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Editorial

Pediatric Dysfunctional Elimination: Cars and Continence—Is Electricity the Future?

Electric cars are the future, and each year we've seen automakers add more EVs to their lineups. The same can be said for the treatment of pediatric bladder dysfunction. Electrical energy has been used to treat a variety of medical maladies for centuries. Its history as medical therapy is beyond the scope of this editorial; however, as early as 2500 BC, stone carvings depict Roman physicians using electric fish to treat conditions.[1] In AD 1745, the Leyden jar, which was able to store static electricity, was used to treat pain. In 1746, the German physicist Christian Kratzenstein was probably the first modern scientist to report therapy with electricity. He claims to have ameliorated paralysis by passing electric currents through the diseased part. During the remainder of the 1700s and 1800s, electrical stimulation was used to treat "convulsions and various palsies" using the earliest form of batteries. In the mid-20th century, the clinical application of electrical stimulation therapy became all but forgotten because of remarkable progress (revenue growth) in pharmaceutical drugs. In 1967 neurosurgeon C. Norman Shealy began implanting neurostimulators in humans for pain relief. Thus began the modern era of clinical neuromodulation.

In urology, electrical stimulation has been primarily used to treat a vast spectrum of voiding and pelvic floor disorders and in 1988, Schmidt and Tanagho began the discussions of urological applications in earnest.[2] They proposed neuromodulation and electrical stimulation of the sacral nerve. The term "neurostimulation" was later recoined to "neuromodulation," as experts in neurourology argued that electrical currents not only stimulate but also modulate the nerves involved in micturition.[2] The modern era of using neuromodulation to treat pediatric voiding disorders was initiated in 2001 by Hoebeke et al when they reported clinical effects of transcutaneous neuromodulation on refractory detrusor overactivity in children with the urge syndrome who failed anticholinergic therapy.[3] They concluded that transcutaneous neuromodulation could improve symptoms of detrusor overactivity with minimal complication. Since that time, numerous authors have reported the positive effects of neuromodulation, ranging from parasacral transcutaneous electrical nerve stimulation (PTENS), tibial nerve stimulation and implanted sacral nerve stimulators.

Bowel and bladder dysfunction (BBD) composes roughly 40% of the modern pediatric urology practice. It involves abnormalities in both bladder and bowel emptying. The mainstay of treatment has been urotherapy, biofeedback, and anticholinergic/alpha adrenergic medications. Increasingly, electrical nerve stimulation is being used to treat refractory cases. The children with refractory BBD are some of the most frustrating patients we, as pediatric urologists, see. There is often very little we can do to help them when standard treatment fails. Families, patients and providers are all frustrated. The children are embarrassed and bullied at school and have low self-esteem and depression. Their quality of life is often dismal, and they come to us for help.

Neuromodulation has given us another tool to help these children. In this issue of *The Journal of Urology®*, de Abreu et al (page 1785) discuss the use of parasacral transcutaneous electrical nerve stimulation to treat BBD in children and adolescents.[4] While most studies have looked at neuromodulation to treat refractory patients, this study looks at the use of PTENS as a primary adjunct to urotherapy. They demonstrated significant improvement in incontinence (though no better than urotherapy alone), but the big advantage was in the treatment of functional constipation, which we all know is a primary factor in bladder dysfunction. In a recent meta-analysis, O'Sullivan et al reported that PTENS is beneficial in children with LUTS[5] and the authors of this month's article have also shown that PTENS is an effective and safe treatment for overactive bladder. This modality requires patients to attend 20-minute treatment sessions 3 times weekly for a total of 20 sessions. This schedule can be quite onerous for the family and must be considered when considering treatment options.

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Some studies have promoted the use of transcutaneous posterior tibial nerve stimulation (TPTNS) in the treatment of pediatric BBD and have shown it to be an efficient, minimally invasive alternative in patients who do not respond to medical treatment. TPTNS provides a significant improvement on episodes of frequency, episodes of incontinence, overall and daytime Dysfunctional Voiding Scoring System (DVSS) scores, and quality of life scores.[6]

Several groups have reported excellent results with an implantable sacral neuromodulation device, and despite high reoperations rates, patients and families are very satisfied with this from of treatment. Dwyer at al reported "improvement" in symptoms and high patient satisfaction rate despite a high reoperation rate (>50%).[7] Our group has reported similar results with significant improvement and durable results especially in patients with detrusor overactivity and poor bladder emptying.[8] In addition, sacral nerve stimulation has been reported to be a promising and durable treatment for children with refractory constipation and fecal incontinence.[9] This treatment also appears to be time limited as device explanation for cure occurs with increasing likelihood after 2 years.[10] There is currently a multi-institutional study ongoing (Sacral Neuromodulation Alliance for Pediatric Patients) to further evaluate this modality.

In conclusion, our options for treating children with severe BBD are ever increasing. In 1910, Charles Potts, Instructor in Nervous Diseases at the University of Pennsylvania, wrote in JAMA about the "Practical Uses of Electricity in Medicine": "While it is true that electricity is an agent of much practical therapeutic value, it is also true that it is looked on with skepticism by a large number of the profession… some have in their enthusiasm made such extravagant claims on slight evidence that many have come to look on all claims made for it either with distrust, or attribute any beneficial results to its psychic influence alone." This is still painfully true today. We still have little insight into the mechanism of action for electrical stimulation, but there is no doubt that treatment successes occur whether from true physiological changes, placebo effect or both. Large players in the medical device arena are investing billions of dollars in bioelectronic medical research. Hopefully this investment will pay off in a better understanding of physiology and mechanism of action. In the meantime, we can still offer these modalities as viable treatment options. When severe BBD is successfully treated, we give these children a new lease on life. They often come into our offices with tears of joy. There is no greater satisfaction in medicine. We must continue to innovate and use our technology to help these patients. Kudos to de Abreu et al for taking another step in moving the ball forward.

John C. Pope IV
Division of Pediatric Urology
Monroe Carell Jr. Children's Hospital at Vanderbilt
Nashville, Tennesee

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