

SPECIAL ISSUE

Case Study: Improved Breathing Regulation Using Biofeedback

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A case study is described of a patient experiencing chronic pain with disordered breathing and discomfort for most of her life. Exploration of her childhood history revealed several incidents and conditions that apparently combined to inhibit comfortable breathing. The use of three forms of breathing biofeedback was helpful in amplifying her awareness of frequent breath stopping and hyperinflation. Changing her habitual breathing pattern with brief biofeedback and a split-attention technique resulted in more normal, comfortable breathing and abatement of most symptoms.

Introduction

This is a summary of a case in which a patient's growing awareness of breathing abnormalities, coupled with some biofeedback and simple direction in altering breathing patterns, resulted in remission or improvement of symptoms that had been present for decades.

Background

The patient (C.W.) was a woman, 64 years of age, referred to Kaiser Permanente's Chronic Pain Management program in San Francisco, California. At intake, she reported being in pain for 54 years, starting with fractured vertebrae from a fall. Medical diagnoses included osteoarthritis, myofascial pain, and Lyme disease contracted 15 years ago, plus evidence of an anxiety disorder, although brief screens for depression and anxiety were within normal limits. Intelligent, well spoken, and with a master's degree in education, C.W. was on disability after leaving teaching because of pain and the debilitating effects of Lyme disease. She had practiced meditation and other relaxation techniques for many years but had never felt comfortable with her breathing.

Group Interventions

C.W. completed the multidisciplinary, 5-week Intensive Reconditioning Group program, focused on improved body use via Feldenkrais movements along with behavioral and psychological pain management. She reported an improved mood, better physical functioning and sleep quality, and optimism regarding her skills in pain management. She

next entered the 6-week biofeedback group and learned the basics of regulating her muscle tension, skin conductance, breathing, and hand temperature. This gave her more strategies for managing pain and anxiety; she relied especially on autogenic phrases and practiced diligently. Her medication regimen was daily low doses of tramadol and gabapentin.

During the biofeedback group, C.W. absorbed the objective psychophysiological information provided and developed some skill in hand warming, muscle relaxation, and breathing regulation. Electromyographic monitoring of her shoulders seemed to improve her breathing somewhat as well as reduce her neck and shoulder pain. However, she was still uneasy about her breathing.

Following the biofeedback group, she requested individual help with breathing regulation. Her interest in this was first piqued during the pain management group when breath holding was named as a stress indicator. The value of smooth, steady breathing was emphasized, and a Feldenkrais instructor had also instructed her not to hold her breath during movements. She became more and more aware that her breathing was irregular, with frequent breath holding, difficulty getting a full breath, and general dyspnea.

Individual Work

At our first appointment, I inquired about any early incidents or traumas related to disrupted breathing, and the rest of the story began to emerge. There were three important factors in her history:

1. Around age 10, she jumped out of a tree and landed on a wasp nest, with many stings resulting. Her mother called a physician, who, after hearing the symptoms (face turning blue, difficulty breathing), diagnosed anaphylactic shock and rushed to the home to administer adrenaline. This near suffocation was very frightening to C.W.
2. At age 11, she fell down some icy stairs, fractured vertebrae in her tailbone, and experienced a brief period of gasping for air—having the wind knocked out of

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her and not being able to inhale. She thought she was dying. For months, she wore a cast and later braces as her fractured tailbone healed.

3. During C.W.'s childhood, her mother was hypochondriacal and apparently had strong emotional reactions to both of the above events. The patient's recovery from the fall was quite prolonged; although she learned later that the fracture probably healed quickly and she could have returned to normal activities, she continued through her teenage years to overprotect her back, avoided sports, and became significantly deconditioned. She was very fearful of reinjuring herself by falling again. She sometimes dreamed about falling and would awaken gasping for air. Her fear of insect bites, anaphylactic shock, and suffocation also continued.

The patient's mother was extremely fearful of illness and often stated that she could die soon and that she might kill herself. Around the age of 12, C.W. adopted the role of emotional caretaker of her mother. This involved constant vigilance, in expectation of some health emergency or disaster, and she considered herself still injured and fragile. She developed a style of self-sacrifice whereby the needs of her family came before her own.

She went through adulthood with a general state of hypervigilance, on guard most of the time regarding either her mother or herself, carrying an EpiPen® in case of insect bites and mindful of the danger of her lungs shutting down. When she came to our pain management program, she was living with her grown daughter and her family and tended to give priority to their needs, leaving sometimes little time for self-care.

During our second appointment, a strain gauge was placed around her mid-thorax to display breathing rate, regularity, and depth. She could maintain a regular breathing rhythm and rate using the feedback, but the volume was low. The most prominent abnormality in her breathing seemed to be slowness and shallowness.

Hyperinflation

Hyperinflation has been studied mainly in relation to chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis. In the hyperinflation pattern, airflow is restricted and the lungs become overfilled. It is especially troublesome during exercise, when insufficient time is allowed for the breathing to reach resting equilibrium, the point at which exhalation switches to inhalation. Breathing in before the previous breath is fully exhaled results in an excess of dead air in the lungs and not enough usable space to breathe into. Associated with

this pattern are a chronically flattened, partially contracted diaphragm and shortened respiratory muscles, plus difficulty getting a deep breath. Although hyperinflation is common with COPD because of physical and structural limitation of airflow, it can appear in other situations involving anxiety about breathing, and anxiety can complicate the breathing of COPD patients.

The essential intervention for C.W. was to exhale a little more, in a relaxed way, past the point at which she would normally stop and begin her inhalation. Doing this results in more lung space available for the next breath, relaxation of the diaphragm and intercostal muscles, and effortless abdominal breathing.

This breathing change was monitored by the strain gauge, and the screen display showed the tidal volume nearly doubling shortly after she began emphasizing exhaling instead of inhaling. As C.W. experimented with this change, her whole breathing process became easier. She practiced various degrees of exhalation to confirm that inhalation felt more natural and easy when her lungs were relatively empty.

Her long-standing anxiety about her breathing appeared to be linked with inhibited and incomplete exhalation, which had become the functional equivalent of mechanical obstruction. This reduction of inspiratory volume might best be called behavioral hyperinflation. When feeling short of breath, people focus most on inhaling, but that compounds the problem if the lungs have not adequately emptied. "Take a deep breath" is a common admonition to anxious people, but breathing out first makes the deep breath possible.

Breath Holding

Besides using the strain gauge, no pulmonary assessment was done with C.W., so describing her breathing pattern as hyperinflation was based on signs and symptoms only. But it made sense to the patient, and by the next appointment, she had practiced breathing with a more complete exhalation. As she became more conscious of her breathing, she discovered how often she was holding her breath after inhalation, after exhalation, and during mid breath. We discussed common psychological concomitants of this pattern such as apprehension, suspense, annoyance, attending to a stimulus, indecision, and emotional inhibition, and she could identify with several of these.

The possibility of chronic hyperventilation also needed to be considered because it is often associated with anxiety, an irregular breathing pattern, periodic pauses, and shallow chest breathing, all of which she exhibited. A capnometer was used to sample her end-tidal CO₂ measured with a sampling tube at the nostril. A reading below roughly 33

torr would suggest hyperventilation at that moment (more CO₂ exhaled than produced). But her readings were in the opposite direction, consistently about 45 torr, which indicates moderate retention of CO₂ and possibly insufficient breathing for the body's needs. Although this was a brief sample of her breathing behavior, the conclusion was supported by moderately high CO₂ readings recorded during the biofeedback group. Also, frequent breath holding could reduce the amount of air taken in (reduced minute volume) and thereby raise the CO₂ level.

This tendency toward hypoventilation proved relatively easy for C.W. to normalize. When she practiced more complete exhalation, her CO₂ level dropped to the optimal 38 to 40 range, the tidal volume increased, and her breathing became easier. She practiced for awhile, eyes closed, imagining her breathing as ocean waves, steady and unstoppable. She understood the need to switch her attention to internal cues and sensations rather than depend on the external biofeedback because the instruments were not going home with her.

Changing Breathing Habits

Using biofeedback and with full attention to the process, C.W. could optimize the dimensions of her breathing: rate, depth, locus (chest vs. abdomen), smoothness, completeness of exhalation, nasal rather than mouth, rhythm, and continuity. Breathing this way felt more comfortable to her, but she knew that during her ordinary everyday breathing, habit was usually running the show. She saw the need to affect her automatic, default respiratory settings, and this was done by practicing activities that required only partial attention, devoting the rest to maintaining breathing awareness. This can be done either by a continuous splitting of attention or by a rapid switching back and forth.

For several weeks, she tried this exercise with activities such as dishwashing, driving, and whatever else did not require her full attention. Her main objective with this generalization practice was to observe the attributes of her breathing and make minor adjustments with half a mind as she went about her daily activities. She wanted above all to catch herself breath holding and simply resume breathing. She discovered that stoppages were very common but could be inhibited by continuing to breathe as she did something else. She also discovered that she sometimes held her breath as a self-calming procedure, as if the act of breathing was itself associated with anxiety.

C.W. had once been an avid swimmer but had never been comfortable with the crawl stroke. The demand to inhale, submerge her face, swim, breathe out, and lift her face out of the water for another breath had always felt awkward for

her, and she felt unable to hold her breath longer than two strokes. This made sense to her in terms of hyperinflation; she understood that she was most likely not exhaling enough, so there was insufficient lung space for the next quick gulp of fresh air.

Conclusions

During our fourth and last appointment, all of the preceding material was reviewed and discussed. She reported that her breathing had become smoother, calmer, and much less interrupted; whenever she felt a warning sign that her breathing was faltering, she could easily keep it going. She also mentioned that before the pain management group, she was often sleeping 13 to 14 hours per day, with daytime naps. Her sleep had been steadily improving for months and was now averaging 7 to 8 hours per day, without naps. She may have had undiagnosed sleep apnea, perhaps from the breathing interruption habit extending into sleep.

She stated that her pain and medication use were both lower and that she was feeling more energy. She was planning to find a place to volunteer her services and also to do more swimming, curious about whether her new breathing control would make the crawl stroke more effective. It was apparent to her that her former dysfunctional breathing habit (frequent breath stopping, hypoventilation, and hyperinflation) was linked to the long-ago fall down the stairs, to the wasp-stings and resulting anaphylactic shock, and to the chronic state of being on guard that had plagued her for so many years.

The information and suggestions offered to C.W. for her breathing disorder and her chronic pain were not treatments. The biofeedback was the catalyst for improved self-regulation, furnishing essential indicators of an automatic body process that had become dysregulated. But a long-term psychophysiological problem was finally brought under control only by means of C.W.'s perseverance with active learning, observation, introspection, and practice.



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