

# Chapter 11

## Voluntary Control of Respiration Patterns

Controlled respiration is one of the oldest and certainly the single, most efficient acute intervention for the mitigation and treatment of excessive stress. Any clinician treating patients who manifest excessive stress syndromes should consider controlled respiration as a potentially suitable intervention for virtually all patients. The purpose of this chapter is to discuss the uses of voluntary control of *respiration patterns* in the treatment of excessive stress. As used in this text, this term refers to the process by which the patient exerts voluntary control over his or her breathing pattern—in effect, breath control. There are hundreds of diverse patterns of controlled respiration; we examine several that we feel have particular introductory utility for the clinician concerned with the treatment of the stress response. The exercises presented in this chapter are by no means inclusive. We have simply chosen several patterns that are simple to learn and effective. Again, the goal of voluntary, controlled respiration in the treatment of excessive stress is to have the patient voluntarily alter his or her rhythmic pattern of breathing to create a more relaxed state.

### History

As mentioned earlier, voluntary control of respiration patterns (breath control) is perhaps the oldest stress-reduction technique known. It has been used for thousands of years to reduce anxiety and to promote a generalized state of relaxation. The history of voluntary breath control dates back centuries before Christ. References to voluntary breath control for obtaining a relaxation state can be found in the Hindu tradition of Hatha Yoga. In fact, “the word *hatha* itself comes from the Sanskrit root *ha*, meaning sun, and *tha*, meaning moon, and refers to the incoming and outgoing breaths in breathing” (Sethi 1989, p. 69). Thus, Hatha Yoga (the yoga of postures) is built on various patterns of breathing known as *pranayama*. The term *prana* literally means “life force,” and *ayama* means “to prolong.” Therefore, *pranayama*, which consists of three phases: “puraka” (inhalation), “kumbhaka” (retention), and

“rechaka” (exhalation) (Jerath, Edry, Barnes, & Jerath, 2006) loosely translates into prolonged breath control or breath restraint (Fried, 1993; Telles & Naveen, 2008), and more than 3,000 years ago, yogis proclaimed that “life is in the breath.”

While in ancient India breath control was developing in the Hindu tradition, the Chinese were practicing it as well. The development of the movement arts of T'ai Chi and Kung Fu both included controlled breathing as an essential component. These “martial arts” continue to enjoy enhanced popularity in the USA.

Perhaps the most widely used form of breath control today is the procedure for “natural” childbirth, in which various types of controlled breathing are used to reduce pain for the mother during delivery and to facilitate the descent of the child through the birth canal (Spiby, Slade, Escott, Henderson, & Fraser, 2003).

In this chapter, we focus on the voluntary, controlled breathing patterns that seem most useful as general aids to relaxation, without any specific goal other than common stress reduction.

## Basic Patterns of Breathing

In this section, we briefly describe the fundamentals involved in the breathing process by examining the four phases of the respiratory cycle and describing three basic types of breathing.

According to Hewitt (1977), and elaborated upon by Fried (1993), Austin (1998), and more recently Drummond (2010), four distinct phases of the breathing cycle are relevant in learning voluntary control of respiration patterns (the clinician may find this cursory phasic division useful in teaching any form of deep-breathing technique):

1. *Inhalation or inspiration.* Incidentally, it is no coincidence that the word *inspiration* is used to recognize the connective link between breathing and vital energy (i.e., we all have at times felt “inspired” by a creative idea or an influential other). Inhalation occurs as air is taken into the nose or mouth, descends via the trachea, the bronchi, and bronchioles, and finally inflates the alveoli, which are the air sacs constituting the major portions of the lobes of the lungs. As the lungs expand, their stretch receptors tighten, which in turn sends inhibitory signals from the vagus nerve to the brain stem, signaling inhalation to stop.
2. *The pause that follows inhalation.* During this pause, the lungs remain inflated.
3. *Exhalation or expiration.* Again, note the connection between breathing and life force in the term *expiration*. For example, when someone passes away, we say that they have expired, or that they have breathed their last breath: in essence, that their life energy is now gone. Exhalation occurs as the lungs are deflated, emptying the waste gases from the alveoli.
4. *The pause that follows the exhalation phase.* During this phase, the lungs are at rest in a deflated state.

Rama, Ballentine, and Hymes (1998) describe three basic types of breathing that differ primarily according to the nature of the inhalation initiating the breathing cycle: clavicular, thoracic, and diaphragmatic.

The clavicular breath, the shortest and shallowest of the three, can be observed as a slight vertical elevation of the clavicles, combined with a slight expansion of the thoracic cage upon inhalation.

The thoracic breath represents (in varying degrees) a deeper breath—deeper in the sense that a greater amount of air is inhaled, more alveoli are inflated, and the lobes of the lungs are expanded to a greater degree. It is initiated by activation of the intercostal muscles, which expand the thoracic cage up and outward. The thoracic breath can be observed as a greater expansion of the thoracic cage, followed by an elevation of the clavicles on inhalation. Thoracic breathing is the most common breathing pattern.

Finally, the diaphragmatic breath represents the deepest of all the breaths, with the most air inhaled and the greatest number of alveoli inflated. In addition, for the first time, the lowest levels of the lungs are inflated. The lower third of the lungs contains the greater part of the blood when the individual stands vertically; therefore, the diaphragmatic breath oxygenates a greater quantity of blood per breathing cycle than the other types of breathing. During the diaphragmatic breath, the diaphragm (a thin, dome-shaped sheet of muscle that separates the chest cavity and the abdomen) flattens downward during inhalation. This causes the abdominal muscles to relax and rise, and push the organs in the abdominal cavity forward, which creates a partial vacuum and allows air to descend into the lungs. Thus, the movement of the diaphragm becomes the major cause of the deep inhalation. The full diaphragmatic breath may be observed as the abdominal cavity expands outward, followed by expansion of the thoracic cage, and, finally, elevation of the clavicles.

Variations of the diaphragmatic breath are considered by many to be the simplest and most effective form of controlled respiration in the reduction of excessive stress. Therefore, we limit our discussion to the role of diaphragmatic patterns in reducing excessive stress. It would, however, be helpful to the clinician to learn to identify all the three basic patterns of breathing.

## **Mechanisms of Action**

Although the specific mechanisms involved in stress reduction via breath control may differ from technique to technique, a general therapeutic factor is thought to be the ability of the diaphragmatic breath to induce a temporary trophotropic state. Jerath and colleagues (2006) note that the tone of the sympathetic and parasympathetic nervous systems is greatly affected by the process of respiration. Harvey (1978) recognizes that “diaphragmatic breathing stimulates both the solar plexus and the right vagus nerve in a manner that enervates the parasympathetic nervous system, thus facilitating full relaxation” (p. 14).

Expiration is also thought to affect the relaxation response. In fact, the mere act of breathing out may increase parasympathetic tone (Ballentine, 1976) and serve to slightly decrease neural firing in the amygdala and hippocampus (Austin, 2006; Frysinger & Harper, 1989). Moreover, prolonged expiration, along with quieter breathing, may further reduce neural firing in the amygdala that could lead to

physiological calming (Zhang, Harper, & Ni, 1986). It is notable that during most types of diaphragmatic breathing, expiration is protracted. Interestingly, the normal person spends less time breathing in (about 43%) than breathing out; however, monks practicing the meditative art of zazen have been known to increase the exhalation phase of their respiratory cycle to around 75% (Austin, 1998). In patients practicing guided imagery, Austin (2006) notes that when successful they have been able to slow their respiration to 3–5 breaths per minute. He also notes that breathing techniques that prolong exhalation may increase the inhibitory tone of the vagus nerve and reduce respiratory drive in the brain stem. Additionally, deep, slow diaphragmatic breathing is considered to initiate inhibitory signals in lung tissue that overall may lead “to changes in the autonomic nervous system and a resultant condition characterized by reduced metabolism and parasympathetic dominance” (Telles & Naveen, 2008, p. 72).

Independent of the predominately physiological mechanisms, voluntary breath control may prove therapeutic from a cognitive perspective as well. The rationale for this statement comes from the supposition that concentration on respiration patterns may serve to enhance a perception of internal control, along with ways to compete with obsessive thought patterns, and maybe even compulsive behaviors. More recently, studies have assessed how the respiratory system may be involved in the activation of the fear network, composed of the prefrontal cortex, the amygdala, the hippocampus, and the subsequent brainstem projections, in patients suffering with panic disorder (de Carvalho, Rozenthal, & Nardi, 2010; Nardi, Freire, & Zin, 2009). In addition, it has been hypothesized how slow breathing exercises that increase parasympathetic tone might be effective in reducing seizure frequency in those with refractory epilepsy (Yuen & Sander, 2010).

## Clinical Research

One of the seminal studies related to the efficacy of breathing training is on 105 male patients awaiting imminent electric shocks to the hand. Those who were instructed to regulate their breathing to only eight breaths per minute evidenced lower subjective arousal, and less change in skin resistance and finger pulse volume than control participants who were not taught respiratory control (McCaul, Sollmon, & Holmes, 1979).

1. Use of deep breathing meditation was effective in mitigating the effects of stress and test anxiety in a sample of 64 post-baccalaureate premedical students (Paul, Elam, & Verhulst, 2007).
2. Controlled breathing has been used effectively as part of the treatment of children and adults with asthma (Chiang, Ma, Huang, Tseng, & Hsueh, 2009; Meuret, Ritz, Wilhelm, & Roth, 2007), and slow, regular diaphragmatic breathing has been shown to reduce the potential of hyperventilation in asthma patients and improve quality of life (Thomas et al., 2003).

3. The benefits of controlled breathing have been observed in 76 post-MI patients (van Dixhoorn, 1998), in patients experiencing non-cardiac chest pain (Van Peski-Oosterbaan, Spinhoven, van Rood, Van der Does, & Brusckhe, 1997), and in children experiencing chest pain (Lipsitz, Gur, Albano, & Sherman, 2011).
4. Cognitive-behavioral interventions for panic disorder, which reliably entail breathing retraining, have been associated with decreased frequency and intensity of attacks (Meuret, Wilhelm & Roth, 2004). In a recent meta-analysis of 42 studies assessing the treatment of panic disorder, with and without agoraphobia, Sánchez-Meca, Rosa-Alcázar, Marín-Martínez, & Gómez-Conesa (2010) reported that the combination of exposure, relaxation training, and breathing retraining provides the best evidence for treating panic disorder.
5. Breathing retraining has also been implemented in cognitive-behavioral program used to treat PTSD (Mueser, Rosenberg, & Rosenberg, 2009).

## How to Implement

Voluntary breath control appears to be the most flexible of the interventions for the reduction of excessive stress. It can be used under a wide variety of environmental and behavioral conditions.

Despite its versatility, voluntary breath control should be used with precautions. When breathing is used as a meditative device, the precautions discussed in the chapter on meditation are relevant. The primary precaution, relatively unique to voluntary breath control, is regarding hyperventilation. Simply defined, hyperventilation is a condition in which the patient's rate and depth of breathing is too much for the body's needs at a particular time. Hyperventilation can quickly create the condition of hypocapnia, a decreased production and availability of CO<sub>2</sub>. Hypocapnia results in decreased blood flow to the extremities and to the brain (Fried, 1993). The symptoms of hyperventilation, which include dizziness, panic, fatigue, feelings of suffocation, chest pain, stomach cramps, racing heart, trembling, loss of consciousness, tenseness, hot flashes, and nausea, overlap considerably with the symptoms of stress and anxiety. Many of these symptoms could appear after several minutes of prolonged hyperventilation. According to Grossman and DeSwart (1984), dizziness, tiredness, and feelings of suffocation and panic are the most commonly reported hyperventilation symptoms.

Fried (1993) offers the following insights, recommendations, and additional precautions in the use of diaphragmatic breathing:

1. Some individuals with a high stress profile may unknowingly hold their diaphragm in a partially contracted position; therefore, diaphragmatic breathing may initially produce cramps.
2. If pain or discomfort is experienced due to muscle or tissue injury, then the diaphragmatic breathing exercise should be stopped.
3. In cases where metabolic acidosis may occur, such as severe hypoglycemia, kidney disease, heart disease, or diabetes, approval from a physician should be acquired before beginning diaphragmatic breathing.

4. Since diaphragmatic breathing may significantly lower blood pressure, individuals with normally low blood pressure or syncope should use the technique cautiously.

Since the publication of the last edition of this text, there has been increased treatment interest in the use of voluntary hyperventilation that involves having a patient breath “fast and deep” and to focus on “exhaling hard” from 18 to 60 breaths/min for 1–3 min (Meuret, Ritz, Wilhelm, & Roth, 2005). Most clinical applications of voluntary hyperventilation are associated with breathing training that is designed to induce and then mitigate acute decreases in arterial  $p\text{CO}_2$  by breathing more diaphragmatically (Craske, Barlow, & Meadows, 2000). Even though not all data support the use of voluntary hyperventilation tests to diagnose or assess hyperventilation syndrome (Hornsveld, Garssen, Fiedeldij Dop, van Spiegel, & de Haes, 1996), voluntary hyperventilation is an integral part of the cognitive-behavioral technique of interoceptive exposure (IE) used in the treatment of panic disorder. IE involves having patients repeatedly induce, experience, and attend to their feared sensations, such as dizziness, feelings of suffocation, heart palpitations, and shortness of breath, and to then challenge their catastrophic thinking, to understand the physiological mechanisms involved in the response, and to learn to accept their anxiety so that the physiological arousal sensations do not result in panic and avoidance (Lee et al., 2006; Otto, Powers, & Fischmann, 2005; Stewart & Watt, 2008).

Predicated on a breathing method developed over the past 25 years in Europe, van Dixhoorn (2007, 2008) has offered an integrative systems and process model of breathing, known as whole-body breathing that incorporates elements of direct respiratory retraining, as well as indirect approaches of respiratory modification for breath training and relaxation. According to the systems approach, respiration has two functions: regulation of mental and physical tension, and provision of information regarding internal tension. Van Dixhoorn’s (2008) approach offers patients a range of treatment modalities and techniques (e.g., breathing, self-talk, postural changes, mental images), as well as broad treatment goals (e.g., lower arousal, attentional shift; renewal of energy or balance, increased body awareness, organization of functional movement that follows the skeletal structure; cognitive restructuring, and functional breathing). In addition, whole-body breathing relies on information gathered and observed from a first-person as well as a third-person (or external observer) perspective. The whole-body approach and its suggestions should be considered when reviewing the exercises below.

Listed below are three diaphragmatic breathing exercises reported to be useful in promoting a more relaxed state. In teaching any form of diaphragmatic breathing, the clinician must monitor the activities of the patient to assure proper techniques. Hewitt (1977) offers the following guidelines, which we believe are still appropriate for all forms of diaphragmatic breathing:

You fill the lungs to a point of fullness without strain or discomfort (p. 90). If after retention [of the inhalation] the air bursts out noisily, the suspension has been overprolonged; the air should be released in a steady smooth stream... Similarly, following the empty pause, the air should unhurriedly and quietly begin its ascent of the nostrils [as the new inhalation begins]. (p. 73)

We consider these general guidelines useful to avoid patients' over breathing, as well as other inappropriate breathing practices. These guidelines should be followed when instructing a patient in each of the following three breathing exercises.

### ***Breathing Exercise 1***

This breathing technique may be thought of as a "complete breath." In fact, variations of this breath appear with similar names in the Yogic literature. The technique is extremely simple to complete. In order to assist the clinician in teaching the exercise to patients, we present the four phases of breath described by Hewitt (1977).

*Inhalation.* The inhalation should begin through the nose if possible. The nose is preferred to the mouth because of its ability to filter and warm the incoming air. On inhalation, the abdomen should begin to move outward, followed by expansion of the chest. The length of the inhalation should be 2 to 3 s (or to some point less than that in which the lungs and chest expand without discomfort).

*Pause after inhalation.* There should be no pause. Inhalation should transfer smoothly into the beginning of exhalation.

*Exhalation.* Here, the air is expired (through the mouth or the nose, whichever is more comfortable). The length of this exhalation should be 2–3 s.

*Pause after exhalation.* This pause should last only 1 s, then inhalation should begin again in a smooth manner. We have found that this exercise can be repeated by many patients for several minutes without the initiation of hyperventilation. However, patients should usually be instructed to stop when lightheadedness occurs.

### ***Breathing Exercise 2***

This breathing exercise may be thought of as a form of "counting breath," of which variations appear in the Yogic literature. The term *counting* is applied to this exercise because the patient is asked literally to count to him- or herself the number of seconds each of the four phases of the exercise will last. In order to assist the clinician in teaching this exercise, we present the four phases of breathing described by Hewitt (1977).

*Inhalation.* The inhalation should begin through the nose if possible. The abdomen should begin to move outward, followed by expansion of the chest. The length of the inhalation should be 2 s (or to some point less than that in which the lungs and chest expand without discomfort). The length of the inhalation should be counted silently, as 1,000; 2,000, etc.

*Pause after inhalation.* There should be a pause here, following the 2-s inhalation. The counted pause here should be 1 s in duration.

*Pause after Exhalation.* This counted pause should last 1 s. The next inhalation should follow smoothly. We have found that this exercise can be repeated by many patients for several minutes without the occurrence of hyperventilation. However, patients should usually be instructed to stop when light-headedness occurs.

### ***Breathing Exercise 3***

This technique, developed by G. S. Everly, is designed to rapidly induce (within 30–60 s) a state of relaxation. Research has shown it to be effective in reducing muscle tension and subjective reports of anxiety, as well as having some potential for reducing heart rate (see Everly, 1979b, c; Vanderhoof, 1980). The following description is presented as if instructing a patient:

During the course of an average day, many of us find ourselves in anxiety-producing situations. Our heart rates increase, our stomachs may become upset, and our thoughts may race uncontrollably through our minds. It is during such episodes that we require fast-acting relief from our stressful reactions. The brief exercise described below has been found effective in reducing most of the stress reaction that we suffer from during acute exposures to stressors—it is, in effect, a quick way to “calm down” in the face of a stressful situation.

The basic mechanism for stress reduction in this exercise involves deep breathing. The procedure is as follows:

*Step 1.* Assume a comfortable position. Rest your left hand (palm down) on top of your abdomen, over your navel. Now place your right hand so that it rests comfortably on your left. Your eyes can remain open. However, it is usually easier to complete Step 2 with your eyes closed (see Fig. 11.1).

*Step 2.* Imagine a hollow bottle, or pouch, lying internally beneath the point at which your hands are resting. Begin to inhale. As you inhale imagine that the air is entering through your nose and descending to fill that internal pouch. Your hands will rise as you fill the pouch with air. As you continue to inhale, imagine the pouch being filled to the top. Your rib cage and upper chest will continue the wavelike rise that began at your navel. The total length of your inhalation should be two seconds for the first week or two, then possibly lengthening to two and a half or three seconds as you progress in skill development (see Fig. 11.2).

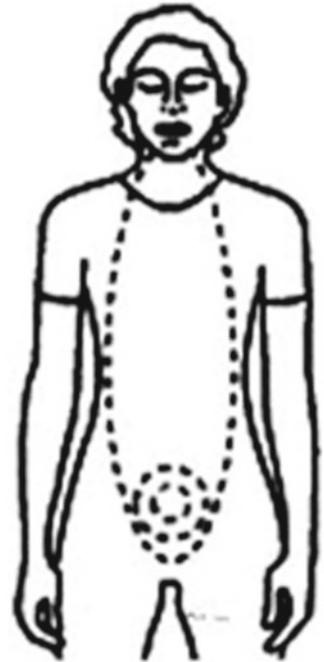
*Step 3.* Hold your breath. Keep the air inside the pouch. Repeat to yourself the phrase, “My body is calm.” This step should last no more than 2 s.

*Step 4.* Slowly begin to exhale—to empty the pouch. As you do, repeat to yourself the phrase, “My body is quiet.” As you exhale, you will feel your raised abdomen and chest recede. This step should last as long as the two preceding steps, or may last one second longer, after a week or two of practice. (*Note.* Step 1 need only be used during the first week or so, as you learn to breathe deeply. Once you master that skill, you may omit that step.) Repeat this four-step exercise three to five times in succession. Should you begin to feel light-headed, stop at that point. If light-headedness recurs

Fig. 11.1 Step 1



Fig. 11.2 Step 2



with continued practice, simply shorten the length of the inhalation and/or decrease the number of times you repeat the exercise in succession.

Practice this exercise 10–20 times a day. Make it a ritual in the morning, afternoon, and evening, as well as during stressful situations. Because this form of relaxation is a skill, it is important to practice at least 10–20 times a day. At first you may not notice any on-the-spot relaxation. However, after a week or two of regular practice, you will increase your capabilities to relax temporarily. Remember, you must *practice regularly* if you are to master this skill. Regular, consistent practice of these daily exercises will ultimately lead to the development of a more calm and relaxed attitude—a sort of anti-stress attitude—and when you do have stressful moments, they will be far less severe.

## Summary

This chapter has presented a discussion of voluntary, controlled patterns of respiration for use in reducing excessive stress. As mentioned earlier, the goal of voluntary respiration in the treatment of excessive stress is to have the patient voluntarily alter his or her rhythmic pattern of breathing to create a more relaxed state.

1. Dating back to centuries before Christ, there is a rich and lengthy history of using breath control as a means to enhance relaxation.
2. There are three basic types of breathing patterns—clavicular, thoracic, and diaphragmatic. The first two are associated with (and may stimulate) a sympathetic response. The latter is associated with (and may stimulate) a parasympathetic response (see Ballentine, 1976). It has been found useful for the clinician to learn to recognize these patterns in patients and to teach them how to recognize these patterns in themselves.
3. Although the literature (especially that of Yoga) presents myriad diverse respiratory techniques for relaxation, we have focused in this chapter on diaphragmatic breathing. This emphasis is based on the conclusion that variations of diaphragmatic breathing are the simplest to teach and among the most effective for achieving a relaxed psychophysiological state. For these reasons, the clinician may find the variations of the diaphragmatic pattern most useful.
4. In the final analysis, the clinician needs to assess the suitability of using voluntary, controlled respiration with each patient on a case-by-case basis. The clinician may attempt to teach the three different exercises presented in this chapter in order to assess which may be of most utility. These variations of diaphragmatic breathing are not provided as a prescription, but as a sample of breath control techniques that have been beneficial in reducing excessive stress. Many other useful variations exist (see Fried, 1993; Hewitt, 1977; van Dixhoorn, 2007).
5. The primary precaution in the use of breath control in stress reduction regards the hyperventilation reaction. This is usually not a problem when the patient uses breathing exercises (such as those described in this chapter) for short time

durations and ceases if light-headedness ensues. The Yogic literature reports that no more than 15 min of any hour should be spent in *pranayama* practice. Again, this topic should be addressed with patients individually.

6. In conclusion, Patel (1993) states that “if breath influences both the body and the mind, not only physical, mental, and emotional states are reflected in the pattern of breath, but through breathing we can also influence our physical, psychological, and spiritual well-being” (p. 119). This analysis certainly seems accurate. Additionally, teaching breath control may serve to enhance an overall perception of enhanced personal control.

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