

ABSTRACT: Clinical signs and symptoms of spasticity include hypertonia, involuntary movements (spasms, clonus), decreased range of motion, contractures, and often spasm-related pain. When spasticity is refractory to medical management, patients may be referred for intrathecal baclofen (ITB) pump placement. We reviewed a cohort of amyotrophic lateral sclerosis (ALS) patients with intractable spasticity requiring ITB to further define the impact of ITB on pain relief in this patient population. From 2003 to 2005, eight patients (mean age 43.8 years; 5 men, 3 women) with ALS received ITB for pain associated with intractable spasticity at our institution. Mean disease duration preoperatively was 47.4 months, mean follow-up was 9.8 months, and pain was evaluated using a 0–10 scoring system. All patients experienced spasticity relief in response to a preoperative bolus test injection of ITB (25–50 μ g) via lumbar puncture. Following ITB pump placement, the average reduction of pain was 54% ($P = 0.0082$). Six patients (75%) experienced pain score reduction, three of whom had complete pain relief. Postoperative pain reduction was predicted by the degree of pain reduction following preoperative ITB test injection. These results support ITB as a treatment modality for pain associated with spasticity in ALS.

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INTRATHECAL BACLOFEN FOR SPASTICITY-RELATED PAIN IN AMYOTROPHIC LATERAL SCLEROSIS: EFFICACY AND FACTORS ASSOCIATED WITH PAIN RELIEF

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Spasticity results from the absence of inhibition of alpha or gamma motor neurons.⁹ This loss of inhibition results in involuntary muscle contraction that causes stiffness interfering with movement, speech, and locomotion.¹¹ Common clinical manifestations include hypertonicity, clonus, fixed joints, and spasm-related pain.^{3–5,10} Symptoms can present either intermittently or continuously, and are often cutaneously induced.⁷

The initial treatment modalities for these symptoms involve stretching exercises and medications to reduce the pain associated with spasms and stiff-

ness.² Although such pain is usually adequately controlled with medication and physical therapy, some patients are refractory to treatment or experience dose-limiting side-effects.⁶ For this subpopulation, an implantable intrathecal baclofen (ITB) pump may provide adequate pain relief for an otherwise untreatable condition.¹ We reviewed a cohort of amyotrophic lateral sclerosis (ALS) patients with intractable spasticity requiring ITB to define the impact of ITB on pain relief in this patient population.

METHODS

Patient Selection/Demographics. The data used for this analysis came from the Mellen Center Intrathecal Baclofen registry. This registry was approved by the Cleveland Clinic Institutional Review Board. Patients were selected by physicians specialized in treating ALS and spasticity on the basis of a history of

Abbreviations: ALS, amyotrophic lateral sclerosis; ITB, intrathecal baclofen
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severe and intractable ALS-associated spasticity despite optimal medical treatment. Optimal medical treatment consisted of aggressive oral medication trials (usually baclofen, tizanidine, or both), and had led to lack of symptom relief at high doses or to dose-limiting side effects (usually sedation). The expected duration of life for each patient was discussed by staff of the ALS clinic and spasticity clinic. Candidates for ITB therapy were carefully preselected among patients who exhibited slower disease progression and predominant upper motor neuron features in addition to medically refractory spasticity. Because patients with predominantly upper motor neuron features typically have a slower disease progression with longer survival, the presence of marked spasticity essentially self-selected those patients with expected longer survival.

All patients who were considered good candidates for implantation underwent a test injection of intrathecal baclofen (either 25 or 50 μg) in our outpatient clinic, with 25 μg the preferred dosage for ambulatory patients. Following successful test injection (defined as reduction/relief of spasticity), patients were referred to the Cleveland Clinic Foundation for programmable intrathecal infusion system implantation. Only one patient had lack of pain relief with the test injection; however, because the primary endpoint for pump implantation was spasticity relief rather than pain relief following test injection, he went on to undergo surgery as spasticity improved following test injection. All ITB pump implantations were performed by a single surgeon (N.M.B.).

From January 2003 through December 2005, programmable ITB pumps were implanted in eight ALS patients (five men, three women) with intractable spasticity and related pain. The age range was 33–77 years, and the mean age at surgery was 43.8 years. ALS symptom duration ranged from 14 to 108 months, with an average of 47.4 months at surgery. Pain was quantified by patient response to a physical therapist using a 0–10 scale, with 0 representing no pain and 10 representing maximal pain. Complete pain relief was defined as a zero score on the pain scale. The mean modified preoperative pain score was 7.69, ranging from 6 to 10, and the degree of pain relief following preoperative ITB test injection was recorded in seven of the eight patients (87.5%); these data were unavailable for the one patient. The success of the test injection of ITB was not only judged based on relief of spasms and spasm-related pain, but also on spastic hypertonia reduction and improvement of ease of movement. The mean preoperative Ashworth score was 2.93. Patients who did

not receive adequate relief of spasticity following test injection did not undergo pump implantation.

Operative Techniques. All patients in this study were implanted with an ITB pump via standard percutaneous placement technique under general endotracheal anesthesia. The pump (Medtronic, Minneapolis, Minnesota) was typically filled with 500 $\mu\text{g}/\text{cm}^3$ of baclofen prior to implantation. Fluoroscopy was used to pass the distal catheter through the L2–3 interspace to the T9–10 interspace in patients with spastic lower extremities, and T4–5 in patients with associated upper-extremity spasticity. Insertion of the pump was through a 5-inch abdominal incision made lateral to the umbilicus down to the rectus fascia. After implantation, the pump was programmed based on the total volume of the catheter system, after which the patient was placed in an abdominal binder and kept flat for 24 hours.

Postoperative Care. Following surgery, patients were transferred to an inpatient rehabilitation unit before returning home with continuing outpatient or in-home rehabilitation. Patients were subsequently followed by a team including neurologists, physical therapists, nurses for ITB pump adjustments and refills, and the implanting neurosurgeon. Postoperative pain relief was quantified with the same 0–10 scoring system used preoperatively. Mean follow-up was 9.8 months.

RESULTS

Following ITB pump placement, the average pain score was 3.56 (range 0–8), a statistically significant reduction of 54% from preoperative scores (two-tailed *t*-test; $P = 0.0082$; GraphPad Software, San Diego, California). No patient experienced neurologic morbidity or mortality, or any decline in respiratory function, even those patients with higher catheter tip placement (T4–5). Six patients (75%) experienced reduction of preoperative pain scores, three of whom had complete pain relief (postoperative pain score of 0). The degree of pain score reduction following preoperative ITB test injection was predictive of the degree of postoperative pain reduction following ITB implantation in six of the seven patients with recorded preoperative ITB test injection results (Table 1). Of the three patients who experienced complete postoperative pain relief, two had preoperative ITB test injection pain scores recorded, and in both complete pain relief following test injection (Table 1). All patients survived for

Table 1. Pain score comparisons of patients in this study (0–10 pain score scale).

Patient	Pain score prior to preoperative ITB test injection	Pain score following ITB test injection compared with initial score	Postoperative pain score (ITB pump implantation)
1	6	Not recorded*	0
2	7	Reduced	2
3	7.5	Resolved	8
4	7.5	Reduced	5
5	10	Resolved	0
6	10	Resolved	6
7	6	Resolved	0
8	7.5	Unchanged	7.5

Results following preoperative ITB test injection were recorded as follows: resolved = 0 pain score; unchanged = no change from pain score prior to test injection; reduced = reduction in pain score from prior to test injection.

*These data were not available for patient 1 despite intensive chart review.

more than 1 year following surgery, and the mean postoperative Ashworth score was 1.72.

DISCUSSION

Our findings in eight patients with ALS indicate that ITB is an effective and safe treatment modality for relief of spasticity-related pain, with no postoperative neurologic morbidity/mortality in our population. An important observation in our series is that postoperative pain score reduction was predicted by the degree of pain score reduction observed following preoperative ITB test injection. Therefore, any ALS patient for whom ITB is being considered should undergo preoperative test injection, both to assess the degree of relief from spasticity and to determine how much pain relief a patient may expect. Patients who have little or no pain relief following test injection are less likely to experience significant pain reduction following ITB implantation, although improvement in spasticity and quality of life can still be expected.⁸ We do not believe that ITB has an effect of the course of the disease or compensates for underlying loss of motor control; however, we have consistently observed an improvement with ease of movement following ITB, which is evident in the postoperative reductions in both spasticity-related pain and Ashworth scale scores. Our observation that pain relief following preoperative ITB test injection is greater than following pump implantation has been anecdotally observed previously, and may be caused by desensitization or downregulation of re-

ceptors in the spinal cord in response to chronic exposure. Future studies will be needed to elucidate further the functional outcomes following ITB pump implantation in ALS patients.

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