TECHNICAL NOTE

First experiences with pudendal nerve stimulation in fecal incontinence: a technical report

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Abstract Sacral nerve stimulation (SNS) is an established treatment for refractory lower urinary tract and bowel dysfunction. In some urological patients, SNS does not have satisfactory results. Pudendal nerve stimulation (PNS) has recently been proposed for these patients and successfully tested. Given the sometimes unsatisfactory results after SNS in fecal incontinence (FI), we tested PNS on patients suffering from FI. We used the device and implantation technique described by Spinelli et al. By making a slight change in the device, we developed a quick and easy-to-use method for successful PNS implantation, based on electrophysiological response. We present the results of a feasibility study, in which we tested the effectiveness of PNS with our modified implantation technique on 2 patients, with very satisfactory early results in a 4-month follow-up.

Keywords Sacral nerve stimulation · Pudendal nerve stimulation · Bowel voiding dysfunction · Fecal incontinence

Introduction

Sacral nerve stimulation (SNS) is an established treatment for refractory lower urinary tract and bowel dysfunction with published failure rates of 20% and more for fecal incontinence and urinary bladder dysfunction [1, 2]. The lower success rates in some urological disorders have led to the search for alternative methods [3]. Spinelli et al. tested the possibility of pudendal nerve stimulation (PNS) in patients for whom SNS did not yield satisfactory results [3]. In their study, after a screening phase, a definitive impulse generator for PNS was successfully implanted in 12 out of 15 patients with neurogenic bladder dysfunction, resulting in total success or a significant reduction in incontinence. In 2007, a randomized study comparing PNS with SNS in patients with interstitial cystitis showed a similar or even better outcome in patients treated with PNS [4].

To our knowledge, PNS has not yet been tested in patients with fecal incontinence (FI). We therefore began testing the method described by Spinelli et al. [3]. We made a slight modification in the device, which resulted in a quick and easy-to-use method for PNS implantation. In a feasibility study, we achieved very promising results in our first 2 patients.

Methods

The pudendal nerve, one of the major nerves, which innervate the pelvic floor, derives its fibers from S2–S4. It innervates the pelvic floor muscles, the external anal sphincter and the external urethral sphincter. After passing through the intrapiriform foramen, it forms an arc around the ischial spine to reach the ischiorectal fossa through the lesser sciatic foramen. In Alcock’s canal, it divides into three branches: the perineal nerves, the inferior rectal nerves and the caudal portion, the first two of which are responsible for the sensory and motor innervation of the bulbocavernous muscle and external anal sphincter.
The idea behind PNS is to treat lower bowel disorders with more selective neural stimulation than is possible with SNS. Although the underlying neurophysiologic mechanisms are not completely understood, it is generally assumed that the effect must be based on the interaction of somatic and autonomic pathways within the spinal cord and higher centers [5].

We started by using the established device for SNS already used for PNS by Spinelli et al. [3]. The device was given an CE mark for PNS in 2008. However, we found the placement of the tined lead, which is usually inserted under fluoroscopy, more demanding given the absence of useful anatomic landmarks. We therefore modified the technique described by Spinelli et al. for the posterior approach [3]. With the patient in the prone position and under general anesthesia, the ischial spine on each side was marked by drawing two lines, one between the two greater trochanters and another extending cephalad from the tip of the ischial tuberosity. The latter two landmarks were easily found by palpation. The ischial spine was found at the intersection of the two lines (Fig. 2. Modified introducer sheath already in place). A 20-gauge insulated needle (model 141829; Medtronic, Minneapolis, USA) was inserted at this point to reach the pudendal nerve in Alcock’s canal. The surgeon’s gloved index finger was placed inside the rectum to guide the needle toward the nerve and to prevent rectal or vaginal injury. The needle was guided by the finger to the course of the pudendal nerve, which is well known to our surgeon from the pudendal nerve terminal motor latency measurement with the St. Mark’s fingertip electrode [6]. During that manoeuvre electrical stimulation was applied to the tip of the needle, leading to sphincter contraction. The surgeon’s finger was used to assess the motor response elicited, and the best position for the needle was determined by the maximum motor response. The reliability of this factor has already been evaluated for SNS by Dudding et al. [7]. As soon as the best stimulation position with the lowest possible stimulation amplitude (less than 1 V) was found, a guide wire was inserted into the needle after removal of the stylet and the needle was exchanged for an introducer (model 3550-18, Medtronic). The difficulty now was to insert the tip of the lead introducer exactly as far as the tip of the needle had been inserted, making it possible to introduce the elastic, blunt quadripolar tined lead electrode (model 3889, Medtronic) close to the nerve. Our modification of Spinelli’s technique consisted in cutting off a proximal section of the insulating introducer sheath (Fig. 3). At this point, we were able to attach the grip stimulation wire (model 041831, Medtronic) to the metal obturator and could thus apply electrical stimulation to the tip of the introducer, where the metal obturator touched the tissue (Fig. 2). When the stimulated tip of the metal obturator reached the nerve, pelvic floor contraction was
observed. The metal obturator was then removed and the quadripolar tined lead (model 3889, Medtronic) inserted. By consecutively stimulating the four poles, the one closest to the nerve was identified. The insulating plastic sheath was removed. Subcutaneous tunneling of the tined lead made it possible to connect it to either an external preliminary (model 3625, Medtronic) or an internal definitive impulse generator (model 3058, Medtronic).

Case reports

Our modified method was first tested on 2 patients, the first after failed SNS and the second as a primary treatment. We obtained the informed consent of both patients.

Case 1

A 70-year-old woman had been successfully treated with SNS for FI for 17 months. Originally, she had sphincter incontinence of multiple origins, involving a neurological insufficiency caused by Parkinson’s disease, as well as a complication of abdominal surgery. She had been suffering from at least 4 episodes of FI each day, which were frequently so severe as to be unmanageable with panty liners. After SNS implantation (amplitude 1.4 V), there were no more episodes of incontinence. Recently, the voltage amplitude had to be increased continuously in order to achieve constant continence. A pelvic X-ray, compared to the control image obtained directly after the implantation, showed displacement of the electrode. By applying increasing electrical stimulation to the SNS electrode, continence could be reestablished, but due to the high voltage the battery rapidly went flat and the impulse generator had to be exchanged. Given the voltage amplitude applied to the existing SNS electrode (3.4 V minimum), it would have been necessary to exchange the generator frequently in the future, with surgery required each time. The patient therefore agreed to have a PNS electrode implanted. The existing impulse generator with flat battery was exchanged during the same session and the new pudendal electrode connected directly to this stimulator. A bowel diary kept by the patient before and after surgery showed very good continence after implantation of the PNS electrode, with a remarkably lower voltage amplitude (0.7 V). So far, not a single episode of incontinence has been reported since implantation (4-month follow-up).

Case 2

A 77-year-old woman had been suffering from severe fecal and urinary incontinence since undergoing surgery of a thoracoabdominal aortic aneurysm with debranching 1 year previously. She remained housebound, suffering from complete loss of bowel control which made it necessary for her to change her panty liners up to 7 times a day. She claimed not to have had a single episode of continence during the past year, despite all medical treatment. She agreed to have an SNS or PNS electrode implanted. Intraoperative testing showed excellent pelvic floor contraction upon direct pudendal nerve stimulation with 0.4 V, whereas evaluation of the sacral foramina S3 and S4 on both sides showed poor motor response with high stimulation amplitude. A successful test period with PNS on the left side was followed by permanent implantation. PNS was very effective in treating both fecal and urinary incontinence, with no episodes of incontinence during the screening phase. The definitive impulse generator was therefore implanted after a 2-week screening phase. At follow-up, (currently 4 months), the patient has not yet reported any episodes of involuntary defecation.

Discussion

For the first time, we were able to show that it is possible to successfully treat patients with severe FI using PNS. With our modified device, percutaneous pudendal nerve stimulation can be easily performed, using a technique that does not require fluoroscopy.

Based on the use of PNS by Spinelli et al. for bladder dysfunction [3], we were able to successfully apply PNS in patients with FI for whom SNS treatment did not yield satisfactory results. The greater difficulty in placing the tined lead in the pelvic floor was overcome by positioning the lead introducer while under electric stimulation. To our knowledge, it has not yet been demonstrated in a clinical study that placement of the electrode is determined more precisely by electrical stimulation than by X-ray. However,
throughout the literature [3, 4], the best place for stimulation is found electrophysiologically and not radiographically. Further studies are needed to confirm this relationship.

We do not, however, recommend searching for the nerve using the lead introducer, because the greater diameter of the introducer compared to the stimulated foramen needle will cause increased tissue damage. The position of the nerve is identified by the foramen needle as usual, but exact placement of the tined lead can be facilitated by positioning the introducer tip under stimulation.

As already discussed by Spinelli et al. [3], neurogenic disorders may form a subgroup for which PNS will yield better results than SNS. However, as Peters et al. showed in their study on interstitial cystitis [4], PNS may also prove to be superior to SNS in treating some non-neurogenic disorders. The good effects of PNS may be explained by the more selective stimulation of nerve fibers innervating the external urethral and external anal sphincter muscles.

It has yet to be determined which lower bowel disorders might be treated most successfully with PNS rather than SNS. Dudding et al. analyzed predictive factors for successful SNS stimulation in 2007 and could not find any significant differences between the subgroups idiopathic, obstetric, postsurgical and miscellaneous [7]. However, Peters et al. tested PNS versus SNS in a randomized study on interstitial cystitis with an overall success rate of 77%, in which 76% of the successfully stimulated patients reported that PNS yielded better results [4].

As regards our 2 patients, we found a possible explanation of why PNS worked and SNS did not. In the first patient, the cause of ineffective SNS may have been presacral fibrosis and/or damage done to the plexus by the former surgery, while in the second patient, the probable cause was placement of the electrode closer to the nerve. So far, it has not been necessary to increase the voltage amplitude for either patient.

Given the fact that it has not yet been clearly determined which subgroups are best treated by SNS or PNS, patients in whom one method has failed should be candidates for the other. This approach may yield more satisfactory results and lead us to understand more exactly which patients may profit from which method in the long term.

Conclusion

To our knowledge, there are as yet no published studies of PNS in FI. The results of our first experience, albeit with only 2 patients, are very satisfactory. Moreover, the more selective stimulation of the pudendal nerve may even require a lower stimulation amplitude and thus prolong battery life. As far as surgical access for PNS is concerned, our method represents a quick and easy minimally invasive way for placement of the electrode, even without fluoroscopy.

Further research is required in order to demonstrate the benefits of PNS in FI and determine the best stimulation parameters.

References