Sacral Nerve Stimulation for Treatment of Intractable Pain Associated with Cauda Equina Syndrome

Jong-Hoon Kim, M.D., Joo-Chul Hong, M.D., Min-Su Kim, M.D., Seong-Ho Kim, M.D., Ph.D.
Department of Neurosurgery, College of Medicine, Yeungnam University, Daegu, Korea

Sacral nerve stimulation (SNS) is an effective treatment for bladder and bowel dysfunction, and also has a role in the treatment of chronic pelvic pain. We report two cases of intractable pain associated with cauda equina syndrome (CES) that were treated successfully by SNS. The first patient suffered from intractable pelvic pain with urinary incontinence and fecal incontinence after surgery for a herniated lumbar disc. The second patient underwent surgery for treatment of a burst fracture and developed intractable pelvic area pain, right leg pain, excessive urinary frequency, urinary incontinence, voiding difficulty and constipation one year after surgery. A SNS trial was performed on both patients. Both patients’ pain was significantly improved and urinary symptoms were much relieved. Neuromodulation of the sacral nerves is an effective treatment for idiopathic urinary frequency, urgency, and urge incontinence. Sacral neuromodulation has also been used to control various forms of pelvic pain. Although the mechanism of action of neuromodulation remains unexplained, numerous clinical success reports suggest that it is a therapy with efficacy and durability. From the results of our research, we believe that SNS can be a safe and effective option for the treatment of intractable pelvic pain with incomplete CES.

KEY WORDS : Sacral Plexus - Neuromodulator - Pain - Cauda Equina.
MN, USA) was placed percutaneously using a dorsal approach through the right S3 foramen (Fig. 1). The predicted S3 foramen location was a line connection the inferior border of the bilateral sacral iliac joint. The point of lead insertion was approximately 1.5 cm above the marked location of S3. During the procedure, stimulation produced a contraction of the pelvic floor as well as plantar flexion of the great toe, and adjacent toes, so confirming the location of S3 root. Her pain was significantly relieved from 9 to 3 on VAS and her urinary incontinence was reduced during the trial period. And, the sensory at saddle area was recovered moderately. After that, she underwent surgical implantation of a permanent pulse generator which was placed in right lower quadrant of abdominal subcutaneous layer (Fig. 2). Last stimulation parameters programmed in this patient were as followed: electrode, 2(-), 1(+); pulse width, 300 μsec; rate, 54 Hz; amplitude, 3.8 V. In last follow-up 18 months after the operation, her pain maintained a score of 4 on VAS without medications. Activities of daily life were restricted by her pain, but she is performing a daily life without an inconvenience at present.

**Case 2**

A 58-year-old female patient suffered an L1 burst fracture and underwent surgery (transpedicular screw fixation on T11, T12, L1, L2) one year prior to presentation. She developed intractable pelvic area pain, right leg pain, urinary frequency, urinary incontinence, voiding difficulty and constipation. She was taking oral codeine, acetaminophen, ibuprofen, and gabapentin (1,800 mg/day). Her pelvic and right leg pains were 10/10 on VAS prior to undertaking a SNS trial (Fig. 3). NCS, EMG and SSEP finding was bilateral polyradiculopathy with sacral arc lesion, clinically, cauda equina syndrome. The procedure was same as Case 1. After a week, her pain was relieved, down to 5 on VAS, and her urinary frequency was much improved. She decided to have a
permanent pulse generator implanted. After that, she underwent surgical implantation of a permanent pulse generator which was placed in right lower quadrant of abdominal subcutaneous layer (Fig. 4). Last stimulation parameters programmed in this patient were as followed: electrode, 1(+), 2(-); pulse width, 330 μsec; rate, 50 Hz; amplitude, 3.6 V. In last follow-up 20 months after the operation, her pain maintained at 5 on VAS with intermittent medication. The result of psychiatric test was depressed mood, but it was much improved postoperatively.

DISCUSSION

In 1997, sacral nerve modulation (InterStim, Medtronic, Minneapolis, MN, USA) was approved by the Food and Drug Administration for urinary urge incontinence, urinary urgency-frequency, and nonobstructive urinary retention. The major frontiers for sacral neuromodulation in adults are interstitial cystitis and chronic pain syndromes (pelvic pain, prostatodynia, epididymo-orchalgia, and vulvodynia), neurogenic bladder from spinal cord injury, fecal incontinence, and erectile dysfunction. The mechanism of action of sacral neuromodulation remains uncertain. The mechanism of action of direct spinal cord stimulation is generally assumed to be based on the gate control theory of Melzack and Wall. Sacral nerve stimulation for the control of pain is thought to work by a similar mechanism.

Surgical implantation of a permanent pulse generator with follow-up ranges up to 14 years. Ripetti et al. reported that neuromodulation improves incontinence and obstructive defecation symptoms. Ganio et al. showed sacral neuromodulation decreases the number of unsuccessful defecation attempts and reduces the difficulty of defecation. In addition, Gstaltner et al. retrospectively studied 11 patients suffering from flaccid paresis of the anal sphincter muscle and fecal incontinence caused by CES. They reported that, in the case of flaccid paresis of the anal sphincter muscles caused by an incomplete CES, permanent SNS offers a promising option for the treatment of fecal incontinence.

In each of our cases, the patient suffered from intractable pelvic pain, urinary incontinence and fecal incontinence. Clinical signs accompanying CES may differ in each individual patient but the fully developed syndrome is characterized by low-back pain, bilateral sciatica, pelvic hypeaesthesia or anaesthesia, motor weakness of the lower extremities, impairment of anal, bulbocavernous, medioplantar, and Achilles’ tendon reflexes bilaterally, rectal and bladder sphincter dysfunction, and sexual impotence. Although a precise definition of CES has not been well established, most authors believe that an element of bladder dysfunction is required for the diagnosis. We believe that SNS can be effective in these patients. However, there are limitations and precautions for the use of SNS in CES patients. If the sacral parts of the spinal cord or all the responsible sacral nerves are completely transected, the stimulation will not be effective. It is quite difficult to distinguish between complete and incomplete CES. Also, it is uncertain what degree of injury is best treated by SNS. Therefore, indications for the appropriate use of SNS should be considered.

CONCLUSION

SNS is simple, non-destructive and reversible. We suggest that this procedure may be an effective treatment option with low morbidity for the management of patients with intractable pain with combined urinary or fecal dysfunction associated with CES. It remains difficult to predict which patients will most benefit from this treatment. Longer follow-up periods with more cases are needed to fully validate efficacy of this treatment.
Acknowledgements
This research was supported by the Yeungnam University research grants in 2008.

References
1. Ahn UM, Ahn NU, Buchowski JM, Garrett ES, Sieber AN, Kostuik JP: Cauda equina syndrome secondary to lumbar disc herniation: a meta-analysis of surgical outcomes. Spine (Phila Pa 1976) 25: 1515-1522, 2000
2. Aho AJ, Auranen A, Pesonen K: Analysis of cauda equina symptoms in patients with lumbar disc prolapse. Preoperative and follow-up clinical and cystometric studies. Acta Chir Scand 135: 413-420, 1969
3. Aló KM, Holsheimer J: New trends in neuromodulation for the management of neuropathic pain. Neurosurgery 50: 690-703; discussion 703-704, 2002
4. Bernstein AJ, Peters KM: Expanding indications for neuromodulation. Urol Clin North Am 32: 59-63, 2005
5. Comiter CV: Sacral neuromodulation for the symptomatic treatment of refractory interstitial cystitis: a prospective study. J Urol 169: 1369-1373, 2003
6. Everaert K, Kerckhaert W, Caluwaerts H, Audenaert M, Vereecke H, De Cuypere G, et al.: A prospective randomized trial comparing the 1-stage with the 2-stage implantation of a pulse generator in patients with pelvic floor dysfunction selected for sacral nerve stimulation. Eur Urol 45: 649-654, 2004
7. Floman Y, Wiesel SW, Rothman RH: Cauda equina syndrome presenting as a herniated lumbar disk. Clin Orthop Relat Res: 234-237, 1980
8. Ganio E, Masin A, Ratto C, Altomare DF, Ripetti V, Clerico G, et al.: Short-term sacral nerve stimulation for functional anorectal and urinary disturbances: results in 40 patients: evaluation of a new option for anorectal functional disorders. Dis Colon Rectum 44: 1261-1267, 2001
9. Gstalmer K, Rosen H, Hufgard J, Mörk R, Schrei K: Sacral nerve stimulation as an option for the treatment of faecal incontinence in patients suffering from cauda equina syndrome. Spinal Cord 46: 644-647, 2008
10. Kostuik JP, Harrington I, Alexander D, Rand W, Evans D: Cauda equina syndrome and lumbar disc herniation. Bone Joint Surg Am 68: 386-391, 1986
11. Matzel KE, Lux P, Heuer S, Besendörfer M, Zhang W: Sacral nerve stimulation for faecal incontinence: long-term outcome. Colorectal Dis 11: 636-641, 2009
12. Mayer RD, Howard FM: Sacral nerve stimulation: neuromodulation for voiding dysfunction and pain. Neurotherapeutics 5: 107-113, 2008
13. Melzack R, Wall PD: Pain mechanisms: a new theory. Science 150: 971-979, 1965
14. Orendáková J, Cázková D, Kafka J, Lukácová N, Marsala M, Sulla I, et al.: Cauda equina syndrome. Prog Neurobiol 64: 613-637, 2001
15. Ripetti V, Caputo D, Ausania F, Esposito E, Brunì R, Arullani A: Sacral nerve neuromodulation improves physical, psychological and social quality of life in patients with fecal incontinence. Tech Coloproctol 6: 147-152, 2002
16. Siegel S, Paszkiewicz E, Kirkpatrick C, Hinkel B, Oleson K: Sacral nerve stimulation in patients with chronic intractable pelvic pain. J Urol 166: 1742-1745, 2001
17. Shapiro S: Cauda equina syndrome secondary to lumbar disc herniation. Neurosurgery 32: 743-746; discussion 746-747, 1993
18. Vastenholt JM, Snoek GJ, Buschman HP, van der Aa HE, Allerme ER, Ijerremann MJ: A 7-year follow-up of sacral anterior root stimulation for bladder control in patients with a spinal cord injury: quality of life and users’ experiences. Spinal Cord 41: 397-402, 2003
19. Vignes JR, De Seze M, Dobremez E, Joseph PA, Guerin J: Sacral neuromodulation in lower urinary tract dysfunction. Adv Tech Stand Neurosurg 30: 177-224, 2005