather than verbal skills. Again, hemisphere related cognitive testing was not done during a breathing exercise.

CLINICAL STUDIES EMPLOYING UFNB

THE TREATMENT OF ANGINA PECTORIS

In 1948 Friedell reported what may be the first contemporary clinical trial for any UFNB or alternate nostril breathing technique.[38] He found that "diaphragmatic breathing with attention to both phases of respiration and the intervening pauses" coupled with "alternately closing one nostril while inhaling slowly through the other" had profound effects on patients with angina pectoris. The 11 patients in this study all experienced relief from symptoms using this breathing practice and were able to eventually curtail the use of nitroglycerin. It is likely that the alternate nostril breathing technique directly effects the lateralized sympathetic and vagal input to the heart, thereby inducing a balance in ANS activity. This may help to reset the electrical patterns affecting the heart muscle and also to help achieve more normal blood flow to the heart muscle.

THE TREATMENT OF OBSESSIVE COMPULSIVE DISORDER (OCD)

OCD is one of the most disabling of the anxiety disorders with a life long prognosis and is estimated to be the fourth most common psychiatric disorder

following phobias, substance abuse, and the major depressive disorders, and is twice as common as schizophrenia and panic disorder.[51] This disorder often begins during childhood or adolescence, has a lifetime prevalence rate of 2.5% to 5.0%, and has proven to be refractory to traditional insight oriented psychotherapy.[51,52]

In 1996, Shannahoff-Khalsa and Beckett employed a Kundalini Yoga (KY) meditation protocol that included a technique that was said to be specific for treating OCD.[53] They conducted an open uncontrolled trial with a group of patients that had not achieved satisfactory results using conventional modalities (medication and behavior therapy). This protocol included a left nostril specific UFNB technique from the system of KY as taught by Yogi Bhajan. This author learned the "OCD-specific technique" in 1975 during his early years of training with this yogic system. The protocol includes 8 primary techniques and 3 non-mandatory techniques and was published in complete detail in 1997 by Shannahoff-Khalsa.[54]

The OCD specific yogic technique requires blocking the right nostril (a thumb tip or secure plug can be used) with slow deep inspiration through the left nostril, breath retention, slow complete expiration through the left nostril, followed by a long hold-out period. This pattern is continued for a maximum time of 31 minutes. The patient is instructed to make every effort to maximize the four phases of the breath cycle until the complete breath cycle equals one minute with the four respective phases each lasting exactly 15 seconds for 31 consecutive minutes; thus perfecting the technique. This technique is perhaps one of the most difficult yogic pranayams and is thus included in an entire protocol that helps to condition the patient for this practice and can easily take 2-7 months for conditioning, which is dependent on the patients basic physical constitution and daily discipline. This protocol also includes a technique for inducing a protected meditative state that is always taught in the system of KY as taught by Yogi Bhajan, two for "energizing," three for treating anxiety-related disorders and emotional stress and mental tension, a 3-min. technique specific for learning to manage fears, a mantra for turning negative thoughts into positive thoughts, another for meeting mental challenges, and finally a mantra specific for tranquilizing an angry mind.[54] The last three techniques are the three "non-mandatory" techniques, but also proved to be quite useful for the patients at different times during the trial. While this clinical trial included much more than a single

UFNB technique, it would be quite impractical to expect a clinical success without the additional techniques, and thus, this was a trial based more on an entire protocol.

This uncontrolled trial started with eight patients and for the five of eight patients to complete a 12-month trial, the group showed a mean Yale-Brown Obsessive Compulsive Scale (Y-BOCS) improvement of 54%.[53] The Y-BOCS is the current "gold standard" for measuring treatment effects for OCD. The Symptom Checklist-90-Revised (SCL-90-R) for the obsessive compulsive (OC) scale and the Global Severity Index (GSI), showed a mean 53.33% and 52.69% improvement, respectively for the five completers. These five were previously stabilized with fluoxetine for greater than three months prior to the start of the study. Of the five, three were completely free of medication for at least five months prior to the end of the 12-month study and the other two were significantly reduced. One year later four of the five subjects had been off medication for periods between 9 and 19 months with lasting improvement. Generally, once an OCD patient is much improved while on medication, and then stops medication, the severity at the origin of treatment returns within several months. Thus, it is a very rare event for a medicated patient to get off medication and to also show improvements. However, while OCD patients are perhaps the last group of psychiatric patients to improve by placebo effects, a controlled trial was clearly indicated, even though OCD patients usually only show placebo improvements in the range of 7% - 13%.[55]

In 1993, the National Institutes of Health, Office of Alternative Medicine, funded a randomized controlled trial using the original KY meditation protocol compared against a combination of the Relaxation Response (RR) for 30 min. plus the Mindfulness Meditation (MM) technique for 30 min. as the control-comparison group.[56,57] Early preliminary results were published in 1997 and the final results were published in 1999 by Shannahoff-Khalsa, Ray, Levine, Gallen, Schwartz and Sidorowich.[54,58]

The two groups were matched for sex/age/medication status/OCD symptom severity, and patients were randomized, and blinded to the comparison protocol for a 12-month trial, unless one protocol proved to be more efficacious, then groups would merge and those from the less efficacious therapy would get 12 additional months using the more efficacious protocol. Eleven adults were in

the KY Group and ten adults in the RRMM group at baseline. Baseline and 3–month interval testing was employed for the Y-BOCS, SCL-90-R OC and SCL-90-R GSI Scales, Profile of Mood States (POMS), Perceived Stress Scale (PSS), and Purpose-in-Life (PIL) test.

Seven adults in each group completed the first three months of therapy. The KY Group demonstrated greater improvements compared to the RRMM group (Student's Independent Groups T-test) on the Y-BOCS, SCL-90-R OC and GSI Scales, POMS, and greater but non-significant improvements on the PSS and PIL scales compared to the RRMM group. An intent-to-treat analysis (Y-BOCS) for the baseline and 3-month tests showed that only the KY Group improved. Within group statistics (Student's paired T-tests) showed that the KY Group significantly improved on all six scales but the RRMM Group showed no improvements. Groups were merged for an additional year using the KY techniques. At 15 months, the final group (N = 11) improved 71%, 62%, 66%, 74%, 39%, and 23%, respectively, on the six scales; $p \leq 0.003$ (analysis of variance).

This study was the first randomized controlled trial (RCT) using any KY meditation technique, and to the author's knowledge the first RCT employing a UFNB technique for the treatment of a psychiatric disorder. The 71% Y-BOCS improvement is clinically very significant when compared to current drug therapy. In a meta-analysis, Griest, Jefferson, Kobak, Katzelnick, Serlin compared the results from four multi-center placebo-controlled trials of clomipramine, fluoxetine, fluvoxamine and sertraline and found respective percent Y-BOCS improvements of 39%, 27%, 20%, 26% for the "best dose comparisons."[59] Kobak, Griest, Jefferson, Katzelnick, Henk recently conducted a meta-analysis to compare behavior therapy to the serotonin reuptake inhibitors and concluded that "behavior therapy was comparable to the serotonin reuptake inhibitors."[60] In addition, "40% to 60% of patients exhibit only minimal improvement or no change with serotonin re-uptake inhibitors alone," and "as many as one third are unimproved after apparently adequate drug treatment," yielding the "drug treatment resistant patient."[61] In responders, medication produces "only a 30% to 60% symptom reduction and patients tend to remain chronically symptomatic to some degree despite the best of pharmacologic interventions," and a "20% to 35% decrease in mean Y-BOCS scores may represent a clinically meaningful change in symptom severity."[62,63]

The results of others (reviewed see 53 and 64) identify right hemisphere abnormalities with OCD. This suggests that this left UFNB technique may be efficacious due to a related effect. Our preliminary unpublished magnetoencephalography results studying the effects of this technique in a trained normal subject show that while stimulation of the right hemisphere is diffused and dramatic our data indicates a strong effect on the frontal and prefrontal right cortex that may help to compensate for the OCD-related defect.

This protocol eliminates the need for an individualized treatment plan that is otherwise the case with medication(s) and behavior therapy. Group therapy reduces the financial costs to the patient and minimizes therapist time, however, the time course for treatment is long and requires near weekly attendance and considerable homework, comparable to behavior therapy. Our experience shows that about one year is required to achieve the maximal outcome when the patient is in group therapy.

THREE ADDITIONAL PHENOMENA RELEVANT TO THE NC AND UFNB

THE FIFTH INTERCOSTAL SPACE, NASAL DOMINANCE, AND THE TRANSITION STATE

Yogis discovered how posture can alter the NC and corresponding mental/energy state. Novice practitioners learned to lean on the "yoga danda" stick for altering NC dominance. Pressure on the fifth intercostal space while in any posture can induce a shift in the NC and this has been well documented over the last 30 years.[4,65,66] This non-invasive mechanism was used by the less adept practitioner to shift mind-body states. An advanced yogi can consciously select which hemisphere he wants to use within the span of one breath (private communication, Yogi Bhajan). He can switch back and forth fully activating one side of his brain along with its energetic correlates within this very short time. At this level of development this otherwise autonomic phenomenon becomes a consciously regulated activity. This reflects a very advanced stage in the discipline of yoga. Also, there is a transition state where the left and right NC dominance and respective correlates are equal and balanced. But this transition state in the un-adept is very short-lived and only

lasts a few minutes. However, a yogi can sustain this state with ease and for very long periods of time. This is the most interesting state.

Unique Case Studies of Endogenous Hemisphere Switching and the NC

In 1955, Ischlondsky reported significant lateralized findings during a neurological examination of two different multiple personality disorder (MPD) patients with similar personality traits where each patient had: "two diametrically-opposed personality types. One was an impulsive, irresponsible, mischievous and vindictive personality, full of rebellion against authority and of hate towards the people around her, the patient in this phase was extremely aggressive, using abusive language and scaring other patients with lurid tales of state hospitals, sex relations, etc.; in the opposed behavioral pattern to which the first personality would suddenly switch, the patient appeared dependent, submissive, shy, self-effacing, affectionate, and obedient. In a very timid way she expressed friendliness, sought affection, acceptance, and approval from the same personnel she had reviled and abused. There was no trace left of any inappropriate word or expression, no manifestation of hostility to her surroundings, and not the slightest reference to sex. In fact, any sex thought or word would induce in her extreme fears of perdition, feelings of guilt and anxiety, depression, and shame."[67]

In each of these two opposed mental states there was amnesia to the other, which is characteristic of MPDs. "A strong stimulus was capable of evoking the antipode of the existing mental condition." During the aggressive or active phase of the patient's behavior "examination revealed that the left and right sides of her body responded differently to sensory stimulus: while the right side was hypo-sensitive the left side displayed hyper-sensitivity. Thus vision and hearing were unclear and far away on the right side but very clear and close on the left side. Her response to touch and pain showed a high threshold on the right, and a low threshold on the left side. Characteristically, with regard to the olfactory sense the patient in this mental state manifested a diametrically opposed attitude: she was hyper-sensitive to smell on the right side and her right nostril was clear, while on the left side her sense of smell was absent and the nostril congested and closed. With regard to the other

neurological signs such as the size of pupils, reflexes, salivation, sweating, there was a similar difference in the response of the two sides of the body: the aggressive personality type displayed on the right side, a small pupil, a hypo-secretion of saliva, absence of sweating on sole and palm and lack of abdominal reflexes, while on the left side there was a large pupil, hypersecretion of saliva, very strong sweating on palm and sole and extremely strong abdominal reflexes." It is difficult to account for the observation of pupil size etc. inconsistent with nasal congestion. And just as fast as the psyche switched to the shy, passive, and permissive personality all neurological manifestations also switched to reverse dominance, where the "olfactory sense proved now to be very sharp on the left side while completely absent and with nostril congested and closed on the right side." This extraordinary case study showing that lateralized ANS phenomena switch instantaneously with the psyche in two patients suggests that right nostril dominance or sympathetic dominance on the right side of the body correlates with the active phase of the BRAC and the fight-or-flight response pattern, or a (yogic) state where pingala dominates, or where (Chinese Medicine) yang dominates. The case reports of Ischlondsky represent an adaptive form of this lateralized switching mechanism.[67]

Gott, Hughes, and Whipple reported a study of a 31 year-old woman, unaware of the phenomenon of the cerebral rhythm and NC.[68] She was self-trained, without fully understanding her achievement, and was able to voluntarily select and hold either of two qualitatively different states of consciousness, that when studied in the laboratory gave evidence of differential dominance of the left or right hemisphere. "Asymmetries of EEG alpha and task performance scores indicated a state dependent shift in functional lateralization." The woman reported "that her state switch had been involuntary from early childhood. At age 16 she learned to select her state at will, thereby improving her school work and personal behavior."

Unilateral Chronic Nasal Obstruction

In 1957, Riga published observations on unilateral chronic nasal obstruction which he thought might predispose people to a variety of disorders.[69] Patients presented with a range of symptoms which he classified as: "local disorders; nasal respiratory insufficiency, hypertrophic rhinitis of the obstructed nostril and allergic disorders, and neighboring disorders; spontaneous painful sensitivity

in the periphery, sinusitis, cattarh of the Eustachian tube, hypacousia and otorrhea, bronchorrhea all on the obstructed side, and distant disorders; intellectual asthenia with frequent amnesia, headaches, hyperthyroidism, cardiopulmonary asthenia with tachycardia and asthmatic disorder with sometimes hypertrophy of the left cavity of the heart and pulmonary emphysema, hepatic and gall bladder, gastritis, enterocolitis, sexual disorders, dysmenorrhea, and decrease of virility."

Eighty-nine percent of the cases with right nasal obstruction were found to be afflicted to some degree with this widespread and apparently unrelated array, but only 26% of the cases with left nasal obstruction were afflicted. This suggests that a right-sided obstruction may more seriously effect health.

Chronic unilateral obstruction may alter both the peripheral ANS and CNS activity and energies of "ida and pingala" or "yin and yang." Deviated septums are common and may impair health in unexpected ways by off-setting this CNS-ANS rhythm.

ADVANCED YOGIC UFNB TECHNIQUES

This section is an effort to further the readers awareness about more advanced yogic UFNB meditation techniques that go beyond the simple left versus right or alternate nostril breathing techniques. Several from the system of KY, as taught by Yogi Bhajan, are included. Each has one unique element. Breathing is performed only through a selected nostril for the majority of the practice, and thus qualifies as a pranayam in the UFNB category. Thousands of other meditation techniques have been taught in this same system. Yogi Bhajan's interest was to share the ancient and sacred heritage that had evolved during the time of the rishis, which previously has not been taught openly for thousands of years.

Note: In the system of KY as taught by Yogi Bhajan a mantra is chanted prior to the practice of any techniques. This was alluded to in the discussion of the OCD protocol, see above. However, here the technique to induce a meditative state, also called "tuning in" is described at length. This technique helps to stabilize and protect the meditative state of the practitioner.

Sit with a straight spine and with the feet flat on the floor if sitting in a chair. Put the hands together at the chest in "prayer pose"—the palms are pressed together with mild pressure between the hands. It is not intense but with a pressure of hand against hand using 10-15 lbs. of pressure. The area where the sides of the thumbs touch rests on the sternum with the thumbs pointing up (along the sternum), and the fingers are together and point up and out with a 60-degree angle to the ground. The eyes are closed and focused at the "third eye" (imagine a sun rising on the horizon).

A mantra is chanted out loud in a 1 1/2 breath cycle. Inhale first through the nose and chant "Ong Namo" with an equal emphasis on the Ong and the Namo. Then immediately follow with a half breath inhalation through the mouth and chant "Guru Dev Namo" with approximately equal emphasis on each word. The "O" in Ong and Namo are each a long "O" sound. The "Dev" sounds like dave, a long "a" sound. The practitioner should focus on the experience of the vibrations which these sounds create on the upper palate and throughout the cranium while letting the mind be carried by the sounds into a new and pleasant mental space. This should be repeated a minimum of three times.

A Left-Nostril UFNB Technique to Strengthen the Immune System

General Position: Sit in a crossed-legged posture or in a chair with a straight spine. Close the eyes or have them 9/10ths closed. Arms and Hands: For the main part of the exercise bend the elbows and raise the hands to the level of the shoulders. Make the sun mudra with the left hand: with the palm facing forward and the fingers extended up straight, bend the sun (ring) fingertip to touch the tip of the thumb. Hold the mudra near the shoulder. Extend the Jupiter (index) finger of the right hand. Bend the other fingertips down to the mounds at the base of the fingers. Lock the thumb over the fingers. Close the right nostril with the right index finger. Breath: Move the navel and breathe a very powerful "breath of fire" (kapalabhati) through the left nostril only. Maintain the intensity of the breath throughout the exercise. Length of time: This part of the exercise is 15 min. maximum, but can be practiced anywhere between 3-15 min. Other conditions: Cover the head with a natural

fiber. Be careful to hold the mudra with the left hand and do not let it slip. To conclude the exercise interlace the fingers in a hand lock in front of the chest at the level of the heart center and inhale deeply and pull on the hands as hard as possible for 15 sec. or as long as possible, then exhale. Repeat the inhale and hold two more times. Comments: This powerful breath will change the cooling effect of the left nostril to a powerful healing heat. This breath meditation strengthens the immune system to fight both viruses and bacteria and thus prevent illness. Pulling the hand lock helps to stimulate the thymus. (Note: Yogi Bhajan taught this technique around 1988 in the US.)

An interesting CNS physiological correlate to this left UFNB exercise deserves attention since it is likely that peaks of immune function, regeneration, and healing occur during the increased parasympathetic state (ida/yin state) of right brain/left nostril dominance. Neveu has reviewed how lateralized lesion studies in the neocortex of the rat can demonstrate how the two hemispheres play profoundly different roles in regulating activities of the immune system.[70] He states "the asymmetry in the cerebral control of immune responses should represent a phylogenetic advantage which has to be elucidated." He claims that lesions to the left neocortex are more harmful to immune-related functions and he summarizes the effects of lateralized neocortical lesions on spleen weight, thymus weight, number of T cells, percent of helper T cells, percent of cytotoxic/suppressive T cells, antibody production, T and B lymphocyte proliferation, and natural killer cell activity. These lateralized differences in immunomodulation suggest that cerebral rhythms also play an important role in the health and homeostasis of immunity.

Since this powerful left UFNB technique stimulates the sympathetic nervous system on the left side of the brain, one can postulate that this yogic pranayam activates the immune system by stimulating immune-related areas of the cortex in the left hemisphere via sympathetic activation, while the right hemisphere becomes dominant for blood flow and general cognitive function. Numerous studies of the immune system show that related structures (thymus, bone marrow, lymph glands, etc.) are innervated by the sympathetic nervous system. Our understanding of psychoneuroimmunology may be increased by considering how the ANS acts as a neural matrix for coupling mind and immunity. Different stressors may play key roles in how the pendulum of CNS-ANS activity effects immune functions. Over-stimulation or abnormal activity of one hemisphere may over- or underactivate different immune functions.

Pranayam Technique for a Comprehensive, Comparative, and Intuitive Mind

This meditation technique, as taught by Yogi Bhajan, was published in 1991 by Shannahoff-Khalsa.[71]

Description: The is an advanced exercise and requires substantial effort. Practice of this exercise is quite rigorous and is best attempted after having developed the endurance to complete less advanced techniques. Its format is complex and the times should be followed exactly. It has four sections with the first three sections broken into three additional parts. The sitting posture requires a straight spine and the eyes are closed and focused on the position of the etheric "third eye"—the visual point off in the distance where the "sun sets" on the horizon. Begin by using the thumb of the right hand to block the right nostril, making sure to lower the elbow to reduce strain on the arm for this time period. The left hand is relaxed in the lap. The breathing pattern is a series of broken breaths (short steps) taken to complete a full inhale, the rate is about one part per second with the 4-part breath and then faster thereafter with the 8-part and 16-part patterns.

Section 1 (total time is 9 minutes) Part A. Inhale through the left nostril in 4 parts and out the left nostril in 1 part, continue this pattern for 3 minutes. Part B. Inhale through the left nostril in 8 parts and out the left nostril in 1 part, continue this pattern for 3 minutes. Part C. Inhale through the left nostril in 16 parts and out the left nostril in 1 part, continue this pattern for 3 minutes. Section 2 (total time is 9 minutes). Repeat the entire procedure, parts A, B, and C of section 1 completely, but start by breathing through the right nostril instead and use the left thumb to block the left nostril for this entire period. Section 3 (total time is 9 minutes). Relaxing both hands in the lap complete the breathing pattern of the three parts given in A, B, and C, without blocking either nostril. The initial phase of the NC is not a concern with this exercise. However, one side of the nose may be more difficult to breathe through. Section 4 (total time is 4 minutes). Again, relax the hands in the lap. Curl the tongue in a u-shape and extend it from the mouth, inhale in 4 parts through the curled tongue and then close the mouth and exhale in one part out the nose, four parts in through the curled tongue and one part out the nose and continue for 4 minutes. When finished completely relax on the back for 10-30 minutes.

Comments: This technique works by first selectively stimulating the right hemisphere, then the left, and then part C. balances both. The increasing complexity of the 4-, 8-, and 16-part breath inspirations respectively have an energizing, awakening, and healing/repair effect on the related regions of the brain. Part D, stimulates the thyroid and parathyroid glands to help provide adequate glandular support for higher cortical functions. In addition, this section also has a "cooling" effect on the nervous system. This technique helps to achieve a more balanced, intuitive, awakened, and neutral state of mind.

THE ULTIMATE PRANAYAM—SO DARSHAN CHAKRA KRIYA

Yogi Bhajan taught this technique, initially in Formello, Italy, on December 12, 1990, and it was first published in 1996.[72] He comments:

> If you can do this meditation for 62 minutes to start with, and develop it to the point that you can do it 2 1/2 hours per day, it will give you "Nao niddhi, athara siddhi" or the nine precious virtues and 18 occult powers. And in those 27 total virtues of the world lies the entire universe. When practiced 2 1/2 hours every day, it makes a perfect superman out of you. It purifies, it takes care of the human life and brings together all 27 facets of life and makes a human perfect, saintly, successful, and qualified. This meditation also gives one the Pranic power. This kriya never fails. It can give one all the inner happiness, and bring one to a state of ecstacy in life. It will keep all the chakras open so you will not fall into any ditch. It is better to live a life of courage than to live many many years like a coward. Courage is in inner vitality, and if all your chakras are open, you will not be handicapped in vitality. You will get a grip on your life. No matter how bad circumstances are, your intuition will guide your way to happiness, and your vitality shall support you.

This pranayama technique, as a single technique, is the ultimate in meditation techniques in the KY system. Its multiple facets make it a completely balanced technique. When practiced alone there are no other requirements for other techniques to achieve the full awakening and development of the human. For example, the rate of respiration can eventually be reduced to less than one breath per minute during practice. This rate produces profound changes in

the way the brain functions and helps reduce any chance of a pending disease. This technique changes one's perception of the self and the world. The practitioner develops a consciousness that becomes the living experience of the timelessness of life, transcending all time and space. The negative patterns of the subconscious mind are eliminated. This technique helps to overcome the stumbling blocks of the inner world. It helps to cut through inner darkness, and it eliminates both neurotic and psychotic patterns of the mind. According to Yogi Bhajan "You are cleaning your subconscious. You can clean it as fast or as slow as you want. You have to decide how much time you want to devote to getting rid of the fear, anger, insecurity, etc. . . the negative thoughts in your subconscious that block your success and prosperity."

Description of Technique: Sit with a straight spine on the floor in a cross-legged position, or on a firm chair with both feet flat on the ground. The lower spine (lumbar region) is pressed forward slightly. This spinal posture signals the nervous system to remain alert, it sets a "ready mode."

The eyes are open and focused at the tip of the nose—the end that you cannot see. This eye posture is also called Ajna Band which means mind lock and one effect of this eye posture is to stabilize the frontal lobes. With eyes focused at the tip, the sides of the nose appear to blur. Some individuals are less able to achieve this eye focus, and practice over time can help to overcome this deficit. Focusing the eyes in this way pressurizes the optic nerve and helps to stabilize thought processes. It is a common element with meditation techniques that are used to tranquilize the mind. Initially the eye muscles may become sore due to a lack of use.

The breathing pattern has three stages:

1. Use the right thumb tip to block off the right nostril (close the nostril by covering the end, not by pushing in the side), keep the four fingers of the right hand pointed up straight, inhale slowly and completely fill the lungs;

2. While holding the breath begin pumping the navel point in and out for a total of 48 pumps while mentally vibrating the sound Whahay Guru 16 times per 48 pumps, with one pump per Wha, one pump per Hay, and one pump per Guru, or 16 x 3 sounds = 48 pumps;

3. Then slowly exhale by closing the left nostril with the end of the index finger. This three stage cycle is repeated. (Note that the reverse pattern of inhaling through the right nostril, holding, and exhaling through the left nostril is NOT performed.) Yogi Bhajan has recommended a counting scheme to maintain the exact numbers of pumps and "Whahay Gurus."

   For counting 1-16 (Whahay Guru's), one (with three pumps), two (with three pumps), three (with three pumps) is counted with the little finger moving slightly three times, four (with three pumps), five (with three pumps), and six (with three pumps) moves the ring finger three times, seven (with three pumps), eight (with three pumps), nine (with three pumps) moves the middle finger three times, ten (with three pumps), eleven (with three pumps), and twelve (with three pumps) moves the index finger three times, thirteen (with three pumps), fourteen (with three pumps), fifteen (with three pumps) moves the thumb slightly for three beats, and sixteen (with three pumps) brings the index finger over to close the left nostril just before exhaling through the right nostril.

When ending this meditation, after the last exhale, inhale and hold the breath for 5-10 seconds and mentally circulate the energy produced, then exhale. Then stretch and shake the entire body for 1 minute to complete the exercise.

The bija mantra Whahay Guru induces a state of great wonder, bliss, and ecstacy, an experience of the totality of the universe, the universal nature of consciousness, and the oneness and unity of creation.

A modified and simpler version of this technique is accomplished by applying only one pump per Whahay Guru, thus yielding 16 pumps corresponding to 16 Whahay Gurus. This version is also less potent, but it is a good place to start if the advanced version is too difficult. An adequate lung capacity can be slowly achieved with the beginner's version. Ultimately, this breath cycle can be reduced to one cycle per minute or less. When respiratory rates of less than one breath/minute are achieved profound changes are more quickly induced.

The difficulty with this technique, beyond lung capacity, is primarily with developing the counting skill and coordination between pumping and sounds, all of which can eventually become a near "automated or second nature" level

of processing. While the practitioner is still consciously involved with the pump-sound-counting coordination the technique can be painfully difficult. The time required to become a "learned response" varies amongst individuals and their training and capacities. It can easily take 2-4 weeks to achieve a comfortable level of practice. Eleven minutes is the first plateau of accomplishment, followed by 31 minutes, 62 minutes, and 151 minutes (2 hours 31 minutes).

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