Spinal Cord Stimulation, Conception, Pregnancy, and Labor: Case Study in a Complex Regional Pain Syndrome Patient

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ABSTRACT

Introduction. Interventional modalities for pain treatment are reserved for patients failing multidisciplinary pain management, including psychological, physical, pharmacological, and anesthetic techniques. The purpose of this study is to find out whether spinal cord stimulation may be safe during conception, pregnancy, and delivery.

Objective. Medications for intractable pain may be unacceptable because of the risk of teratogenic effects. The indication for SCS in patients otherwise successfully managed with non-interventional modalities for pain control.

Materials and Methods. We report a 30-year old, female, neonatal nurse who developed left hand burning pain, swelling, coldness, and weakness following a mild brachial plexus injury in a motor vehicle accident. The patient responded well to a combination of Neurontin, Trazadone, Ultram, and Vicodin. A year later, the patient married and wanted to become pregnant but was afraid of possible teratogenic effects of the medications. Therefore, she requested an interventional modality for control of her symptoms. We recommended spinal cord stimulation (SCS) based on our excellent experience with this modality in the management of complex regional pain syndromes (CRPS). However, we did inform the patient that no data had been published regarding the safety of this modality in pregnancy and labor.

Results. Cervical SCS resulted in excellent pain control and discontinuation of the medications. Thirteen months later, she delivered a healthy five pound baby girl. Mother and baby were discharged home in two days. The SCS was not turned off at any time during the labor and delivery.

Conclusion. SCS was safe for implantation in our case study of a pregnant woman. This may constitute a new indication for SCS in patients otherwise successfully managed with non-interventional modalities for pain control.

Key Words: Brachial plexus injury, causalgia, complex regional pain syndrome, labor, pregnancy, reflex sympathetic dystrophy, spinal cord stimulation.

Complex regional pain syndromes (CRPS) clinical course, physiopathology, and choice of treatment modalities remain subjects of debate. However, it occurs more frequently in middle-aged adults with a female to male ratio of 2 or 3 to 1 and even 4.5 to 1 (1,2). According to the Bureau of Labor Statistics, today more than 57% of women are part of the workforce (3), and the tendency is for women to wait until later in their physiologic reproductive age to become pregnant. It is expected that some may suffer from CRPS. There is general agreement that early intervention is needed. Recently a consensus report provided a treatment algorithm including physiotherapeutic, pharmacological, psychiatric/psychological, regional anesthetic, and neuromodulation modalities (4). Medications are given in a sequential step-like fashion initiated with the
administration of nonsteroidal analgesics, tricyclic antidepressants, anticonvulsants, antiarrhythmics, calcium channel blockers, and opioids. Invasive sympathetic blocks may be interjected early or later on. Patients who have intolerable or undesirable side effects or fail to respond are evaluated for interventional modalities (neuromodulation, sympathectomy). We describe the case of a female discontinuing a medication regime which successfully controlled her CRPS to have a spinal cord stimulator implanted so that she could become pregnant without the risk of possible teratogenic effects from medication.

CASE REPORT

On March 25, 1996, a 31 year-old, right-handed female nurse was injured in a motor vehicle accident in which she was rear-ended by a car going 60 mph. She suffered a whiplash neck injury, developed an immediate onset of weakness and sensation loss in her left hand, and five days later, noticed her left hand was swollen and bluish. She was admitted for intensive management which included a stellate ganglion block resulting in a Horner’s syndrome with pain relief lasting for 10 days. An electromicrograph confirmed a mild brachial plexus injury. Cervical spine X-rays were within normal limits. MRI of the brachial plexus was unremarkable; but the cervical spine study revealed a Chiari I malformation, although that was considered incidental. She regained strength and sensation but developed burning pain in her left hand and an inability to tolerate touch, movement, temperature fluctuation, or air current, and she subsequently required the use of a sling and a cloth to keep the hand protected. She noticed bluish discoloration and the hand became sweaty and cold. She was evaluated at a multidisciplinary clinic and with a pharmacological regime of Neurontin 600 mg twice a day, Trazadone 100 mg at bedtime, Tramadol 50 mg four times a day, Vicodin and Motrin, she obtained satisfactory pain control. She later married and wanted to become pregnant, but was afraid of possible teratogenic effects of these medications. The pain clinic referred her for evaluation for an interventional pain control procedure which would allow discontinuation of medication.

On evaluation, her left hand had bluish discoloration and allodynia, and thermography indicated the symptomatic hand to be 1° to 5°C colder. A psychological self-report test battery was administered; this consisted of the Multidimensional Pain Inventory, the Pain Experience Scale, the Center for Epidemiological Studies Depression Scale, the Locke-Wallace Marital Adjustment Scale, and the Oswestry Disability Questionnaire. Her responses were compared with those of a normative sample of chronic pain patients. Her results suggested that her depression score was in the average range for chronic pain patients and slightly higher than the cutoff which is suggestive of a possibility of a mood disorder. Otherwise, marital satisfaction and family support appeared to be better than average for this population. No animal or human studies regarding possible teratogenic effects or fetal/maternal risk using SCS at the time of conception, pregnancy, and labor were available, and this was explained to the patient who signed an informed consent. In July, 1997 she underwent a successful three-day trial of cervical SCS with a Medtronic Resume TL thin line lead (a Quad lead could not be advanced percutaneously) on the left dorsal epidural quadrant with the 0 electrode at the C2–3 level and a Medtronic Itrel-III pulse generator (Minneapolis, MN) was implanted in the upper gluteal region instead of the abdomen because of the patient’s concern of discomfort during pregnancy and risk of damage if a caesarean section was necessary. She had excellent pain control (close to 100%) and dramatic decrease of her allodynia/hyperpathia using less than 1 volt amplitude, 180 μsec pulse width, and a rate of 55 pps. She noticed that the pain recurred in 45–60 min after turning the stimulator off, and therefore used it 24 h a day. After having been successfully tapered off medications, she became pregnant and delivered a healthy, five-pound baby female 5 weeks early on August 8, 1998. At no time during the labor and delivery was the SCS turned off. Both mother and baby were discharged from the hospital in two days. (Fig. 1)

DISCUSSION

Pregnancy has been reported as a predisposing factor for CRPS, but there is no data about whether pregnancy would aggravate a pre-existing syndrome (5). Therefore, there was not a formal contraindication for our patient with CRPS to get pregnant.
Medications are classified in the pharmacopeia (6) according to the evidence existing in the literature regarding possible teratogenic effects in the following risk categories: “A” (controlled studies in women showing no risk), “B” (animal studies do not show risk but no adequate human studies have been done), “C” (animal studies show some fetal risk but no animal/controlled studies have been done), and “D” (evidence of human fetal risk). Our patient was receiving Trazadone (category C; excretion into breast milk unknown), Vicodin (category C; 7.2% teratogenic effects; is not excreted in breast milk), Motrin (category B; is not excreted in breast milk), Tramadol (category C; excretion into breast milk unknown), and Neurontin (not available). Therefore, our patient’s wish to discontinue her medications before she became pregnant seemed reasonable.

Spinal cord stimulation is effective in the treatment of CRPS (7–9). Improvements are objectively measured by quantitative noninvasive assessment of autonomic function (10). We believe SCS has to be offered as the first choice for interventional augmentative modality before of intra-axial continuous infusion.

A literature search on the use of SCS in humans at the time of either conception, pregnancy, or labor/delivery retrieved only one study, effects of transcutaneous electrical nerve stimulation (TENS) on hormonal parameters of placental function in cases of placental insufficiency (11). A significant elevation of HPL and Estriol serum levels were found; a correlation between the onset of therapy at a certain week of gestation and its effect could not be proved.

In any case, even if these results could be extrapolated to SCS, they are not harmful for gestation. However, the possible consequences to the developing embryo need to be considered.

We would also like to speculate about what other mechanisms may be influenced by SCS during pregnancy and labor. It has been demonstrated that during pregnancy and labor in rats, guinea pigs, and humans, there is an opioid-mediated elevation in the threshold for responsiveness to aversive stimuli which reaches a maximum at term. In rats this is mediated, at least in part, via a spinal opioid pathway, which is activated by some aspects of pregnancy. For example, threshold is dependent on the integrity of the hypogastric nerve (12). Although it has been proposed that the SCS analgesic effects may result from release of endorphins (13), it has been shown that they are not affected by Naloxone (14). Whether SCS may reinforce the physiologic analgesic mechanisms occurring during pregnancy and labor therefore remains unknown.

The mechanisms determining the onset of labor are not well understood, but the control of the uterine contractions is predominantly hormonal and not neurogenic. Autonomic neural input to the uterus may actually decrease myometrial contractions (15) and there is loss of uterine body adrenergic fibers (16) and involution of peptidergic neurons late in pregnancy (17). Further proof of the lack of relevance of neurogenic control is the fact that paraplegic women may deliver (18).

A literature search on animal laboratory studies regarding SCS and pregnancy revealed milk ejection was obtained by electrical stimulation of the anterolateral spinal cord in lactating rats; the responses were eliminated after destruction of the pituitary...
stalk and were not associated with blood pressure changes. It was concluded that they resulted from the release of oxytocin (19). Although the functional significance of this reflex may be relevant in pregnancy, it is unlikely that the ventral spinal cord pathways responsible would be stimulated during epidural stimulation of the dorsal spinal cord.

It has been postulated that electromagnetic field forces (EMF) induced by electrical equipment may cause cancer in humans, but it is unlikely they will cause birth defects or miscarriages (20). Government regulations are beginning to regulate the industry. For example, Sweden recommends that video display terminals produce not more than 2.5 mG at 50 cm compared to a typical neighborhood 115,000 v power line which produces 6.5 mG at 50 feet. EMF potentially may be generated around the leads of a totally implantable internal pulse generator (IPG) such as Itrel III; however, that EMF would be very weak because of the low voltage and the closeness of cables connecting to positive and negative poles and cancelling each other. A practical proof of the weakness of the EMF generated by the Itrel III is that it will induce an audible signal on an AM radio synchronized at the appropriate frequency only when the radio receiver is brought close to the skin overlying the IPG. Instead, radiofrequency (RF) systems such as Matrix, Xtrell (Medtronic, Inc.) and MNR/T (Advanced Neuromodulation Systems, Inc., Allen, TX) by definition would create an EMF. Although EMF would be localized and of low power, we still feel that the totally implantable SCS is potentially safer than the radiofrequency model for use in a woman planning to get pregnant.

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