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Epidural spinal cord stimulation for neurogenic bladder

Tasuku Wainai[1], Norimasa Seo[1], Takanori Murayama[2], Yuki Sato[1], and Masaaki Sato[1]

[1] Department of Anesthesiology, Jichi Medical School, 3311-1 Yakushiji, Minamikawachi-machi, Kawachi-gun, Tochigi 329-0498, Japan
[2] Department of Anesthesia and Intensive Care, Omiya Medical Center, Saitama, Japan

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Introduction

Epidural spinal cord stimulation (ESCS) with a percutaneously inserted catheter electrode has produced symptomatic relief of deafferentation pain and vasculopathic pain as well as pain produced by spinal cord trauma, damage to nerve roots or peripheral nerves, and failed back surgery. Other applications of ESCS include urinary incontinence and occipital neuralgia [1]. We present a case in which ESCS was used successfully for the treatment of a neurogenic bladder.

Case report

A 28-year-old man had a 6-month history of urinary incontinence with a urinary frequency of 15–20 times/day and enuresis. His symptoms were thought to be secondary to an incomplete recovery from transverse myelitis, a complication of measles encephalomyelitis that he had one and a half years previously. A urologist diagnosed his case as urge urinary incontinence on the basis of his symptoms. He appeared alert and had no gait disturbance. Neurological examination showed a decrease in superficial sensation below the level of L1 and an increased knee jerk reflex, despite the presence of normal nerve conduction and normal muscle power in the lower extremities. Magnetic resonance imaging of the spinal cord revealed no abnormalities.

The administration of drugs such as oxybutynin hydrochloride (a vagolytic agent) and tamsulosin hydrochloride (an α1-adrenoreceptor blocker) had not alleviated his condition for 6 months. ESCS was proposed because electrical stimulation of the pelvic floor has been reported to be effective in treating an uninhibited overactive bladder [1]. The method and its risks, including the possibility of spinal cord damage, were fully explained to the patient.

Epidural electrodes (Pisces, Medtronic, New York, NY, USA) were introduced under local anesthesia into the posterior epidural space at the level of L2/3, and advanced rostrally up to the T12 level using fluoroscopic examination and intermittent electrical stimulation to confirm proper positioning. The catheter electrodes were fixed at the point at which the stimulator produced a sensation in the perineal region.

After insertion, the patient was instructed in self-administration of ESCS for periods of 30 min four times per day for 1 week. The pattern of stimulation could be adjusted by manipulating the dial of the stimulator. The parameters of stimulation were 0.1-ms duration, 100-Hz frequency, and 20 V.

The 1-week trial of ESCS led to a decrease in the sensation of urinary urgency and diminished urinary frequency to five times per day with an increase in voiding volume (from 30 ml to 155 ml after ESCS). Based on these results, the antenna-receiver system for the cordless generator (Pisces) was implanted permanently. A marked improvement in dysuria was confirmed about 6 months after the implantation by a urodynamic study of cystometry and uroflowmetry (Figs. 1 and 2). The successful treatment by ESCS was continued.

Discussion

ESCS appeared to play an important role in ameliorating the patient's dysuria, because spontaneous recovery

Address correspondence to: N. Seo
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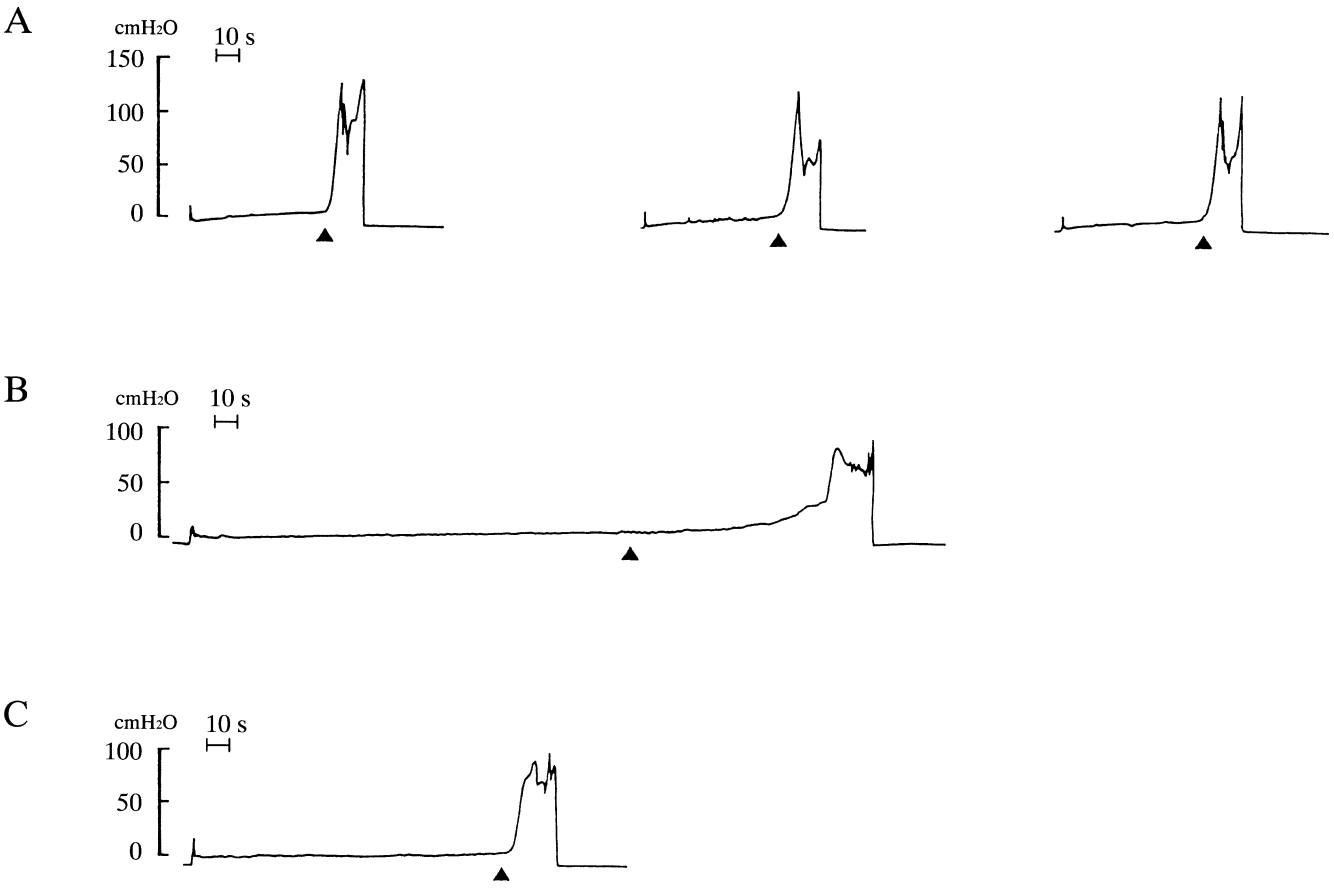

Fig. 1. Cystometrogram. The abscissae indicate the time elapsed after the start of the continuous insufflation of carbon dioxide (100 ml/min) to the bladder. The ordinates indicate the internal pressure of the bladder. The *solid triangle* denotes the initial desire to void. **A** Control. The abrupt increase of internal pressure after the initial desire to void. **B** During epidural spinal cord stimulation (ESCS). The initial desire to void began at 141 ml and the maximum desire to void was observed at 183 ml. The uninhibited contraction of the detrusor disappeared. **C** Two minutes after interruption of ESCS. The initial desire to void began at 94 ml, suggesting a persistent effect of ESCS

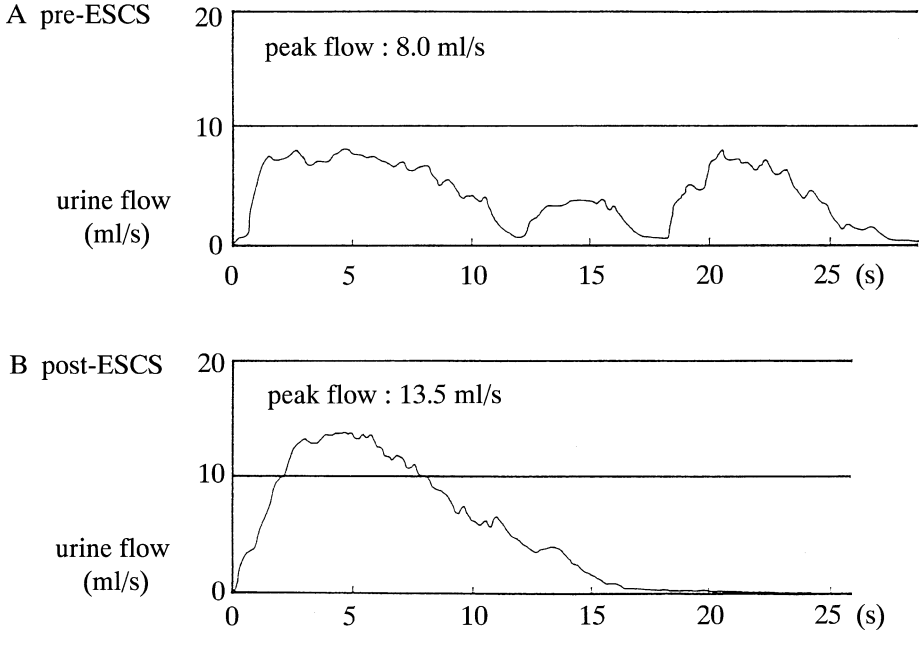

Fig. 2. Uroflowmetrogram. The ordinates indicate the urine flow (ml/s). **A** Pre-ESCS. The continuous polyvertex pattern and lack of residual urine volume indicated hyperreflexia with coordinated sphincters. This finding suggested incomplete damage to the spinal cord above the sacral segments. **B** Six months after the application of ESCS. The single vertex pattern was normal and the peak flow rate was improved

from long-standing dysuria caused by spinal cord damage is rarely encountered. Some mechanisms for the analgesic and vasodilating action of ESCS have been proposed, but none of them would explain the alleviation of urinary incontinence and sense of urgency in this case.

Several types of therapeutic electrical stimulation of the pelvic floor have been reported to be effective in treating incontinence. Anal or vaginal plugs, surface electrodes, or implanted wire electrodes are variously used [2–4]. Such induced electrical stimulation may reflexively depress the hyperactivity of the bladder by stimulating the pelvic and hypogastric nerves. In this case, ESCS may have depressed the hypertonic bladder in the same manner because the electrodes had been fixed where the patient felt the stimulus in the perineal region. However, the mechanism of action of ESCS in such treatment remains to be determined.

In conclusion, because the method is simple and is performed safely and easily, we propose ESCS as one of the treatments for drug-resistant incontinence related to hyperreflexia.

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