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SPECIAL ISSUE

Did You Ask About Abdominal Surgery or Injury? A Learned Disuse Risk Factor for Breathing Dysfunction

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Abdominal surgery or injury may affect breathing and, if the disturbed breathing pattern is maintained, illness may result, as illustrated by two case examples. This report describes the process of learned avoidance of pain through which abdominal surgery may cause dysfunctional breathing. This clinical note is a reminder to clinicians to ask about abdominal surgery or injury during the intake. In cases in which symptoms occurred months after the abdominal surgery or injury, it may be possible to reduce the symptoms through teaching effortless breathing.

Background

Months after surgery involving the abdominal muscles, such as after a gastric bypass surgery or a Caesarean procedure, some patients report that their breathing feels unnatural or describe symptoms similar to hyperventilation syndrome (Fernandez et al., 2004; Mokhlesi, Kryger, & Grunstein, 2008). For example, Sršen, Perko, Pogorelić, and Mimica (2007) conducted a randomized control trail of abdominal incision locations that affect breathing patterns, finding that upper abdominal incisions were associated with greater likelihood of symptoms, such as hyperventilation after surgery, compared to lower abdominal incisions.

When clients report that breathing feels unnatural or have symptoms that could be aggravated by hyperventilation for which there appears no medical or physical cause, and if the symptoms began a few months or longer after abdominal surgery, consider that breathing dysregulation could be a significant factor in the etiology of the symptoms. For example:

I had colon surgery six months ago. Although I made no connection my anxiety just started to increase and I became fearful and I could not breathe. The asthma medication did not help. Learning effortless diaphragmatic breathing and learning to expand my abdomen during inhalation allowed me to breathe comfortably without panic and anxiety—I could breathe again.

—72-year-old woman

One year after my appendectomy, I started to have 12 seizures a day. After practicing effortless diaphragmatic breathing and changing my lifestyle, I am now seizure-free.

—24-year-old male college student

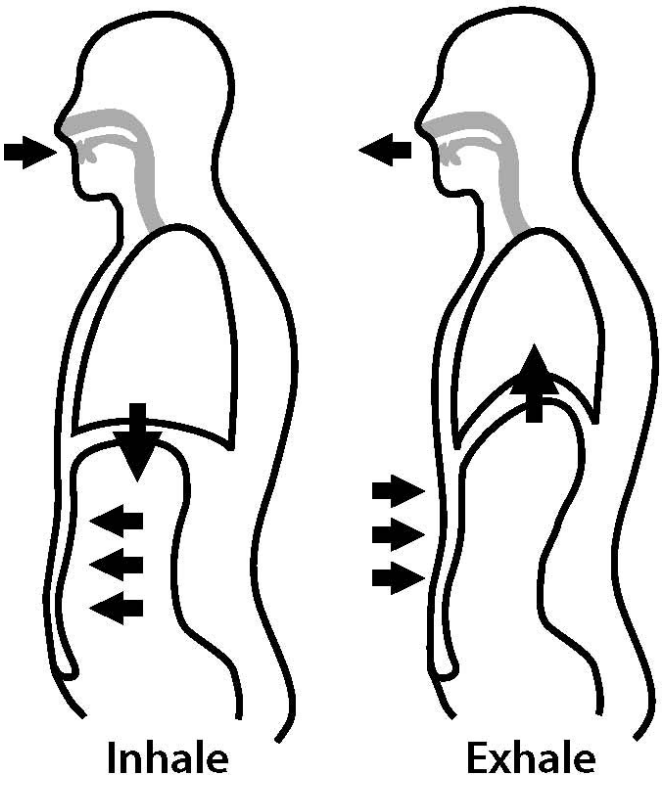

Figure 1. Illustration of effortless whole body breathing in which the predominant movement occurs in the abdomen rather than the chest (Gorter & Peper, 2011).

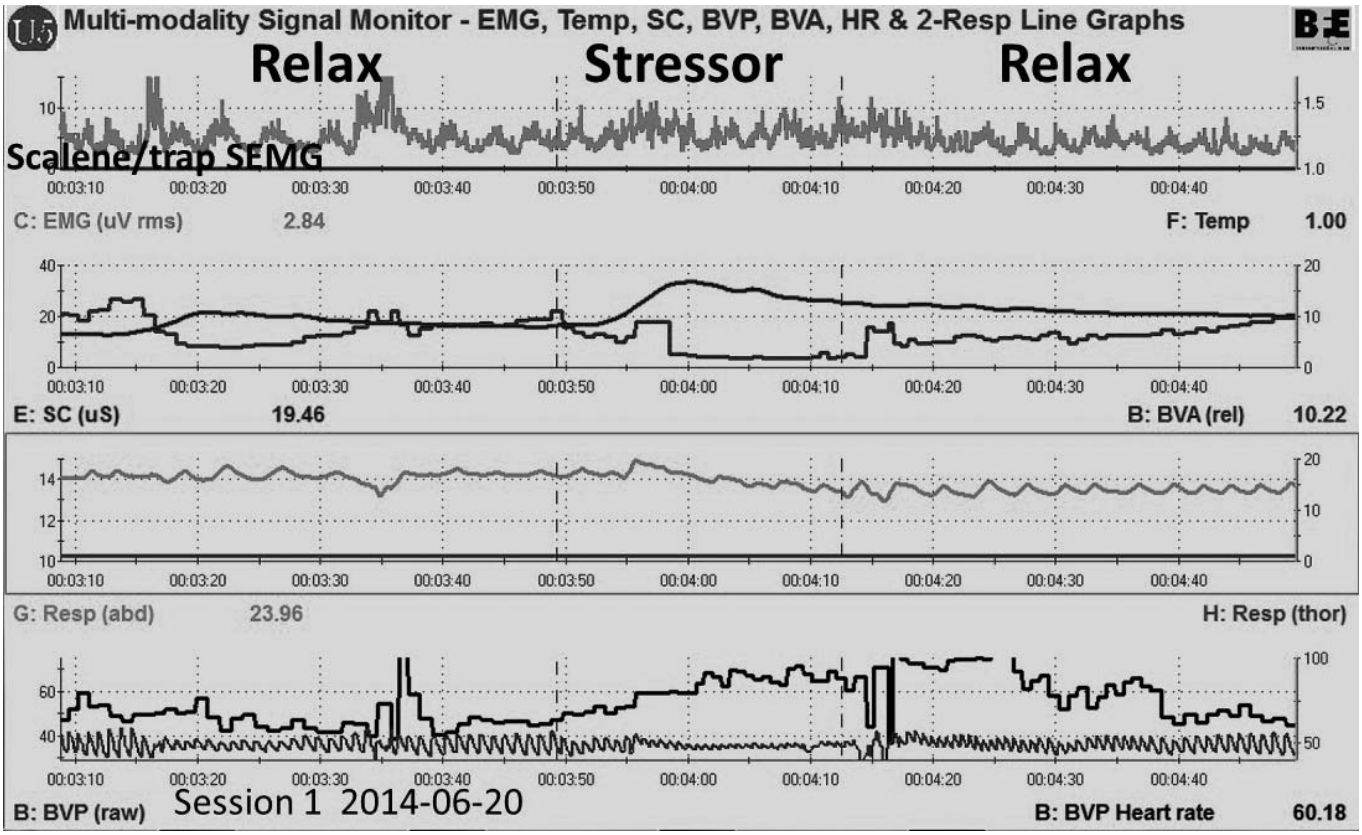

Figure 2. A dysfunctional breathing pattern in a young man with frequent seizures (from Peper, 2015).

A common risk factor that affects breathing is surgery or injury to the abdomen. Procedures such as hernia repair, appendectomy, colon surgery, and Caesarean section can disrupt breathing with the diaphragm. It is common for the recovering patient to reduce pain and protect the tender incision wound by inhibiting the abdominal expansion that normally is part of the breathing cycle. Learned disuse (neglect) of the diaphragm muscle leads to predominantly chest breathing and overuse of accessory breathing muscles, which is not optimal for prolonged use. As a result, numerous symptoms may develop and become chronic. Once a pain-avoidance breathing pattern has been learned, it may not revert back to normal even when the tissue is healed and pain is no longer likely.

Postsurgical aftercare usually emphasizes restoring diaphragmatic breathing using an incentive inspirometer to encourage deep breaths, and stimulating breathing through mild exercise (Davis, 2012). This is done to offset the effects (atelectasis, pneumonia) of general anesthesia. Some nurses teach the patient to place the hand over the incision location during inhalation. Apart from providing feedback about abdominal movement, this maneuver enhances feelings of control over abdominal expansion, a way of reassuring that the stitches won't pull out and the wound won't reopen; however, it often encourages predominant chest breathing.

Diaphragmatic breathing is the natural, optimal way to breathe most of the time, and involves expansion of the abdomen during inhalation (the diaphragm contracts and descends) and abdominal constriction during exhalation (the diaphragm relaxes and rises). This pattern can easily be observed when babies are sleeping or when a dog is lying on its side (see Figure 1).

In addition to providing gas exchange, breathing supports lymphatic and venous circulation in the abdomen. Full use of the diaphragm, through its push-pull effect on intraabdominal pressure, alternately squeezes and enhances the filling of veins and lymph vessels. This action benefits digestion, pelvic functions, and abdominal circulation in general (Haugstad et al., 2008). Yoga literature refers to the diaphragm's rhythmic massaging action on the viscera, facilitating peristalsis and circulation.

Reduced abdominal involvement in breathing is often associated with breathing difficulty or gastrointestinal distress, anxiety or panic, chronic pain, or breathing

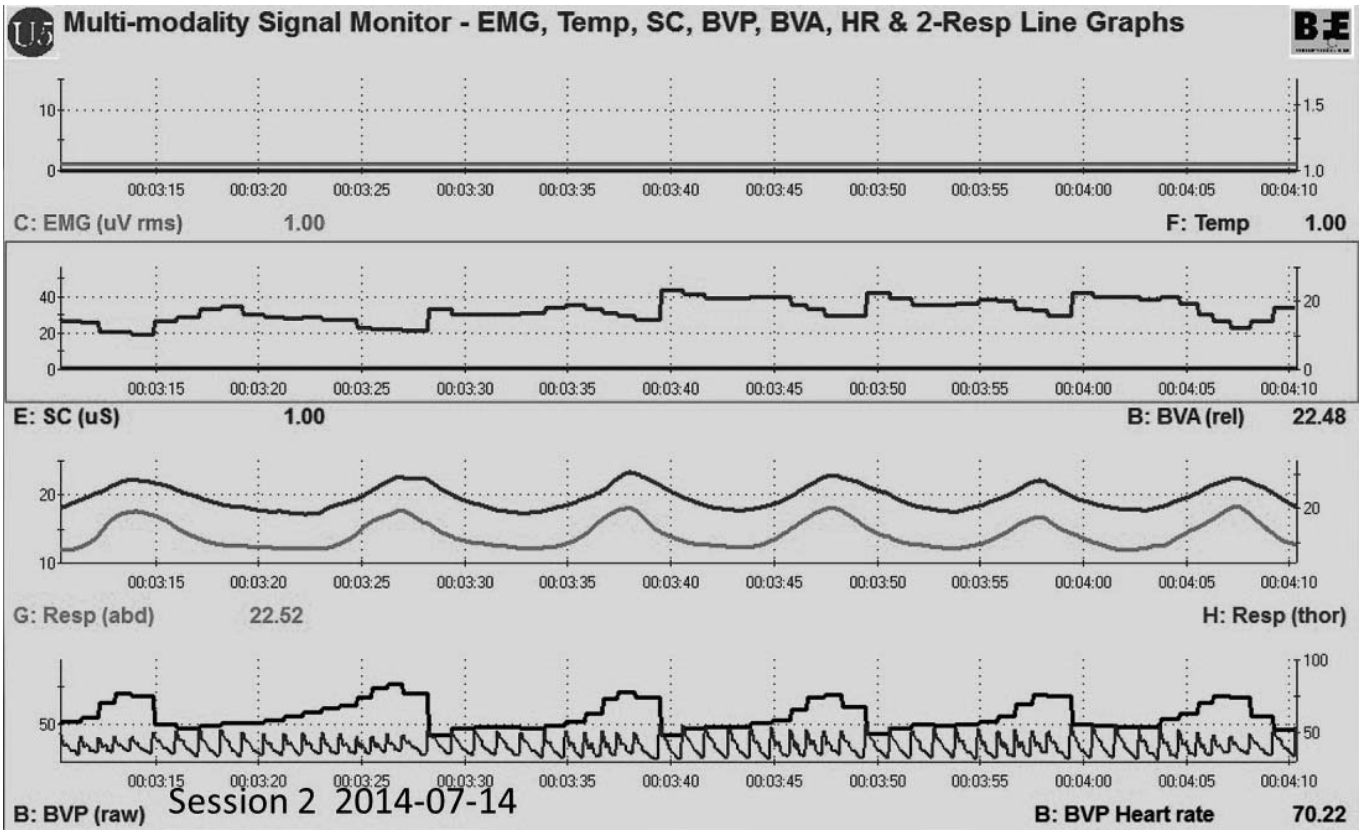

Figure 3. Improved breathing in a young man with seizures, showing mastery of diaphragmatic breathing (from Peper, 2015).

disorders such as asthma. Other factors contributing to decreased abdominal movement during breathing include:

- Clothing: The waist band/belt or slimming underwear (the modern girdle) is too tight and limits abdominal excursion sometimes labeled "designer jeans syndrome" (MacHose & Peper, 1991).
- Self-image: The individual sucks in the abdomen in an effort to look slim.
- Fear and panic: The external abdominal muscles tighten as part of the flexor/bracing response to danger, protecting the visceral organs, and also preparing the individual to run away from threat.

When postabdominal surgery patients immobilize their abdomen and shift to primarily thoracic breathing, their breathing usually becomes more rapid and shallow, and the work of respiration is now being done with neck, chest, and shoulder muscles (Ford, Whitelaw, Rosenal, Cruse, & Guenter, 1983). This breathing pattern that uses accessory inspiratory muscles of breathing may also include episodic sighing and/or hyperventilation. After-care following abdominal surgery, as noted before, has short-term goals and the effects may not persist after hospital discharge. Patients may be completely unaware of long-term changes in their breathing pattern because the resulting symptoms are subtle and not clearly related to breathing.

The benefit of reversing surgically related disuse of abdominal breathing is illustrated in the following two examples.

Example 1: Eliminating Psychogenic Epileptic Seizures

A 24-year-old male college student was referred for biofeedback training because he was experiencing 12 uncontrolled psychogenic epileptic seizures per week. His initial physiological assessment showed very rapid and shallow chest breathing, around 24 breaths per minute, as shown in Figure 2 (see the trace above "G: Resp (abd)").

His seizures started approximately one year following an appendectomy. After learning and generalizing effortless diaphragmatic breathing, he reported: "If immediately before I feel I would have a seizure, I would change my breathing technique and make sure I was

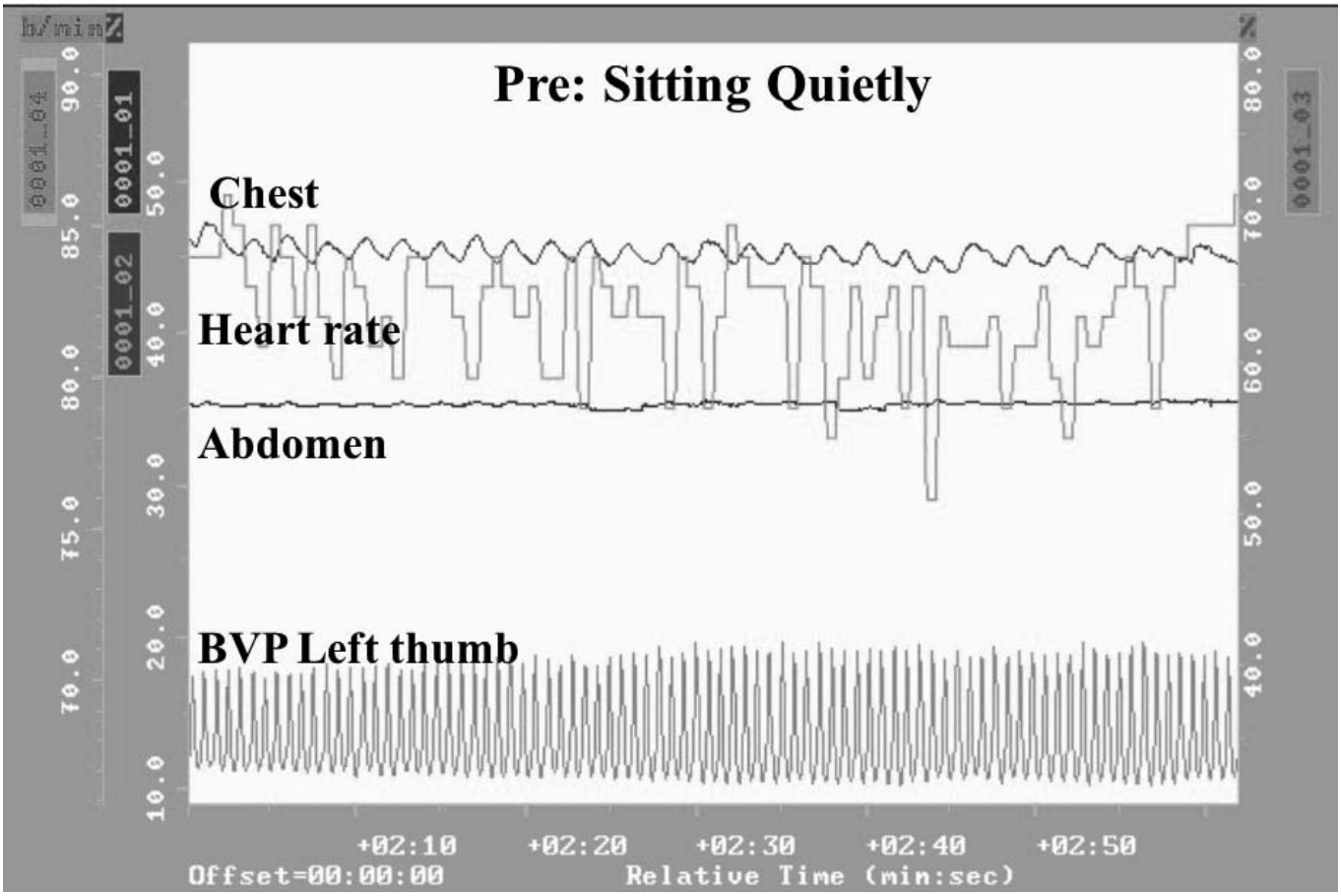

Figure 4. Example of habitual breathing pattern recorded from a 39-year-old woman with anxiety after a kidney transplant. This line graph shows rapid breathing and a near-total absence of abdominal movement 6 months after surgery (from Peper, Castillo, & Gibney, 2001a, 2001b).

breathing slowly and with my stomach, it would avoid the seizure from developing almost half of the time." The training included a holistic approach that also incorporated changing lifestyle and diet. After four sessions of training over a period of 3 months, his seizures decreased to zero; upon 1-year follow-up, he only had one more seizure during the Christmas holidays. He learned and generalized his rediscovered breathing skills as shown in Figure 3.

Example 2: Reducing Anxiety

A 39-year-old female was experiencing severe anxiety, chronic insomnia, and panic 6 months after she received a second kidney transplant following 20 years on hemodialysis. She breathed rapidly (around 25 breaths per minute) in her chest only, even when she "relaxed" (see Figure 4).

She was unaware that, following the kidney transplant, she was tensing her abdomen and breathing almost exclusively in her chest, presumably to avoid creating pain and/or triggering fear associated with the surgery. After she learned to breathe more with her diaphragm by allowing her abdomen to expand, she experienced a significant decrease in anxiety and her insomnia disappeared. In her case it was much more challenging to learn diaphragmatic breathing because she had formed the habit of keeping her abdomen tense following an earlier surgery more than 20 years previously. Nevertheless she did learn (slowly) to allow abdominal movement. Her breathing rate also dropped to around a third of what was shown in Figure 4, with more prominent respiratory sinus arrhythmia (RSA) and stronger blood volume pulse (BVP) as shown in Figure 5.

Discussion

Breathing primarily into the chest as a learned response to avoid pain from abdominal surgery or other injury can persist long after healing. This shallow chest breathing pattern puts the person at risk for the many symptoms associated with increased strain on the neck and shoulder

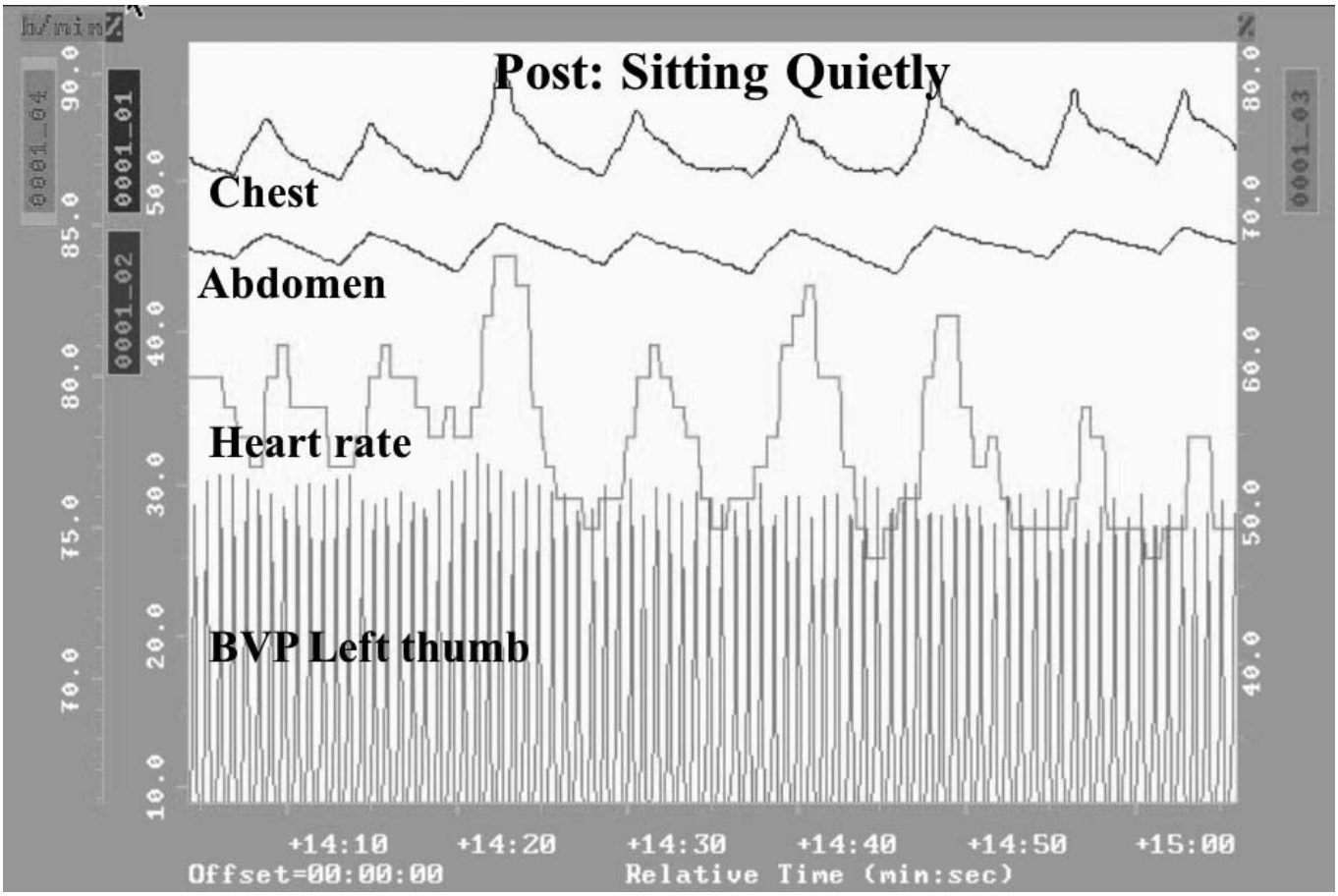

Figure 5. After diaphragmatic breathing retraining of the 39-year-old woman with kidney transplant, This line graph demonstrates significant abdominal movement and much slower breathing (from Peper, Castillo, & Gibney, 2001).

muscles, as well as hyperventilation. The two examples of epilepsy and anxiety suggest that the clients' symptoms may have been the result of inhibiting abdominal movement to avoid expected pain following abdominal surgery. Through biofeedback training focusing on diaphragmatic breathing, and home practice to reinforce learning to integrate effortless breathing into daily life, the two patients' health significantly improved.

There are two behavioral models for how learning affects the body's functionality that can help us understand how breathing dysregulation can be caused by "guarding behavior" following abdominal surgery: (a) constraint-induced movement therapy and (b) learned avoidance.

Constraint-Induced Movement Therapy

The first process of learned nonuse is best seen after a stroke affects one arm (Taub, Uswatte, Mark, & Morris, 2006). The natural instinct is to use the unaffected arm instead, but when that solution is blocked by constraining the good arm, patients must struggle to use the stroke-damaged arm. The constraint placed on the functional arm feels awkward at first (just as diaphragmatic breathing does); however, persisting stimulates recovery of stroke-affected arm and hand, which begin to function to the maximum extent possible. Without constraining the functional arm, the patient would simply use the good arm and never work to regain use of the stroke-affected arm.

The Learned Avoidance Model

From the perspective of learned-avoidance, disuse of abdominal breathing is not usually due to physical impairment, but rather inhibition due to fear of pain, or fear of stitches bursting at the incision site. Overcoming the inhibition of abdominal breathing due to fear of pain or aggravating wound healing may be similar to overcoming a fear of driving again after a collision: The process is scary at first, but ultimately comfortable.

The following is a quote that makes a relevant analogy.

> Getting in the car, I find myself starting these techniques almost immediately. Biofeedback training is wonderful because you learn techniques that can make challenging situations more manageable. For me, the best approach to any situation is to be calm and have peace of mind. I now have one more way to help me achieve this.
>
> —39-year-old woman who previously had anxiety after having a kidney transplant

Conclusions and Recommendations

During the intake interview for a chronic breathing problem, the clinician should always ask about prior abdominal surgery or injury, especially if abdominal movement was limited after the surgery or injury. If the answer is yes, explain that covert fear-avoidance involving expectation of pain or caution about bursting stitches at the site of surgery or injury could still be interfering with a natural breathing pattern that engages abdominal muscles. Discussing the possibility of dysregulated breathing may bring an unconscious breathing habit into consciousness, where effortless breathing can be understood and altered.

There are a few steps that are useful for encouraging effortless breathing patterns: (a) teach the person slow diaphragmatic breathing that incorporates some abdominal expansion during inhalation and passive constriction during exhalation; (b) caution against breathing too deeply to prevent unintentional hyperventilation and dizziness; and (c) recommend practicing effortless breathing patterns many times during the day, integrating it into everyday functioning. Using electronic tools that provide reminders or alerts (e.g., smartphone alarm applications) and linking brief practice periods to cues in the person's setting, such as when the phone rings or during meals, will facilitate integration of new skills into everyday settings. Relearning to breathe with natural abdominal expansion can reverse learned disuse and its myriad associated symptoms. If necessary, more specific biofeedback training using surface electromyography, a strain gauge to monitor respiration, or heart rate variability training techniques can be very helpful; however, helping the client to understand the underlying principle and its self-help remedy is most important.

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