The following article provides a description of the history and development of the biofeedback-assisted relaxation training (BART) program at Children’s Mercy Hospitals and Clinics. Biofeedback is an integral component of the multidisciplinary Abdominal Pain and Integrative Pain Management programs. A description of currently employed biofeedback-assisted relaxation training protocols, including alternative training tools (e.g., novel biofeedback games) intended to improve practice compliance is provided. Finally, biofeedback implementation strategies and barriers are considered also.

Introduction
The biofeedback program at Children’s Mercy Hospitals and Clinics (CMHC) was established in 2004 by the author (P.G.) as part of the Abdominal Pain Program (APP) in the Section of Gastroenterology. The APP is a multidisciplinary program focused on the assessment and treatment of children and adolescents with a variety of functional gastrointestinal disorders (FGIDs), including chronic abdominal pain, eosinophilic gastroenteritis, dyspepsia, and irritable bowel syndrome. Patients seen in the APP receive an extensive evaluation based on a biopsychosocial model of FGIDs. Treatments including medication, cognitive behavioral therapy, BART, and physical therapy are recommended when indicated.

Biofeedback Program History and Development
Drs. Craig Friesen and Jennifer Schurman, codirectors of the APP, were compelled by studies that found biofeedback to be efficacious for patients with recurrent abdominal pain (Blanchard & Scharff, 2002; Humphreys & Gevirtz, 2001) to incorporate biofeedback into the program’s multidisciplinary treatment approach. The program ultimately was launched with grant money donated to the APP; these funds supported a part-time biofeedback practitioner for 1 year and the purchase of basic equipment. Biofeedback has since provided patients with an adjunctive treatment option that has negligible side effects, improves coping skills, and facilitates a sense of self-efficacy.

The CMHC biofeedback-assisted relaxation training (BART) program was developed initially using adult stress management and relaxation protocols, including autogenic training, progressive muscle relaxation (PMR), diaphragmatic breathing strategies (Davis, Eschelman, & McKay, 1995), and Naparstek’s (1994) guided imagery, visualization, and “Special Place” techniques. The wording and length of the relaxation exercises were modified to fit two age groups, 8- to 12-year-olds and 13- to 18-year-olds. It became apparent that the modified PMR exercises were too long and involved for the younger age group. This led to the development of a series of quick relax methods (Mini-Relaxes) based on gentle stretch exercises utilized by physical therapists and yoga instructors. These exercises, along with deep breathing, have become the cornerstone relaxation methods for our patient population. The BART protocols have evolved over time with the addition of evidence-based practice strategies (Howard, 2003; Moss, Culbert, Kajander, & Reaney, 2003; Moss, Cyr, & Culbert, 2005; Schwartz & Andrasik, 2003), techniques derived from conference workshops (Culbert, Cyr, Kajander, & Banez, 2003; Gevirtz, 2004; Stroebel, 2003), and clinical experience.

Since the start of the program in 2004, biofeedback has been well received by patients, parents, and consulting physicians and has been shown to be efficacious in decreasing pain, anxiety, and insomnia (Schurman, Wu, Grayson, Columbo, & Friesen, 2008). Due to the positive outcomes, CMHC chose to continue the program beyond its start-up year and to support the training and certification of three additional biofeedback clinicians. Also as part of the BART program’s growth, services have been extended to patients with tension and migraine headaches, fibromyalgia, sickle cell disease, cystic fibrosis, and complex regional pain syndrome. Such referrals are received from the CMHC Integrative Pain Management program physician and psychologist.

Implementation of BART
Outpatient Practice
When a patient is referred for BART, the practitioner describes the program and protocols to the parent before...
scheduling an initial evaluation, emphasizing that self-regulation skills and symptom reduction are achieved with consistent attendance, the child’s participation during session, and compliance with home practice recommendations. Parental commitment is ascertained to ensure the child will be available for weekly sessions the first month and every other week for an additional 2 months, for an average of 8 to 10 sessions.

The initial evaluation lasts 90 minutes and begins with an explanation of the mind/body connection and the rationale for biofeedback training. The practitioner describes the biofeedback modalities, surface electromyograph (sEMG), peripheral skin temperature (TEMP), and skin conductance (SC), applies the sensors, and performs a stress profile. During the profile, the patient’s baseline stress level, his or her unique response to stressors, and ability to relax at will are measured. Profile results, intake information, and observations during the evaluation are used to formulate an individualized training protocol. However, every patient is taught diaphragmatic breathing and several Mini-Relaxes by the end of the first session. Mini-Relaxes include the “Ragdoll,” the “Elevator,” and “Stop, Drop, and Roll.”

The Ragdoll (see the Figure) is a simple, very brief stretch, yawn, and tension-release exercise that allows the patient to relax, anytime, anywhere. The Elevator, a rapid PMR exercise, takes less than a minute to perform, reduces general muscle tension, and improves kinesthetic awareness. The Stop, Drop, and Roll takes slightly longer than the aforementioned exercises but is especially good for releasing head, neck, and shoulder tension. Patients are encouraged to practice Mini-Relaxes a minimum of three times per day and when they feel anxious or experience discomfort or pain.

At the conclusion of the initial visit, patients are provided with folders containing written descriptions of the exercises, a personalized practice log, relaxation CD, stress control card, and colored dots. Included materials are intended to facilitate and support at-home practice of the biofeedback skills. Most patients find biofeedback intriguing and are willing to return for further training.

In the second session, patients begin their individualized training protocol. Typically, the protocol pathway chosen is based on the modality in which the patient showed the strongest response during the stress profile. Muscle (sEMG) responders are taught PMR and muscle tension discrimination exercises, and when readings reach objective goal levels, advance to visualization/guided imagery and heart rate variability (HRV). Autogenic training is added if indicated. Vascular (TEMP) responders begin with autogenic training, Mini-Relaxes, and diaphragmatic breathing and advance to visual/guided imagery and HRV. Vascular responders also may learn PMR. Patients with high SC focus more on diaphragmatic breathing and begin HRV feedback in the third session; other methods are introduced as needed.

Baseline readings are obtained at the beginning of each session to evaluate progress and to determine whether adjustments to the training protocol are needed. All patients are encouraged to use the EZ Air Plus™ program on a daily basis, starting the second or third session. The simple and engaging breath-pacing program facilitates habitualization of slower, deeper breathing and can be downloaded from the Biofeedback Foundation of Europe’s Web site (http://www.bfe.org) for a 30-day trial.

The majority of patients are eager to learn relaxation strategies to reduce anxiety and discomfort while in session, but some struggle with home practice. Several novel relaxation games have improved patients’ motivation for and compliance with home practice. The Wild Divine Project (Eldorado Springs, CO) developed a series of computer games (e.g., The Passage, Wisdom Quest, Healing Rhythms) that use SC and HRV readings to direct activities on a screen, teaching physiological control. The emWave PC™ (HeartMath), designed by Quantum Intech (Boulder Creek, CO), offers a variety of games that challenge players to focus on positive thoughts and feelings while using relaxed breathing to improve self-regulation skills. Practitioners emphasize that the games require a high level of self-regulation ability, and players will be more successful when they improve skills with regular

Figure. Instructions for training a child to perform “the Ragdoll.”

1) Begin with a 4/4 breath – four counts in, four counts out
2) The next time you breathe in, begin to tense your muscles from the bottom – up, really paying attention to how each part feels:
   - If sitting up with feet on the floor, then push your toes and heels into the floor. If relaxing with feet up, then point your toes downward and push your heels into the surface you are resting on (i.e., bed, chair)
   - Push your knees together
   - Push your bottom into the chair
   - Pull your stomach in
   - Gently arch your back
   - Raise your arms up over your head and STRETCH!!!
   - Stretch from the tips of your toes to the tips of your fingers and YAWN – a big yawn from deep in the back of your throat as you look up at the ceiling
   - Hold the stretch and yawn as long as you would like

3) DROP all the tension, collapsing like a loose, limp ragdoll
4) Shake out any tightness and repeat the exercise at least one more time
5) Close your eyes and scan your body for any tightness left in your body. If you notice any tension, repeat the exercise.

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home practice. Patients who follow recommendations and reach objective goals in all modalities are offered the opportunity to borrow a game for several months.

When training is completed, patients are encouraged to return for “brush-ups” at 3, 6, and 12 months. Some patients schedule yearly brush-ups to refresh their skills prior to especially stressful events, such as midterm and final exams, sports tournaments, and the start of a new school year.

**Inpatient Practice**

Having a patient in the hospital and available for frequent biofeedback sessions appeared, initially, to be an ideal situation for training. However, that proved to be a naïve assumption. Several barriers limited our success: Interruptions by medical personnel, visitors, and a seemingly endless number of other distractions frustrated practitioner attempts to teach relaxation. We tried enlisting staff assistance and placed large signs on patients’ doors announcing, “RELAXATION IN PROGRESS, PLEASE DO NOT DISTURB,” all with little impact. Personnel either did not see or ignored the sign. Parents volunteered to sit outside the door, acting as sentries to block entry; this was helpful but did not stop loud overhead pages, beeping monitors, or alarms.

Patient condition also may be problematic, limiting his or her ability to participate fully due to lack of sleep, medications, pain, or nausea. However, the most troubling factor we encountered was electrical artifact. Readings were erratic and suspect due to overwhelming electrical interference from lighting, TVs, DVDs, electric beds, infusion pumps, and cardiac and oxygen monitors.

Although these barriers cannot be avoided, inpatient biofeedback training can be conducted with some minor modifications. As in the outpatient setting, the practitioner provides patients with information on the mind-body connection, the rationale for biofeedback training, and an overview of the biofeedback protocol. Subsequently, diaphragmatic breathing and Mini-Relaxes are described, modeled, and practiced. The practitioner may use simple, portable, physiological monitors such as the SC911 digital TEMP trainer or the RESPeRATE™ (InterCure, Fort Lee, NJ) breathing device to pique patients’ interest and demonstrate that biofeedback can be fun as well as therapeutic. Patients are provided with a relaxation CD and a stress control card for temperature monitoring, and they are encouraged to practice the assigned relaxation tracks at least four times per day, including bedtime. We like to see inpatients at least twice a week, and weekly outpatient sessions are arranged upon discharge.

Whenever possible, however, arrangements are made for the inpatient to be transported to the outpatient clinic at a mutually convenient time. We have more control over the environment there, keeping it relatively quiet and more conducive to learning and relaxation, and we are able to use all of our physiological monitoring equipment. The biofeedback office is a short 5-minute wheelchair ride from the medical floors and patients sometimes are prescribed the 10- to 15-minute walk to our office as part of their treatment plan.

**Conclusion**

CMHC is committed to evidence-based practice, and in that vein, we have completed a pilot study comparing standard medical care (SMC) with SMC plus BART for patients with eosinophilic gastroenteritis. The preliminary data have been encouraging: Participants in the SMC plus BART group reported more significant decreases in pain duration and intensity compared with those in the SMC-only condition after 6 weeks of intervention (Schurman et al., 2008). Plans are currently in place to pursue a grant for a larger and more comprehensive study of the utility and efficacy of biofeedback training in patients with FGIDs.

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**References**


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