Sacral Neuromodulation as a Treatment for Chronic Pelvic Pain

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Purpose: Chronic pelvic pain syndrome is a debilitating disease which often has a major impact on quality of life. A significant number of patients do not respond to conservative treatment and often no good alternative can be offered except radical surgery. Sacral neuromodulation is a well established therapy for patients with lower urinary tract dysfunction. This therapy has also been suggested to be useful in the treatment of chronic pelvic pain. Although currently no Food and Drug Administration approval exists for this indication, several studies have demonstrated promising results. We provide an overview of the published literature on sacral neuromodulation as a treatment for chronic pelvic pain.

Materials and Methods: A PubMed® search was performed to identify articles in English from 1990 to February 2010 reporting treatment of pelvic pain with sacral neuromodulation. In addition, the current definitions of pelvic pain syndromes and the mechanisms of action are discussed.

Results: A total of 12 relevant articles were identified. Of these articles 10 mainly addressed the efficacy of sacral neuromodulation in patients with interstitial cystitis/bladder pain. The percentage of patients who responded to test stimulation was reported between 51% and 77%. Of the 10 articles 7 reported treatment outcome after implantation. The duration of followup ranged between 5 and 87 months. The mean reduction in pain scores was reported between 40% and 72%. The reoperation rate ranged between 27% and 50% after long-term followup. Two articles included patients with miscellaneous urogenital pain syndromes. The success rates after implantation ranged from 60% to 77% with followup ranging between 19 and 36 months.

Conclusions: Currently there is insufficient evidence to determine the role of sacral neuromodulation in the treatment of chronic pelvic pain. Larger prospective trials with long-term evaluation are required to determine the ultimate efficacy of this treatment.

Key Words: electric stimulation therapy, urinary bladder, pelvic pain

Abbreviations and Acronyms

BPS = bladder pain syndrome
CPP = chronic pelvic pain
FDA = Food and Drug Administration
IC = interstitial cystitis
ICPI = Interstitial Cystitis Problem Index
ICSI = Interstitial Cystitis Symptom Inventory
PNE = percutaneous nerve evaluation
PNS = pudendal nerve stimulation
PTNS = posterior tibial nerve stimulation
SNM = sacral neuromodulation
VAS = visual analog scale

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CHRONIC pelvic pain syndrome is a debilitating disease which often has a major impact on quality of life.[1,2] There are often associated negative cognitive, behavioral, sexual and emotional consequences. This clinical condition presumably has a multifactorial etiology and patients with CPP often tend to undergo a multitude of treatments to control symptoms.[3] However, a subset of patients do not respond to conventional treatments. Patients with BPS or IC are often faced with the decision to undergo radical surgery such as urinary diversion or bladder augmentation. Unfortunately these major interventions are associated with significant morbidity and often these treatments fail to alleviate pain symptoms.[4,5] As many as 50% of pa-

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tients who underwent cystectomy for interstitial cystitis continue to have pelvic pain, presumably secondary to the centralization of pain.[6]

Currently, minimally invasive treatments have been suggested as possible alternatives in the treatment of CPP. These include SNM and intravesical injections with botulinum toxin. Both treatments have shown positive results in the treatment of overactive bladder syndrome and SNM has previously gained FDA approval for this indication.[7–10] In recent years several studies have evaluated the efficacy of sacral neuromodulation in the treatment of CPP. To assess the current evidence for this indication we reviewed the published literature on sacral neuromodulation for chronic pelvic pain. In addition, the current definitions of CPP and the possible mechanism of action are discussed.

MATERIALS AND METHODS

A literature search was conducted using PubMed. Relevant articles in English regarding sacral neuromodulation for the treatment of chronic pelvic pain were identified. This included patients with IC/BPS as well as those with nonspecific pelvic pain symptoms (eg genital, urethral, perineal pain). In this review the emphasis was on studies that evaluated transforaminal S3 nerve root stimulation. Studies that evaluated other neuromodulatory techniques were discussed separately. Relevant articles were selected from these searches and the reference lists from the identified articles were checked for additional sources. The search terms used were sacral neuromodulation or sacral nerve stimulation. These terms were combined using "and" with the term pain. This resulted in a search count of 70 and 145, respectively. The search was specified by using the terms pelvic pain, bladder pain, interstitial cystitis, urogenital pain and genital pain. All clinical trials, meeting abstracts and case reports were reviewed. Only the results of clinical trials were reported. The last search was performed in October 2010.

Definitions

Identifying the location and cause of chronic pelvic pain is complex because the visceral innervation of the pelvic structures shares common pathways along the sacral plexus.[11] Therefore, it is difficult to properly define CPP. The latest European Association of Urology guidelines on chronic pelvic pain include a classification system in which pain syndrome terms are introduced to emphasize the heterogeneity of the concept CPP, and to indicate the multiple physical and psychological mechanisms involved.[12] According to these guidelines chronic pelvic pain is defined as nonmalignant pain perceived in structures related to the pelvis. In the case of documented nociceptive pain that becomes chronic, pain must have been continuous or recurrent for at least 6 months. The pain can be associated with symptoms suggesting lower urinary tract, sexual, bowel or gynecologic dysfunction. Urological pelvic pain syndromes are divided into bladder pain syndrome, urethral pain syndrome, penile pain syndrome, prostate pain syndrome and other. In 2007 the European Society for the Study of Interstitial Cystitis proposed the term bladder pain syndrome as more accurate terminology.[13] The term interstitial cystitis assumes a special type of chronic inflammation of the bladder, whereas BPS refers to pain perceived in the bladder region. Moreover inflammation or the presence of Hunner's ulcers on cystoscopy with hydrodistention is an important feature in only a few patients. The increase in pain on bladder filling was left out of the description because this association is not always present. Although persistent urge to void or frequency are included as typical symptoms in the definition, it must be emphasized that the presence of these symptoms is not necessary to suspect or diagnose BPS.

Mechanism of Action

Neuromodulation has been used for many years as a treatment for various chronic pain conditions. The most accepted neuromodulatory technique is spinal cord stimulation, in which electrical signals are delivered to the spinal cord by electrodes in the epidural space. In addition, peripheral nerve stimulation has been successfully used for various indications such as posttraumatic and postoperative neuropathy, occipital neuralgia and chronic regional pain syndromes.[14] Peripheral nerve stimulation is likely to recruit a larger number of nerve fibers for the purpose of activating inhibitory interneurons than spinal cord stimulation, which exerts its effect through layers of dura and cerebrospinal fluid. It also permits the recruitment of primary afferent delta fibers, which project to the spinothalamic tract and probably not to the dorsal column.[15]

The etiology and pathophysiology of chronic pelvic pain remain a mystery, although central neurological mechanisms are probably involved. There are suggestions that dysregulated central nervous system responses may have a major role in the etiology.[3,12] These dysregulated responses may maintain the perception of pain in the absence of acute injury. In addition, these changes may magnify perception in such a manner that nonpainful stimuli are perceived as painful and painful stimuli may be perceived as stronger than normal.[12] Therefore, it has been suggested that therapies aimed at modulating the nervous system such as centrally acting medications, PTNS and SNM might be effective. A possible working mechanism for neuromodulation in the treatment of pain is based on the gate control theory. This theory states that pain perception depends on a pattern of peripheral nervous input. It is believed that a gate control mechanism at the spinal segment level is present which regulates the interaction between afferent nerve signals and pain sensation.[16] Interneurons of the spinal cord dorsal horn create gating components, and inhibition or facilitation of afferent fibers modulates the input to the spinal transmission neurons. Furthermore, it is believed that the impulses from the dorsal horn are controlled by a descending system containing fibers from the brainstem, thalamus and limbic lobes.[17] Neuromodulation is believed to restore the control at the spinal segmental gate as well as at supraspinal sites such as the brainstem and the limbic system nuclei.