Intrathecal baclofen infusion and subsequent orthopedic surgery in patients with spastic cerebral palsy

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Intrathecal baclofen infusion (IBI) is an effective treatment for spasticity secondary to cerebral palsy (CP).

Object. To assess the need for orthopedic surgery of the lower extremities in such cases, the authors retrospectively reviewed the outcome in 48 patients with spastic CP who were treated with IBI.

Methods. Pumps were placed in 40 patients (84%) suffering from spastic quadriplegia and eight patients (16%) with spastic diplegia. The patients’ ages ranged from 5 to 43 years (mean 15 years). The mean follow-up period was 53 months (range 24–94 months). The mean baclofen dosage was 306 µg/day (range 25–1350 µg/day). At the time of pump placement, subsequent orthopedic surgery was planned in 28 patients (58%); however, only 10 (21%) underwent surgery after IBI therapy. In all 10 cases, the surgical procedure was planned at the time of initial evaluation for IBI therapy. In the remaining 18 patients, who did not subsequently undergo their planned orthopedic operation, it was believed that their lower-extremity spasticity had improved to the degree that intervention was no longer indicated. In addition, although six patients had undergone multiple orthopedic operations before their spasticity was treated, no patient required more than one operation after IBI treatment for spasticity.

Conclusions. The authors conclude that IBI for treatment of spastic CP reduces the need for subsequent orthopedic surgery for the effects of lower-extremity spasticity. In patients with spastic CP and lower-extremity contractures, spasticity should be treated before orthopedic procedures are performed.

KEY WORDS • baclofen • cerebral palsy • orthopedic surgery • spasticity

Cerebral palsy (CP) affects approximately 750,000 individuals in the United States, with an incidence of 1.5 to 2.5 per 1000 live births.1,9 Given the increased survival rates among the lower-birth-weight groups, the rate of CP is actually increasing worldwide. The National Institutes of Health has estimated societal costs at $5 billion for care of individuals with CP who are younger than 18 years of age.1

Cerebral palsy is characterized by abnormalities of movement, including spasticity, athetosis, chorea, dystonia, and ataxia. Two-thirds of the patients with CP have spasticity. In recent decades, neurosurgical procedures such as selective dorsal rhizotomy (SDR) have been demonstrated to reduce lower-extremity spasticity of cerebral origin.4,9,11,20,22,23 More recently, intrathecal baclofen infusion (IBI) has been shown to be an effective treatment for spasticity secondary to CP and traumatic brain injury.2,10,12-14,16,18,23-25,28,30

In the past, cerebral spasticity has often been treated primarily by physical therapists in an attempt to maintain range of motion and improve function. Operations on the lower extremities are frequently required in this population. The orthopedic consequences resulting from spasticity include contractures and dislocations.7,26 Orthopedic procedures include tendon releases and lengthenings and osteotomies. These operations often need to be repeated if the underlying spasticity is not reduced.

Orthopedic surgery and spasticity-reducing procedures have a preventive value because they may reduce the incidence of progressive orthopedic deformities that often occur in patients with spastic CP.9,30,26,32 Such progressive deformities require further orthopedic surgical intervention. A recent study found that early SDR reduces the need for subsequent orthopedic surgery in children with spastic CP.9 The current investigation was undertaken to test the hypothesis that IBI therapy also reduces the need for subsequent orthopedic surgery in this population.
Clinical Material and Methods

This study involved a retrospective analysis of 48 patients with spastic CP who underwent IBI therapy during the period from 1989 to 1995. The patients’ ages ranged from 5 to 43 years (mean 15 years). The mean follow-up period was 53 months (at least 24 months in all cases). Patients with moderate or severe spasticity of cerebral origin were examined by a multidisciplinary team in the Spasticity Clinic at the Children’s Hospital of Pittsburgh. The diagnoses included eight cases of spastic diplegia (16%) and 40 cases of spastic quadriplegia (84%).

Patients were admitted for a screening trial to determine if single IBI doses reduced their spasticity. Patients whose average lower-extremity muscle tone decreased by 1 or more according to the Ashworth scale1 after any IBI dose (50-, 75-, or 100-µg bolus injection) were considered to have a clinically significant response and were offered implantation of a programmable subcutaneous pump for continuous IBI (Medtronic, Inc., Minneapolis, MN). The technique for pump insertion has been described elsewhere.1 The mean baclofen dosage was 306 µg/day (range 25-1350 µg/day).

The goal of IBI therapy is not to abolish spasticity but rather to decrease it to improve range of motion, facilitate movement, reduce energy expenditure, and reduce the risk of contractures. After pump implantation, IBI dosages were increased during the 1st week until the mean lower-extremity muscle tone was perceptibly reduced and then increased again during the follow-up period, titrating the IBI dosage to the desired clinical response. Most patients received physical therapy 2 to 5 days per week for the first 6 months postoperatively and 1 to 3 days per week for the next 6 to 18 months.

Documentation of orthopedic surgery performed before and after baclofen pump placement was obtained from preoperative clinical assessments and postoperative follow-up visits. Orthopedic operations were categorized as adductor releases, heel–cording releases, iliopsoas releases, hamstring releases, femoral osteotomies, ankle–foot osteotomies, or “other” operations that included repair of quadriceps muscle releases, tibial osteotomies, and hip reconstructions.

At the time the decision was made to place the baclofen pump, an orthopedic surgeon (G.F.J.) documented the anticipated need for orthopedic surgical intervention for lower-extremity contractures and/or bone deformities. The criteria for surgical intervention included radiographic evidence of bone abnormalities, degree of spasticity, findings on physical examination (such as hip subluxation, joint range of motion, and presence of contractures), and functional limitations of these findings. In all of these cases, the patients and/or families were informed of the possible need for future surgical intervention. All patients received regular follow-up care from both the neurosurgery and orthopedic surgery services and their responses to IBI therapy and the status of their lower-extremity deformities were evaluated.

Results

Twenty-nine patients (60%) had undergone at least one orthopedic procedure before baclofen pump placement.

The mean patient age at time of the first orthopedic operation was 8 years old (range 2–19 years). The number and types of procedures performed are shown in Table 1. Heel–cording release was by far the most common procedure (42%), followed by hamstring release (33%) and adductor release (31%).

Six patients underwent two separate operations for lower-extremity deformities before IBI pump placement. The ages at surgery and procedures performed in this group of patients are shown in Table 2. A single operative session included all orthopedic procedures performed on a single date. If a patient underwent further or repeated operations at a later date, these were considered to be separate operative sessions.

Subsequent surgery was planned at the time of pump placement in 28 patients (58%); however, only 10 patients (36% of those in whom surgery was planned) eventually underwent orthopedic surgery after IBI therapy. The types of procedures performed in those patients who underwent orthopedic surgery after pump placement are also shown in Table 1.

Further analysis of this group of 10 patients revealed that in all cases the surgical procedure was planned at the time of initial evaluation for IBI therapy. The mean age for this group of patients was 10 years (range 5–19 years). Of

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<tr>
<th>Case No.</th>
<th>Age (yrs) at Op</th>
<th>Type of Surgery</th>
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<tr>
<td>7</td>
<td>7</td>
<td>hamstring release</td>
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<td>8</td>
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<td>9</td>
<td>8</td>
<td>hamstring release, femoral osteotomy</td>
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<td>10</td>
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*In 1984, Penn and Kroin* first reported that a bolus injection of baclofen could transiently reduce spasticity in patients with spinal cord injury. Later this work was extended to involve long-term IBI administration by means of an implanted drug pump.*2,23 More recently, IBI has been shown to be an effective treatment modality for spasticity secondary to both CP and traumatic brain injury.*2,3,6,8,10,12–14,16,18,28,30,31*

In spite of the effectiveness of IBI therapy in relieving spasticity, a substantial proportion of children with spastic CP develop contractures before their spasticity is treated and require surgery to correct the musculoskeletal effects of spasticity. As many as 28% of children with spastic CP require two or more separate operations.*2,9,17*

Many variables influence the rate of operations performed in patients with spastic CP, including the severity of the spasticity, the joints involved, and the age of the patient.*7,11* In addition, there are differences among orthopedic surgeons as to their beliefs about the optimum age at which a patient should undergo a surgical intervention, as well as the surgical indications for each of the different procedures.*26,29* For these reasons, no historical control exists for the rate of surgery in patients with spastic CP.

In a study by Chicoine, et al.,*9* the authors examined the effects of SDR on rates of lower-extremity orthopedic surgery in 178 children with CP. This was the first such systematic analysis of the rates of orthopedic surgery for a large population of children with spastic CP. The authors found that children undergoing SDR at a younger age (between 2 and 4 years) were less likely to require surgery for heel–cording, hamstring, and adductor releases. If the reduced need for subsequent procedures of the lower extremity was due to improvement in lower-extremity spasticity resulting from SDR, then it was postulated that improvement in spasticity as a result of IBI therapy would likewise decrease the need for subsequent orthopedic intervention.

We observed that of our 48 patients who underwent IBI pump placement, 60% had previously undergone at least one orthopedic procedure, a rate similar to those in other reported series.*5,33* The most common procedures were heel–cording, hamstring, and adductor releases. Ten patients (21%) in our series subsequently underwent an orthopedic procedure after IBI therapy. Of note, however, is that 28 patients (58%) had future surgery planned at the time of pump placement. It was believed that the IBI would improve the outcome of the surgery by diminishing the incidence of postoperative contractures. In the 18 patients who did not undergo their planned surgery, it was believed that their lower-extremity spasticity had improved after IBI therapy such that orthopedic intervention was no longer required.
It is our policy at the time of pump placement to avoid orthopedic surgery that might increase the risk of postoperative pump infection. In addition, IBI therapy might reduce the extent of surgery needed or eliminate the need for future orthopedic surgical intervention altogether. This may reflect the decision of the orthopedic surgeon to postpone surgery until the child’s outcome from IBI therapy is more clearly defined.

Of the ten patients who did undergo orthopedic surgery after IBI pump placement, the surgery was planned in all cases at the time of initial evaluation for IBI therapy. All procedures were performed within 18 months of pump placement. No patient who underwent surgery after IBI therapy required a second operation. The most commonly performed procedure after IBI administration was a femoral osteotomy (seven of 10 patients). This contrasts with the frequency of femoral osteotomy in the pre-IBI group (six of 29 patients). This difference likely reflects the fact that nonoperative treatment has historically been unsuccessful in achieving the objectives of proper treatment of the deformity, the goal of surgery being to increase stability of the hip.1,5,12

Given that our study population represents a diverse group of patients with a wide range of ages, it cannot be determined if IBI therapy at an earlier age has greater benefit over pump placement at a later age for a reduction in the development of lower-extremity orthopedic deformities that result from spasticity. However, given the significant number of patients who avoided subsequent surgery after IBI therapy, one might infer that this would indeed be the case. It is not known how many of the patients who avoided procedures may require surgery in the future.

The major limitation of this study is the lack of a simultaneous control group undergoing similar physical therapy intervention. The potential for such bias is a threat to the internal and external validity of this study. In addition, no control group from the literature is currently available for comparison with our rates of subsequent orthopedic surgery. However, comparisons among patients within the study group receiving similar surgical and nonsurgical interventions served to minimize this selection bias. Longer follow-up intervals and larger study populations followed prospectively will help to define further the role of IBI therapy in the reduction of need for orthopedic intervention.

From this series of 48 patients with spastic CP who underwent IBI pump placement, we conclude that IBI therapy reduces the need for subsequent surgery for the effects of lower-extremity spasticity and virtually eliminates the need for multiple orthopedic operations. It is appropriate that patients with spastic CP and significant lower-extremity contractures requiring surgical intervention should undergo evaluation for spasticity reduction before orthopedic procedures are performed.

References

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