

Sacral nerve stimulation: 50 years in the making

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While it is true that sacral neuromodulation has only been approved for use in North America since 1997, the concept of sacral stimulation for “curing” voiding dysfunction first took shape almost 50 years ago. After the success of cardiac pacemakers in the 1960s, hopes were high that a number of body functions could be helped with electrical stimulation.¹ In the early 1970s, the National Institutes of Health began a comprehensive program involving numerous research centres and research disciplines. The goal was to achieve synergic voiding. Although that did not happen, intermittent voiding was achieved and the dawn of sacral nerve stimulation was upon us.^{1,2} In 1981, the University of California, San Francisco initiated the first clinical program on sacral neuromodulation (SNM) followed quickly by a large multi-centred trial from 1985 to 1992. In 1997, the Food and Drug Administration (FDA) granted Medtronic approval of the Interstim system for the treatment of urge incontinence in the United States and in 1999 the FDA approved Interstim for the treatment of symptoms of urgency-frequency syndrome and urinary retention.

Over the next 13 years, SNM has undergone a tremendous therapeutic evolution. There have been advances in treatment, including a tined lead, the use of fluoroscopic imaging and the smaller implantable pulse generators.³ The indications for SNM have also grown to include interstitial cystitis, chronic pelvic pain, fecal incontinence, constipation and neurogenic bladder.⁴⁻⁸ With these therapeutic changes researchers have searched for less invasive modalities to stimulate these sacral nerves. Posterior tibial nerve stimulation (PTNS) was first described in a small study in 1983 and was shown to inhibit bladder contractions for 2

to 3 days.⁹ This technology laid dormant until it was revived in the late 2000s when a large randomized double-blind controlled trial demonstrated it to be a safe, effective and viable treatment option for overactive bladder.¹⁰ Data for this non-invasive technology continue to accumulate with a multitude of excellent studies published over the last several years.^{11,12}

Elkelini and colleagues describe a rodent model that incorporates a novel transdermal amplitude-modulated signal (TAMS) as a non-invasive alternative to an implantable SNM to treat neurogenic detrusor overactivity.¹³ The results appear to demonstrate that the amplitude-modulated waveform is sufficient to overcome skin and tissue impedance and stimulate the sacral nerves. The authors demonstrate a decrease in the calcitonin gene-related protein (CGRP) concentration with neurostimulation and significant lowering of the cystometrogram threshold pressure ($p = 0.02$). Earlier studies using spinal cord injured rodents and SNM revealed a similar finding – lowered CGRP and elimination of bladder hyper-reflexia.¹⁴ Unfortunately for the authors, abolishment of uninhibited bladder contractions in their rodent model were not demonstrated. The results are still nonetheless, encouraging.

Perhaps, these non-invasive modalities, such as TAMS and PTNS, are the way of the future for treating voiding dysfunction. Many are skeptical that peripheral stimulation of nerves with retrograde migration of signal can actually affect various voiding patterns, despite the accumulation of robust evidence that supports this technology. Of course, these same skeptics likely didn't believe that we would be removing a prostate with the use of a robot or using lasers to obliterate stones and evaporate prostates. Whether these non-invasive technologies revolutionize the way urologists treat voiding dysfunction remains to be seen. Until then, to quote Charles Kettering: “Our imagination is the only limit to what we can hope to have in the future.”

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