In: Peper, E. and Tibbitts, V. (2003). Protocol for the treatment of asthma. In: Zheng, Y. (ed). *Clinical Practice of Biofeedback.* Beijing: High Education Press (HEP). 163-176. ISBN 7-04-011420-8

Also in: In: (1999). *The Healing Breath: A Journal of Breathwork Practice, Psychology and Spirituality* 1 (2) .Web publication: http://www.dailymp3.com/main.html

Protocol for the Treatment of Asthma

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ABSTRACT

This paper describes a training protocol to reduce the onset and severity of asthmatic symptoms. Subjects with asthmatic symptoms were initially trained to master effortless diaphragmatic breathing with surface electrolyographic and incentive inspirometer feedback. Inhalation volume was the physiological parameter used to measure skill acquisition. The protocol consisted of a pre-desensitization phase (mastering effortless diaphragmatic breathing, relaxation, peripheral hand warming and generalizing effortless diaphragmatic breathing while performing daily tasks). The desensitization-training phase consisted of inhalation awareness and desensitization exercises to promote effortless breathing under most conditions (abdominal versus thoracic awareness, volume awareness, purposeful wheezing, imagery rehearsal of stressors, role rehearsal and actual exposure to allergens. The methodology and helpful hints are described for each practice. Most subjects mastered the skills, inhibited their automatic escalation of dysfunctional breathing, and demonstrated the ability to continue to breathe diaphragmatically under a variety of conditions. Although this protocol was used with patients with asthma, it could be adapted as a treatment approach to other disorders (e.g., hyperventilation syndrome, anxiety or panic).

Key words: Biofeedback, asthma, desensitization, incentive inspirometer, sEMG feedback.

INTRODUCTION

In 1886 Mackenzie reported conditioning an asthmatic subject to a paper rose which suggested that asthmatic symptoms might be a learned response. Most likely, dysfunctional breathing is partially classically conditioned and part of the interaction of the biological / genetic precondition, psychological / social interactions, and physiological reactivity / response patterns that increase or decrease the probability of symptoms. A number of clinical reports have suggested that desensitization may reduce the onset of asthmatic episodes (Moore, l965; Yorkston et al., l974; Tibbetts & Peper, 1988).

Previously, Peper (1985, 1988) and Peper and Tibbetts (1992) reported that subjects with asthma reduced their symptoms when they learned to decrease their upper thoracic muscular efforts and simultaneously increased inhalation volume. These subjects often noticed that their inhalation volume decreased when they thought about or were exposed to environmental or emotional stimuli. This decrease in inhalation volume was also observed with non-asthmatic subjects when they imagined a stressful episode (Peper & MacHose, 1990). This process was most easily observed when subjects learned to breathe large inhalation volumes at slow breathing rate (3-7 breaths per minute). When subjects learned effortless breathing they became aware of their own specific stressors and used them as cues to trigger slow diaphragmatic breathing (Peper & Gockley, 1990). In this way, subjects experienced a sense of control that decreased their helplessness when overwhelmed by their dysfunctional breathing. In a similarly manner, children can rapidly learn to ameliorate and improve their health by mastering effortless breathing (Culbert, Kajander, & Reaney, 1996; Kajander & Peper, 1998).

This paper describes a training protocol to reduce the onset and severity of asthmatic symptoms. It is based upon a physiological desensitization in which effortless diaphragmatic breathing is pared with exposure to stimuli that would evoke dysfunctional breathing such as breath holding or rapid shallow thoracic breathing. The approach utilized an incentive inspirometer to encourage increased inhalation volumes coupled with slow exhalation in a variety of conditions (Roland & Peper, 1987). The procedure focused upon reducing dysfunctional breathing that tended to consist of thoracic breathing, shallow breathing, gasping and breath holding during movement and stress. These breath patterns are often observed during asthmatic episodes and contribute to the development of hyperventilation syndrome, anxiety, panic, and even epilepsy (Lum, 1976; Fried, 1987).

GENERAL TRAINING PROTOCOL

The protocol consisted of two phases (1) pre-training subjects to learn effortless diaphragmatic breathing and awareness of situations during which their breath patterns became more dysfunctional and (2) desensitization training to inhibit dysfunctional breath patterns with effortless diaphragmatic breathing by interrupting unconscious chained behaviors which may elicit asthmatic responses. The two phases of training included specific practices that were usually learned in groups. Even though there was a large group response to the practices, the subjects showed wide individual variations in their responses: some reacted strongly while others reacted minimally. For example, when subjects were instructed to focus on their abdomen, verbal instruction was sufficient for some, while others needed actual tactile stimulation to direct and hold their attention. Common to all the practices was the assumption that the therapist’s breath patterns were contagious, hence, the therapists all could breathe diaphragmatically under many conditions and were adept at using the incentive inspirometer (Peper and Tibbitts, 1994).

SUBJECTS
Twenty volunteer subjects with asthma participated in a group research study. Mean age 33 (range 22 to 46). Mean length of asthma 11.9 years (range .2 to 32 years).

EQUIPMENT
Inhalation volume was recorded with a Sherwood Medical Inc. incentive inspirometer (Voldyne).

PHASE 1: PRE-TRAINING

All subjects were pre-trained in slow diaphragmatic breathing with surface electromyography (sEMG) and incentive inspirometer feedback, relaxation, peripheral hand warming using guided imagery, and generalization practices (Peper, 1985, 1988, 1990; Peper, Smith, & Waddell, 1987; Peper, Waddell & Smith, 1987; Tibbetts & Peper, 1988). The pre-training mastery was necessary to facilitate recovery from the decreased inhalation volume that was usually induced by stressful events, thoughts, images, or activities (Peper & MacHose, 1990). Namely, after automatically re-sponding to a stressor with decreased inhalation volume, the subject would rapidly return to the higher learned volume levels. The pre-training consisted of mastering effortless diaphragmatic breathing, relaxation and peripheral hand warming, and generalizing effortless diaphragmatic breathing.

A. Mastering Effortless Diaphragmatic Breathing

The subjects with asthma received surface electromyographic (sEMG) feedback from their scalene/trapezius muscles to reduce upper thoracic muscle activity while simultaneously inhaling larger volumes through an incentive inspirometer to learn effortless diaphragmatic breathing. The group training program included information about respiratory physiology and factors than contributed to maintaining health. In a 15-month follow-up, Peper and Tibbetts (1992) reported that the subjects significantly reduced their scalene/trapezius sEMG activity while simultaneously increased inhalation volumes as compared to the beginning of the study as shown in Figure 1. They reduced their medication and increased their sense of control as shown in Figures 2 and reduced their emergency room visits and breathlessness episodes as shown in Figure 3.

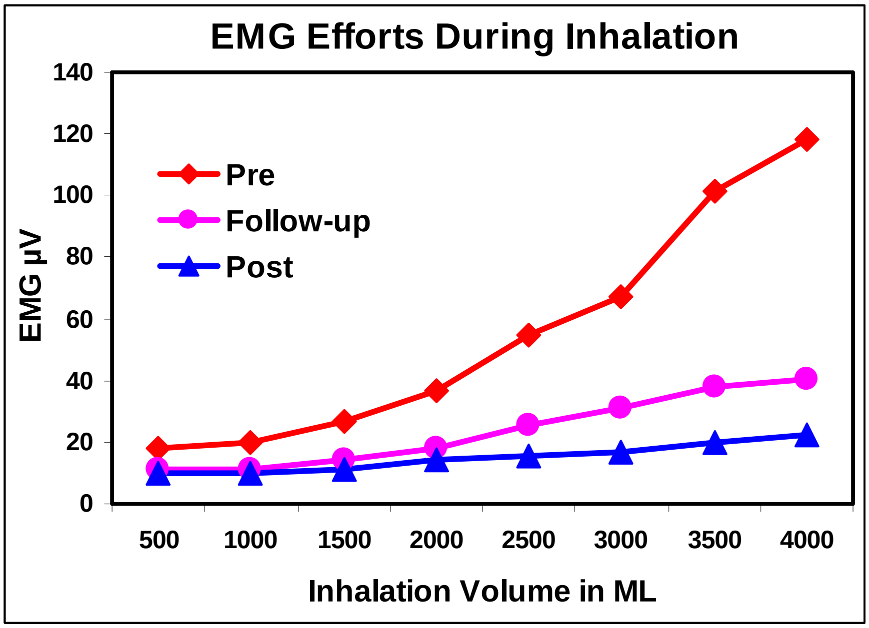

Figure 1. Group pre, post and 15 month follow-up measures of trapezius/scalene EMG effort of breathing. EMG activity represents the average of three sequential breathing trials at each volume (From Peper & Tibbetts, 1992)

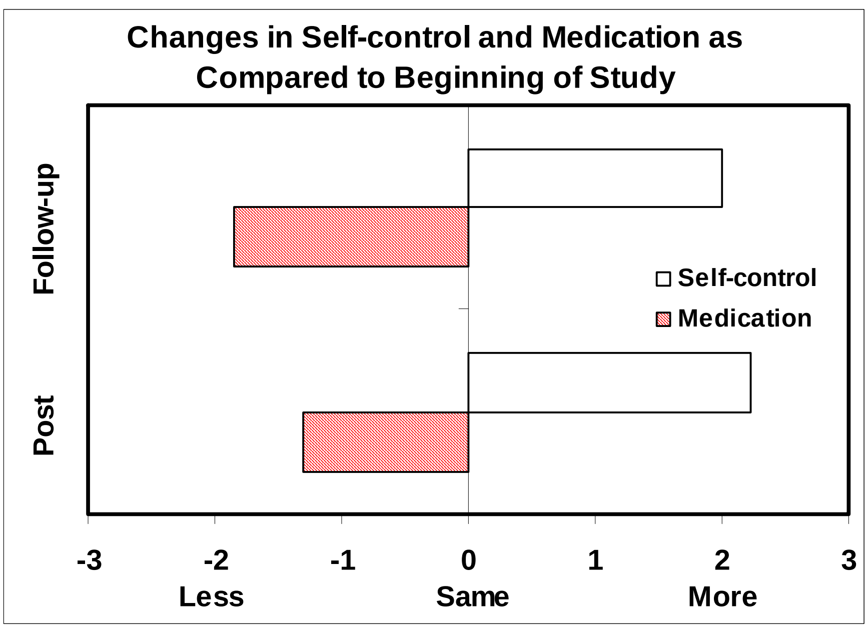

Figure 2. Changes in average emergency room visits per year and breathlessness episodes per day for the subjects who participated in the EMG and inspirometer feedback training program at the end of the training period (post) and after a 15 month follow-up (Adapted from Peper & Tibbetts, 1992).

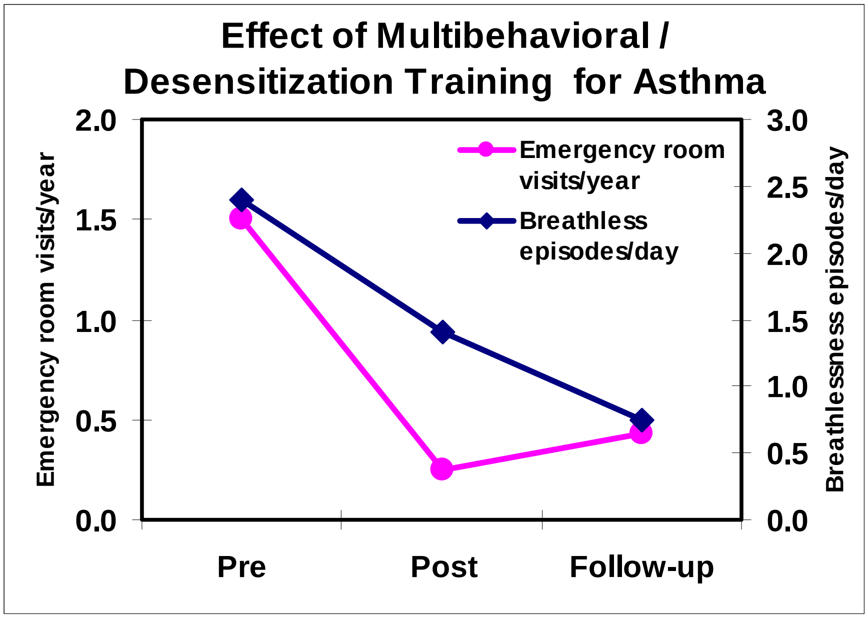

Figure 3. Changes in medication and subjective sense of control as compared to the beginning of the training program (Adapted from Peper & Tibbetts, 1992).

After subjects mastered slower breathing with increasing inhalation volume and less upper thoracic sEMG activity, they practiced lengthening their exhalation rate (lower flow rate for a longer time period). After they exhaled for a longer time period, they observed that their next inhalation volume usually increased when they allowed their abdomen to expand. This learning phase was enhanced with the use of numerous suggestions as previously described by Roland and Peper (1987).

B. Relaxation and Peripheral Hand Warming

Relaxation and peripheral hand warming were taught with guided imagery and temperature biofeedback. Specifically, subjects first learned modified progressive relaxation which they practiced at home with a tape cassette. Then, subjects were taught to warm their hands using autogenic phrases, guided imagery and temperature biofeedback (Tibbetts, Charbonneau & Peper, 1987; Peper & Holt, 1993). The subjects generally practiced very slow diaphragmatic breathing (2-6 breaths/minute) while the exhaled air flowed through and down their limbs warming their hands and feet.

C. Generalizing Effortless Breathing

The generalizing of effortless diaphragmatic breathing was encouraged by having subjects practice breathing while they performed various daily tasks (e.g., sitting, laying down, walking, talking and writing). More importantly they were taught to resume slow diaphragmatic breathing at the first signs of pulmonary discomfort to abort the onset of dysfunctional breathing such as breath holding or shallow thoracic breathing (Peper, 1990; Tibbetts & Peper, l988).

PHASE 2: AWARENESS AND DESENSITIZATION TRAINING

The training focused upon awareness and desensitization to imagined and real stressors. It consisted of the following six practices: A. Abdominal versus thoracic awareness, B. Volume awareness, C. Purposeful wheezing, D. Imagery rehearsal, E. Role rehearsal, and F. Actual exposure to allergens. Although each practice was slightly different, they all used the following general procedure.

General Procedure:

The general procedure was common to all the awareness and desensitization protocols. The aim was to inhibit decreasing inhalation volumes in response to imagined or actual asthma provoking stimuli. During the assessment and training, the subjects usually sat upright, eyes closed, with an incentive inspirometer placed at mouth level. Generally, the procedure consisted first of an effortless breathing pre-baseline, then an exposure to stressors, followed by a post-baseline of effortless breathing. The pre-baseline consisted of breathing a number of effortless diaphragmatic breaths without experiencing air hunger or discomfort. Sequential inhalation volumes were continuously recorded. This was followed by a specific exercise or desensitization strategy.

If inhalation volume decreased significantly or breathing difficulty occurred, subjects were instructed to immediately shift to the post-baseline effortless breathing condition. The post-baseline was similar to the pre-baseline. If the post-baseline was significantly lower (possible respiratory distress) then subjects were instructed to continue to breathe diaphragmatically until the post-baseline volume was similar to, or higher than, the pre-baseline volume. The subjects participated in the specific training exercises for varying lengths of time.

The training was done in groups of 6-8 subjects. Subjects worked with each other in that one subject would record volumetric data from their partner who underwent the desensitization practice. The subject who recorded the data simultaneously practiced breathing slowly and easily through their own incentive inspirometer. This in itself was a covert desensitization procedure that further encouraged the generalization of effortless breathing. After the actual practices were finished, the subjects continued breathing through their incentive inspirometer while writing what they experienced during the desensitization exercise. Finally, subjects practiced with an incentive inspirometer at home.

The specific order of the practices varied. The first two (abdominal versus thoracic awareness and volume awareness) can be taught in any sequence. However, before beginning the more stressful desensitization practices, subjects must have mastered effortless diaphragmatic breathing. The final four practices (imagery rehearsal, purposeful wheezing, role rehearsal, and exposure to allergens) should be taught in sequential order. The following section describes each practice, training observations and helpful hints.

A. Abdominal versus thoracic awareness

The purpose of this practice was to reduce the subjective discomfort that some subjects noticed when they focussed their attention upon their upper chest. This shift in the focus of attention is often unconscious and may be initiated by the tightness and wheezing in their upper chest. The first step for this practice was to observe whether focusing attention on the upper chest or on the lower abdomen effected inhalation volume. The subjects closed their eyes and then attended and focuses their attention upon their lower abdomen, upper chest, lower abdomen, and then upper chest. Sequential inhalation volumes were recorded. At each focus of attention, they breathed 3-4 breaths.

Results

Generally inhalation volume decreased when the subjects focused their attention on their upper chest and the volume increased when focusing on their abdomen, as shown in Figure 4.

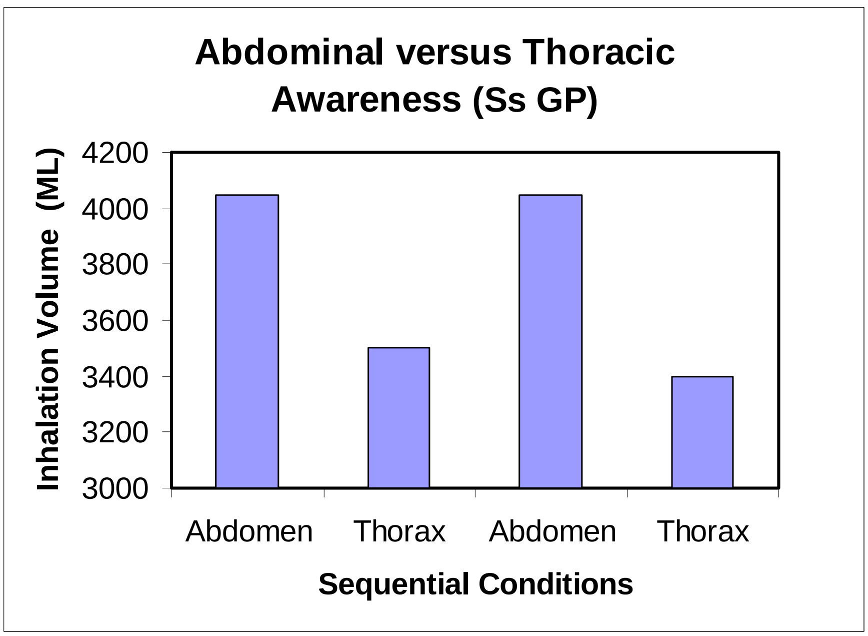

Figure 4. The effect of awareness of different body areas upon inhalation volume.

Discussion

This procedure demonstrated to the subjects that a "positive" feedback mechanism could contribute to the onset of symptoms. Namely, attending to the asthmatic sensations in the upper chest could decrease inhalation volume and increase shallow thoracic breathing thereby triggering wheezing and dyspnea. A similar mechanism may underlie hyperventilation, panic, and other types of chest pain.

During the training procedures, subjects were encouraged to initiate effortless diaphragmatic breathing whenever their attention shifted to their upper chest. In addition, subjects practiced sensing to their upper thoracic region while continuing effortless diaphragmatic breathing.

Helpful hints: To increase the subjects' responses to this exercise, direct the subjects' focus of attention to higher or lower body locations (e.g., notice the sensations in the head to amplify chest focus; feel the sensations in the legs and feet to amplify abdominal focus). For some the verbal instructions were insufficient and they needed to be physically touched at the body location to "capture" their attention. This was done by gently stroking upward on the inhalation and downward on the exhalation using the rhythm of their breath.

B. Volume awareness

The purpose of this exercise was to develop awareness of inhalation volume since some subjects were unaware that their inhalation volume decreased when they thought about stressful events. To enhance the awareness of inhalation volume changes, subjects were trained to sense the sensations associated with the various inhalation volumes.

The procedure consisted of first recording a pre-baseline in which subjects were instructed, with their eyes closed, to inhale to sequential target volumes, such as 1700, 3000, 2200, 1000, 2500, and 1500 ml. Then they practiced breathing to these specific volume levels with their eyes open while attending to the internal sensations associated with that volume level. After practicing with their eyes open, they practiced with their eyes closed until they were able to attain that volume level. They were asked to practice the exercise at home. Success of internal awareness was assessed by measuring the percent error of target volume and calculated as follows: % error = (target volume - actual volume)/(target volume) x 100 (Peper & Crane-Gockley, 1990).

Results

After practice, subjects were more successful at achieving the correct volume levels with their eyes closed. An individual skill acquisition curve for 9 sessions of inhalation volume training is shown in Figure 5.

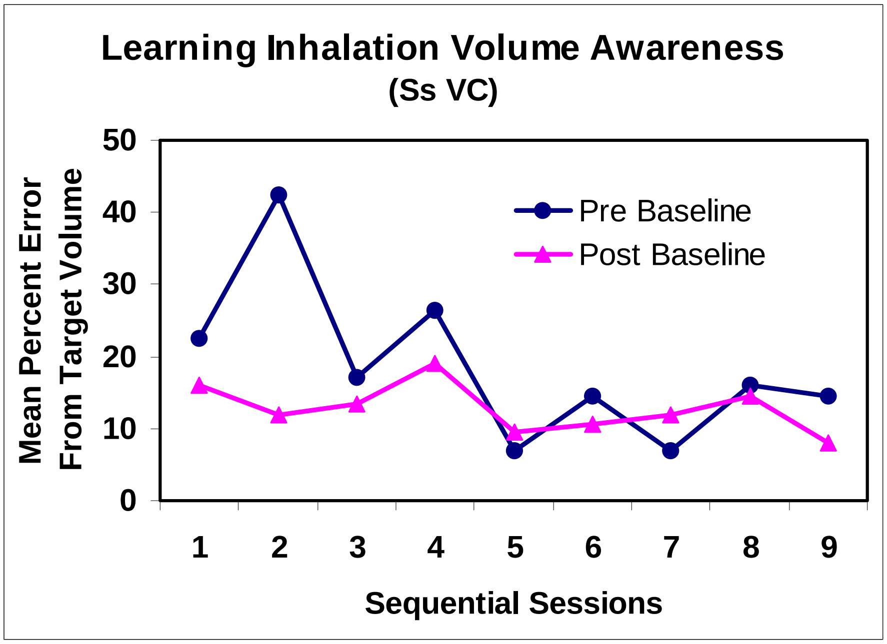

Figure 5. Skill acquisition curve as subject increased her sensitivity to inhalation volume.

Discussion

Generally subjects were inconsistent in obtaining the correct volume levels during the pre-baseline. Once awareness of different volume levels was mastered, subjects were able to use this awareness on a daily basis to identify which stimuli was associated with a change in inhalation volume. In addition, they were able to use the enhanced awareness of decreased inhalation volume as a cue to shift to slow diaphragmatic breathing.

Helpful hints: The range of volumes used for this exercise needed to be within the obtainable inhalation volume range for each subject. The maximum practice volume cannot be above what the subject can achieve. This exercise should also be practiced at home, either alone or with a spouse, while keeping the eyes closed initially and then opening the eyes to check the volume.

C. Imagery rehearsal

The purpose of this exercise was to observe how stressful images reduced inhalation volume and to desensitize subjects by paring effortless diaphragmatic breathing with stressful images. Previously, Peper and Machose (1990) showed that stressful imagery tended to decrease inhalation volume while positive imagery did not effect inhalation volume.

Subjects begin by breathing 6-8 slow breaths for the pre-baseline measurement. Then while continuing to inhale through the incentive inspirometer, they imaged a stressful scene for 4-6 breaths. When imaging it is important to encourage the subjects to be as realistic as possible. Remind them to see or feel every detail of the image. The more involved the subjects were in the image, the more they responded with a reduction in inhalation volume. Subjects could image a known allergen and/or asthmatic stressor, a recent asthmatic attack or hospitalization, or a past or recent emotional conflict. After imaging, the subjects were instructed to let go of the image and return to slow diaphragmatic breathing for 6-8 breaths for the post baseline measurement. After collecting the data, the subjects wrote what they experienced and to what extent they thought their volume level changed while they were breathing through the incentive inspirometer. The subjective measure of changes in inhalation volume was then compared with the actual recorded data and discussed with the subject.

Results

Most subjects' inhalation volume levels decreased when imaging a stressful event. During the training, subjects learned to maintain high inhalation volumes while imagining stressful events. A single subject's response to and ability to not respond to the imagined image after desensitization training is shown in Fig 6 and 7.

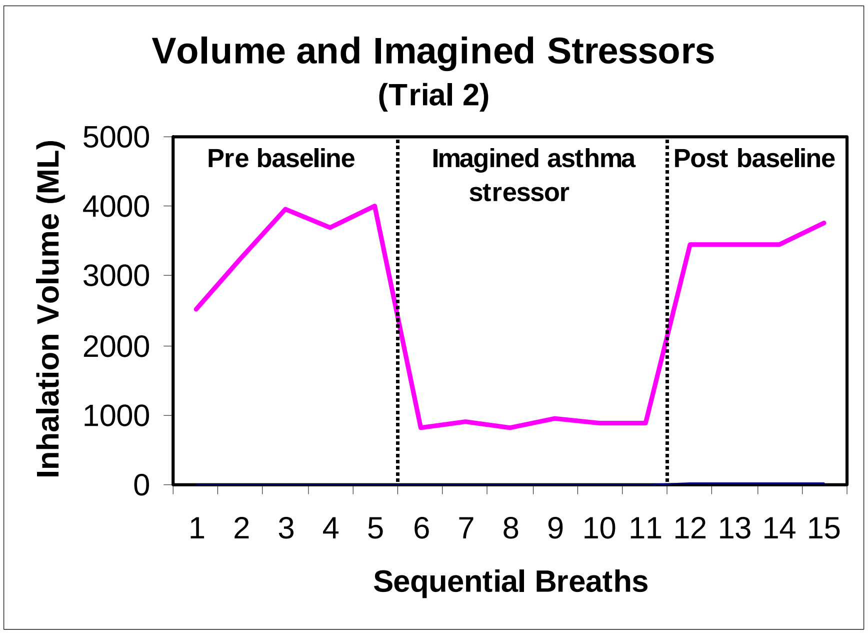

Figure 6. Inhalation volume response to imagined stressor.

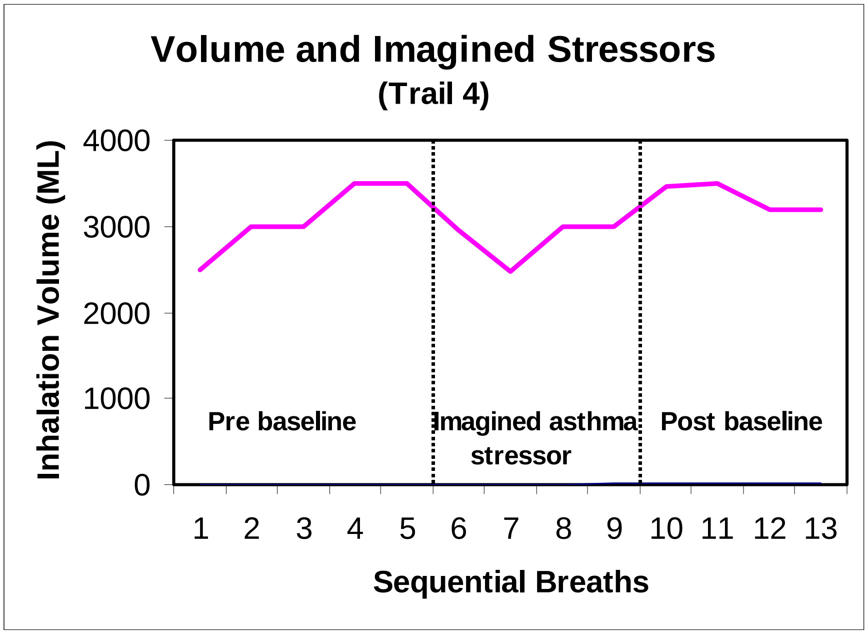

Figure 7. Inhalation volume response to imagined stressor after subject had practiced desensitization to the stressor.

Discussion

While imaging, most subjects were able to learn to inhibit the decrease in inhalation volume by continuing to breathe diaphragmatically. In many cases, additional practice was needed so that they could inhibit this almost automatic reduction in inhalation volume to asthma inducing stimuli. The practice was a powerful learning tool for the subjects when they saw how imagined thoughts or emotions significantly reduced their inhalation volume. Nixon and Freeman (1988) have also reported similar observations with with coronary heart disease patients. They observed a significant decrease in end-tidal CO_2 when the patients thought about personal life stressors.

For some subjects the inhalation volume decreased radically and led to actual respiratory discomfort. Hence, the trainer needed to monitor the changes in volume levels. If there was a rapid and significant decrease in inhalation volume, the subject should stop imaging and practice effortless diaphragmatic breathing. In addition, some asthmatic subjects anticipated the exercise and unknowingly reduced their inhalation volume levels during the pre-baseline period. Hence, it is important to have previous baseline data on the subjects' inhalation volumes during effortless diaphragmatic breathing.

This exercise was also be used to teach new coping techniques such as, assertiveness skills, rewriting your past, and cognitive reframing (Peper & Holt, 1993). With practice, subjects could rehearse alternative coping strategies while breathing effortlessly. For example, one subject who had an attack every time while he rode his bike continued to breathe slowly and easily while imaging himself riding.

In a few cases, the training was not successful even though the subject could breathe slowly while apparently imagining a stressful scene. However, in these cases they were not involved in the imagery. Figure 8 illustrates such a subject who was highly allergic to cigarette smoke. In this case the subject reacted when the therapist simulated a smokers cough during imagery desensitization training which made the image "real" for the subject.

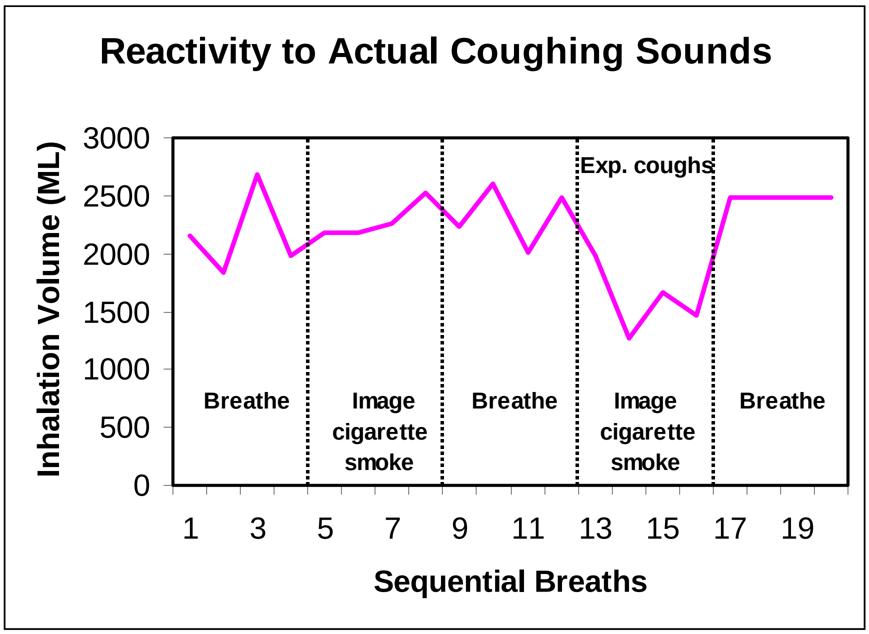

Figure 8. Example of incomplete desensitization. Subject appeared to not response to stressful image, however when more realistic cues were provided (coughing) she again reacted with a decrease in inhalation volume.

Helpful hints: Be sure the imagery is meaningful and relevant for the subjects otherwise their inhalation volume may not be effected. During the post-baseline condition check that the subjects let go of the image and practice effortless breathing. In some instances, the subjects became so involved (captured) with their imagery that they needed external guidance to redirect their attention. To avoid possible respiratory discomfort when subjects respond with large decreases in inhalation volume, practice this exercise for a shorter time period and/or develop imagery desensitization hierarchies.

D. Purposeful wheezing

The purpose of this exercise was to reduce respiratory discomfort that often developed when subjects heard their own or other's wheezing sounds. The purposeful wheezing practice consisted of subjects breathing four to six effortless diaphragmatic breaths and then listening either to someone else wheezing or actually practice wheezing (simulating asthmatic breathing) for a few breaths. After wheezing or listening to the wheezing sounds, they practiced effortless breathing until the inhalation volume was similar or higher than during the pre-baseline. Before subjects begin practicing this exercise *IT WAS ESSENTIAL THAT THEY HAVE MASTERED SLOW DIAPHRAGMATIC BREATHING*. The subjects must be able to breathe diaphragmatically to imagined wheezing sounds and to mild stressors, such as walking or writing. If subjects experienced slight asthmatic sensations such as, airway irritation, dyspnea or panic, discontinue the exercise and resume slow diaphragmatic breathing.

Begin by having subjects breathe 6-8 slow diaphragmatic breaths through the incentive inspirometer. Usually this will also increase respiratory sinus arrhythmia that promotes sympathetic/parasympathetic balance and reduce asthmatic symptoms (Lehrer, Carr, Smetankine, Vaschillo, Peper, Porges, Edelberg, Hamer, & Hochron, 1997). Then have the subjects either wheeze themselves or listen to another group member purposely wheeze for 5-15 seconds (two or three breaths). If subjects do not know how to wheeze, give them the following instructions:

> *"Take a short inspiration, then give a short cough, followed by a prolonged forcible expiration while pressing down on the chest. Attempt to close the glottis by tightening the throat and protruding the head prior to coughing while continuing the 'pressing' expirations" (Peter Mellet, 1978).*

After wheezing or listening to wheezing, have subjects return to the effortless breathing for 6-8 breaths.

Results

Generally subjects' inhalation volume levels decreased while listening to or wheezing themselves. For many subjects the return to effortless breathing and increased inhalation volumes took a number of diaphragmatic breaths. Figure 9 shows a single subject before, during and after wheezing.

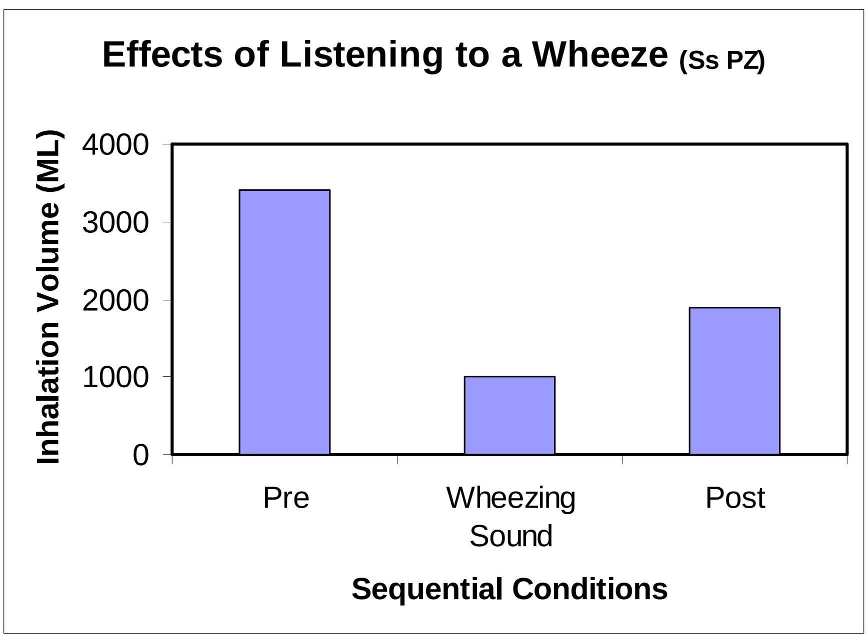

Figure 9. The effect of listening to wheezing sounds upon inhalation volume.

Discussion

This exercise appeared most successful when taught as a group game. Most subjects did not want to practice this by themselves because it induced anxiety and fear that the asthma attack would escalate and really occur. For the group members who were listening to the wheezing sounds, their task was not to react to the sounds (e.g., no changes in inhalation volume). For many subjects the anticipation of this exercise often lowered their inhalation volumes before wheezing sounds were actually heard. While for others, the volume increased after the wheezing stopped (a sigh of relief). Hence, the exercise needs to be practiced until the subjects neither anticipated nor reacted to the wheezing sounds. This reactivity can also be practiced with electrodermal activity feedback (EDA). Often when the person anticipates or actually wheezes their electrodermal activity increases. When such an electrodermal response occurs, stop the exercise and have the person resume slow breathing. This approach is often very helpful with children.

The focus of this exercise was to desensitize the subjects to wheezing sounds and to enhance their feelings of self-control. This sense of mastery occurred in the process of shifting from purposeful wheezing back to slow diaphragmatic breathing without evoking breathing discomfort, which in the past could have led to an escalation of asthmatic symptoms. In addition, the sense of increasing panic was reduced when subjects practiced wheezing and then returned to slow diaphragmatic breathing.

Purposeful wheezing often irritated the airways and induced tightness in the chest and hyperreactive airways. Awareness of these sensations (feeling the chest) tended to reduce inhalation volume. By focussing upon their abdomen and legs (imagining exhaling through the legs and out the feet increased inhalation volume) subjects could reduce their breathing discomfort.

Helpful Hints: Be aware that this exercise may be threatening. We often encouraged subjects to practice purposeful wheezing in order to become aware of precursor symptoms such as tightness. These symptoms became the cues to initiate effortless diaphragmatic breathing.

It may be helpful to have the group leader/therapist demonstrate purposeful wheezing first and then ask for volunteers to allows those with more skill/confidence to show the other group members that they can control their own wheezing sounds. Since, purposeful wheezing irritated the airways, allow enough time (about 15-20 minutes) for the respiratory system to settle down. Be sure to set aside enough time for recovery with effortless breathing. Obviously, if subjects are in respiratory distress do not do this exercise. A similar strategy can be used with subjects who experience panic or hyperventilation. In this case the subjects practiced sequential exhalation of 70% of the previous inhaled air (Peper & Machose, 1993).

E. Role rehearsal

The purpose of this exercise was to desensitize subjects to stressful events/allergens while maintaining large inhalation volumes. After subjects successfully imaged a previously identified stressful event, they were instructed to act out these stressors while continuing to breathe diaphragmatically, thereby generalizing the skill. Often subjects needed additional coaching and encouragement to transfer the newly learned skills into their daily lives.

Subjects began this exercise by first describing their previously identified triggers or situations which aggravated their asthmatic conditions to the group members. Then they assigned different group members to act out the specific roles such as, a family member involved in an emotional scene, a cat, or a painter in a paint shop. It is important that the subject, for whom the role-play is done, describes in detail what/how roles should be acted such as, where to stand, what to say and how to move.

After the initial baseline, have subjects continue to breathe through the incentive inspirometer while entering into the role-playing scene. For example, when members act out a scene in a spray paint shop, have one member physically move as if spraying paint while simulating the hissing noise of the spray gun. Repeating the above example with real props such as an actual air compressor can increase the reality. On the other hand, if talking is a necessary component of the exercise be sure the person allows the air to flow in diaphragmatically while talking and does not gasp for air. In addition, stop the scene occasionally and have the individual use the incentive inspirometer for inhalation volume measurements. After 4-5 minutes of role-play, return to the post baseline effortless breathing for 6-8 breaths. When subjects were able to simultaneously rehearse their role and continue effortless breathing, repeat the exercise without the incentive inspirometer.

Discussion

For most subjects inhalation volumes decreased when they attempted to act out their stressful scenes. Often the subjects became so involved that without the immediate feedback of the incentive inspirometer they regressed to their habitual shallow rapid thoracic breath patterns. Many subjects reported feeling awkward when they first attempted to perform this exercise. However, they were encouraged to adapt a play like attitude and implement new coping skills.

Helpful hints: Often subjects needed to be exposed or taught alternative strategies because they continued to act in their previously unsuccessful strategies. New strategies can also be developed by having other group members demonstrate and role play various alternative options that they developed or used in similar situations. These new behaviors included communication and assertiveness skills. During the role rehearsal, involve as many of the participants as possible. Encourage all subjects to breathe diaphragmatically while speaking, moving, or acting in the role-play.

F. Exposure to allergens

The purpose of this exercise was to have subjects breathe effortlessly while being exposed to actual allergens. The final step consisted of seeing and smelling the asthmatic allergens. This step was only taken if subjects were able to image and role rehearse without any breathing discomfort occurring.

Begin by having subjects bring in odors that had previously been identified as a trigger to increase asthmatic symptoms (Shim & Williams, l986). Then have subjects close their eyes and breathe 6-8 slow diaphragmatic breaths. Next, very slowly introduce a neutral odor while continuing to breathe through the incentive inspirometer. A neutral odor should have a distinct smell, like peppermint, to which subjects have no reactivity. Finally return to the post baseline breathing of 6-8 breaths. If no reactivity occurred then repeat the same procedure using one of the identified allergens or smells. When subjects work in pairs make sure only one of them is reactive to the odor. When subjects can continue effortless breathing while being exposed to the allergen, then repeat this procedure with the eyes open. For many subjects seeing the allergen increased their reactivity.

Discussion

Initially subjects' inhalation volumes decreased in anticipation of the neutral and actual odors. After practice, many were able to continue slow diaphragmatic breathing while being exposed to the allergens. To avoid development of breathing difficulty, expose the subjects to the allergen for a very short period of time (initially a few seconds). Since some subjects have a delayed response to the allergen, allow enough time (about 10-20 minutes) to pass before repeating the desensitization. Interestingly, when subjects inhaled the allergen through their mouth they tended to react less than if they inhaled it through their nose. We wonder if this is odor conditioned pulmonary reactivity similar to that reported by Ader and Cohen (1975) who were successful at behaviorally conditioning imunosuppression in rats to taste and smell.

Helpful hints: Many subjects were very apprehensive about doing this exercise since they have never been exposed to odors without some symptoms occurring. It is helpful to ask for volunteers. Those who feel more in control can demonstrate to the group how this exercise can be accomplished. Only perform the in vivo exposure after subjects have shown no response to imagined or role played exercises.

General conclusion

Many subjects learned to inhibit their normal asthmatic responses by breathing diaphragmatically when exposed to asthmatic provoking triggers although the desensitization to the stressors/allergens took a number of sessions. The acquired skill does not always generalize into the real world. At times when subjects were faced with the asthma provoking stimuli, they often reverted back to their shallow thoracic breathing. This implied that subjects need to over-learn their skills. Although not all subjects mastered this step, they nevertheless reported increased control over their asthmatic attacks.

Common to these exercises was the observation that "awareness" of habitual dysfunctional breathing patterns increased their feelings of anxiety or nervousness. Subjects suddenly realized how often they were breathing in a dysfunctional pattern and blamed themselves. It is important to reframe their self-blame by congratulating them on their newly discovered sensitivity and awareness. Remind them not to expect overnight success, since skills needed to be practiced for a long time before they are effective. Finally, they needed to learn new coping strategies such as, awareness of emotional responses, assertiveness and communication skills. By learning these skills many of the subjects experienced self-direction and self-initiative.

The desensitization exercises were designed to reduce the triggering and escalation of asthmatic symptoms. The subjects' response patterns varied dramatically. Some reacted with a 1000-2000 ml decrease in volume for 10 breaths or more, while others reacted with a 100-200 ml decrease for 1 or 2 breaths. Slow diaphragmatic breathing encouraged a reduction of sympathetic arousal and decreased allergic reactivity. By having subjects purposely wheeze, they used the onset of wheezing/tightness in the chest as a cue to trigger slow diaphragmatic breathing and thereby experience control. This allowed them to alleviate asthmatic symptoms. For example, a subject who always experienced breathing difficulty at his work in a paint factory, found that he could successfully inhibit wheezing with slow diaphragmatic breathing.

Using an incentive inspirometer as a feedback tool had the following advantages because it demonstrated that:

1. Pulmonary reactivity to imagined thoughts as a conditioned component and not just to an actual allergen.
2. Thoracic and shallow breathing (dysfunctional breathing) had lower inhalation volumes than effortless diaphragmatic breathing.
3. Self-control over breathing was possible even when asthma symptoms occurred and that often the symptoms could be reduced by continued effortless diaphragmatic breathing.

Overall, this protocol suggested that an integrated approach restored health although success depended upon transfer of learning effortless diaphragmatic breathing in many aspects of the person's life. The subjects practiced both in the group and also at home. The homework practice of inhibiting reactivity to asthmatic provoking stimuli was individually adapted. Subjects were encouraged to identify cues to begin slow diaphragmatic breathing. These cues ranged from dots on the telephone, seeing a cat on television, a pop up reminder on a computer screen, walking up an incline, to acknowledging an emotional feeling. The benefits of this program are best stated by one subject's report:

> *"I now catch myself sooner so I have a decrease in symptoms because they don't reach that point.", and "I have many times used the diaphragmatic breathing under stress situations when aware of wheezing coming on. Not only has it reduced my asthma but it has calmed my nerves, relaxed my mind and muscles so I don't overreact."*

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