

Intrathecal Baclofen in the management of spasticity due to cerebral palsy

Introduction

This article summarises the setting up, the preliminary results and the future of intrathecal baclofen at Queens Medical Centre, the teaching hospital of the University of Nottingham.

Baclofen, a derivative of diazepam was originally developed in the 1920s as an anticonvulsant. The anticonvulsant action proved to be disappointing, but the effect on spasticity of spinal and cerebral origin was noted. Baclofen, in its oral form, became a drug of relevance to rehabilitation. Oral doses vary and so do the side effects. The effect of oral baclofen is generally paired with gastro-intestinal side effects and drowsiness, effects that occasionally outweigh the benefit. Intrathecal delivery of baclofen was initially done by means of single lumbar puncture. The effect of intrathecal baclofen was noted along with the low dose required to relieve the spasticity, but single lumbar puncture is not a comfortable means for chronic delivery. In the eighties reliable drug-delivery systems became available and intrathecal infusion of a variety of drugs eg morphine, methotrexate and baclofen became effective.

Over the past 20 years Intrathecal baclofen (ITB) has gained a steady foothold in the management of spastic disability. The indications vary and include, in decreasing order of importance spasticity due to spinal cord injury, Multiple Sclerosis, stroke and head injury. Baclofen is a Gamma Amino Butyric Acid (GABA) agonist, which is an inhibitory neurotransmitter for the CNS. Baclofen enhances this effect, particularly in the spinal cord, but more widespread effects in the CNS are noted.

ITB in cerebral palsy

Cerebral palsy affects 2-3 children per 1000. The spasticity of 7% of these children is so severe they are candidates for ITB.

Despite the available literature and proof of effectiveness for the treatment of spasticity in children, the first implants at QMC were seen to be experimental. The resistance for funding this procedure led to the writing of the SchARR (School of Health and Related Research) report on ITB. The SchARR group did a meta-analysis of the literature to establish an evidence base. It became clear that there was a definite benefit of ITB to spastic tetraplegic or tetraparetic patients, including children, but there is no proven benefit for diplegic patients eg ITB for gait disturbance is poorly researched and may not be indicated. This is a discrepancy with the, mostly American, literature where the effect on gait improvement is greatly emphasised. The meta-analysis showed the impact to be the greatest on nursing care, quality of life and to a lesser extent on function. This conclusion led to criteria for ITB:

- 1) Spastic tetraparesis or tetraplegia forms a proven benefit group for ITB and funding should be made available for these patients. This includes children who additionally must be entered in a clinical outcome study.
- 2) ITB can only be offered to diplegic patients in the framework of a randomised controlled trial for research purposes.

ITB in Nottingham

In order to accommodate the demand for ITB, the process has been streamlined. Once a letter of referral is received describing the neurological condition of the child, funding is sought from the health authority or PCT of origin. Children are only reviewed when the local authority has agreed funding for both

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the test procedure and the implant of the baclofen pump. Simultaneously, information packages are sent out to the referring clinician and the carers of the child. Once funding is agreed, a date for the baclofen test is set. The process was set up in this way to avoid crowded clinics and disappointment to the patients and their carers if funding is not available for a potentially good candidate.

The test procedure

The test procedure consists of a multidisciplinary assessment of the child eg OT, Physiotherapy and Neurosurgical during a brief admission (24-48h). The child is examined under general anaesthetic, with muscle paralysis (succinylcholine). The muscle paralysis mimics the effect of baclofen and clarifies the Orthopaedic condition of the child. Many children have fixed joint deformities, because of long-standing spasticity, which are to be treated by further Physiotherapy or Orthopaedic surgery. ITB will act on the muscle tension and can make further Physiotherapy or surgery easier, but ITB in itself has no effect on joint deformity.

During the general anaesthetic a lumbar catheter is inserted into the spinal sack. The child is then woken and transferred back to the ward. When the

post-operative observations are satisfactory, a bolus dose of baclofen, approximately 30 to 50 micrograms, is given. The peak effect of baclofen can be seen four hours after injection. It is important for the carers to be with the child at that time and the child must also be handled and cared for as usual. This helps in assessing the effect of the bolus dose. The carers must also remain with the child overnight to assess the child on the morning after the test. By the next morning the effect of the baclofen will have disappeared, the child will have returned to its pre-injection state and the effect is even more noticeable to the carers. The only effect of importance to the clinician is whether there is a response to baclofen or not. Quantification of the effect of the bolus is not useful at this stage. The effect of receiving chronic ITB is not comparable to the bolus dose. The catheter is removed on the day of the test and the child is usually discharged the morning after.

Side effects of the bolus dose have been reported eg respiratory depression and meningitis, but none have occurred in this series. So far 40 test procedures have been done according to this in-house protocol. Two did not respond to the bolus dose and the baclofen test did not live up to the expectations of the carers in the latter.

We then enter a negotiation phase where the results of the examination under anaesthetic are discussed along with the effect of the bolus dose. Before embarking into an expensive and invasive procedure eg pump implant, the goals and expectations must be clearly outlined.

In summary: ITB improves nursing care, quality of life for the child and its carers. Added bonus effects are: increased interaction with the environment, improved bulbar function eg swallowing, weight gain and improved control in the upper limbs.

The implant

After the test procedure and when the expectations and goals have been determined, a date is set for the implant. The delivery system is a battery driven programmable pump. The pumps cost approximately £7000, have a battery life of 7 to 10 years and are externally programmable by means of a magnetic wand. The device is inserted through a subcostal incision in the

right flank and can be either subcutaneous or, when the child is very catabolic because of the spasticity, the device is inserted under the fascia of the abdominal muscles. A catheter is inserted into the spinal sack through a small incision over the lumbar area. The catheter is fed into the sack with a Tuohy needle and tunneled under the skin to the location of the pump. The proximal end of the catheter is then attached to the pump. The only restriction for implanting a baclofen pump is the physical size of the child; age is not a restricting factor. However, the industrially produced drug, baclofen, is not licensed by the manufacturer for use under the age of 4 years. Because of the limited number of cases implanted at that age our local Committee for Ethics in Clinical Practice has advised that the indication for ITB in a child under the age of 4 years is a decision to be made by the clinician, in the best interest of the child. Consent for 'under 4 ITB' is separate from the regular consent for operation and the carers are to be made aware that Baclofen is not licensed in that age group.

Although there are a variety of programming modes, the children are programmed for continuous dose delivery eg the dose received over 24 hours is constant and tailored to the specific need of the child. Doses vary between 150 micrograms/24h to 550 micrograms/24h. The degree of spasticity, the aetiology of the spasticity and even more the weight and size of the child direct the daily dose.

Depending on the delivered dose, refills occur every six weeks to 3 months. Refilling of the pump reservoir is percutaneous and comparable to injecting a "Hickmann" line.

The results

Beginning of the ITB program at QMC, 10/1998
This assessment, 6/2002

All children have severe spastic tetraparesis with Ashworth score >4, with increasing nursing and care demands, compliant with the criteria. All children are entered in a clinical outcome database, which is perpetually updated.
Of the 37 implanted children 10 have mainstream cognition.

40 children assessed and tested
37 tested and implanted
11 are female, 26 male
The age range at pump implant is 2,5 years to 17 years, mean 11,8 years.

Indications

32 children have cerebral palsy due to premature birth
2 children have cerebral palsy and dystonia
1 child has dystonia of unknown origin
1 child suffered a non-accidental injury
1 child was asphyxiated by drowning

Problems

6 spontaneous lumbar catheter migrations
2 children had side effects of baclofen at low dose delivery (headache, GI problems) which were solved by decreasing the delivery dose
1 elective catheter repositioning*
1 catheter fracture
1 pressure sore over the pump leading to infection, requiring removal of the pump and replacement with a new system at later date
1 low battery alarm, leading to replacing of the pump (after 3.5 years)

No primary infections
No procedure related death or incidents related to drug delivery eg overdose



An example of a programmable drug delivery pump. The illustration shows the body of the pump with the spinal catheter connected to it.

*The elective repositioning was done to enhance the effect of ITB to the lower limbs. Initially the catheter was inserted to the mid thoracic level, causing hypotonia in the dorsal spine.

Outcome

The difficulty with assessing outcome in ITB is the inefficacy of most outcome measures. Traditionally spasticity is measured with the Ashworth scale but the Ashworth scale is not helpful during ITB treatment. The Ashworth score can easily be adapted by modifying the delivery dose eg the more baclofen is

delivered, the lower the Ashworth score. Dose increase is not always to the advantage of the child, as some children require a degree of spasticity to sit upright or in the extreme to bear their own weight. ITB aims to improve ease and range of movement without interfering with the 'functional' spasticity necessary for activities of daily living.

Other outcome measures such as PEDI scale, Canadian Occupational, WeeFIM and the Child Health Questionnaire are not specific enough as many of the effects of ITB are not easily quantifiable eg improvement in nursing care, swallowing, sleep pattern, seating, writing, use of computer etc. The outcome in Nottingham is measured by combining the above-mentioned tools and keeping track of patient satisfaction.

All children have an improvement in their nursing care and activities of daily living; all had relief of their spasticity.
5 children were mobile before the implant and their mobility improved after the implant (mobility in these children being defined as able to make a few steps with help or a frame)
8 children regained lower limb function allowing weight bearing,
1 child improved so much function that he was able to walk 20m independently.

One family is dissatisfied with the treatment. The child had a pump implant and a catheter migration. The catheter was replaced but migrated again. In the meantime the child had made progress and became more mobile despite the on-off way ITB was given. After the second migration it was jointly decided to leave the pump in place, stop the pump delivering Baclofen but to leave the system implanted. Should the spasticity worsen, the catheter can be replaced and the pump can be restarted.

Conclusion

Intrathecal Baclofen is a safe and effective way of dealing with spastic disability due to cerebral palsy. Complications are few and no children have been harmed by the procedure. The most dreaded complication, which has not occurred in this series, is infection of the system, which may lead to meningitis and requires removal of the pump with the catheter. The most frequent problem is catheter migration, despite adequate anchoring and even suturing the catheter in situ, migrations occur. In this series 7 catheter problems occurred, which amounts to 18%. This lies within the bracket of 10 to 20% catheter problems in the international literature. There is no obvious way to avoid this difficulty. The set up of the ITB service must be logical and comprehensive in order to cater to the occasional troubleshooting and refill activity. The refill activity is done on a walk in basis. Each procedure takes approximately 20 minutes. During the refill the child is reevaluated and in joint consulta-

tion with the carers it is decided whether the daily dose needs to be increased. Initially the dose increases rapidly and reaches a plateau after six months. Physiotherapy needs to be adapted to the post ITB status. Where prior to ITB the physiotherapy is directed at improving range of motion of the joints, the post ITB physiotherapy must also help to build up muscle bulk. Years of spasticity have often wasted muscle bulk, sometimes to the point of fibrosis in some of the older children and every effort needs to be made to recover and strengthen the voluntary movements. The effect of ITB on scoliosis is variable. 4 children, who were reviewed regularly by spinal surgeons prior to operative correction of scoliosis have been discharged from their care. The scoliosis had become less severe in 2 and two children remain stable. This can be anecdotally reported for the other common orthopaedic procedures for ITB patients in this series. After a minimum of 6 months of ITB the need for surgery is reduced in some children. Further study is necessary to objectively assess this observation.

During the initial assessment of an ITB candidate a dietitian is involved. Many of the severely spastic CP children have chronic malnutrition because of reflux, swallowing difficulties due to spasticity of the bulbar muscles and consumption of the normal caloric intake by the spastic muscles. Metabolic studies have shown that ITB decreases the caloric need by 40%. This leads to weight gain, which is a bonus effect in catabolic children but can be undesirable in large and heavy adolescents. Inappropriate weight gain may make the child unmanageable for transfers and activities of daily living. Increase in seizure activity has been noted after ITB. In my experience this is a rare occurrence and occurs because of the gain in weight during which the child outgrows its anticonvulsant requirement and is solved by adapting the dosage.

At the present ITB is only justified in spastic tetraplegic or tetraparetic children with increasing nursing demands. ITB for gait disturbance is not indicated in Britain at the present. This

may change in the future when more evidence of effectiveness becomes available. There are otherwise no real contraindications for ITB because the test procedure will, to a certain extent, predict the outcome of the treatment.

The main restriction is funding. All children treated in Nottingham have acquired funding through the process described above and on a named patient basis. Because of the expense involved, this process will be continued indefinitely. The success of ITB depends on patient selection but even more on realistically defining goals and expectations with the child's carers. Carers of a cerebral palsy patient have often been through very difficult times, countless operations and setbacks. The carers are often desperate and wish to offer whatever may be of benefit to the child. The initial assessment and the bolus test cater to this and with these elements in hand a structured plan with realistic outcome can be made.

For further information there is a patient site on www.baclofen.info

References:

The Use of Intrathecal Baclofen in the Management of Spasticity in Children with Cerebral Palsy. M Vloeberghs, M Cartmill, S Bassi. *Child's Nervous System*, 2000; 18/8:540

The Effectiveness of Intrathecal Baclofen in the Management of Patients with Severe Spasticity.

Sampson FC, Hayward A, Evans G, Touch S, Morton R, Vloeberghs M, Playford D, Collett BJ, Critchley P.

Sheffield: Trent Institute for Health Services Research, Universities of Leicester, Nottingham and Sheffield, 2000. Guidance Note for Purchasers: 00/01

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The clinical outcome of the treatment of spasticity of cerebral origin with Intrathecal Baclofen varies with age. Early treatment is advised.

M. Vloeberghs, M. Cartmill.

Proceedings of the EANS winter meeting 2/2002, Adults and Children: Impact of the age on Neurosurgical diseases.

'The Southern Meeting of Minds' A Review of Intrathecal Baclofen (ITB) Therapy for the treatment of severe spasticity

25th October 2002, The London Hilton Metropole - Paddington

Speakers:

Professor Rushton (Kings)

Mr Vloeberghs (Nottingham)

Mr Teddy (Oxford)

Mr Jamil (Salisbury)

Dr Jamous (Stoke Mandeville)

Dr Soopramanien (Salisbury)

Chaired by:

Mr Bullock (Kings) and Mr Simpson (Cardiff)

Are you involved or interested in ITB therapy? If yes come and take part in what promises to be a healthy and exciting interactive debate on the key aspects of ITB therapy. Bring along an unusual or special ITB case study and discuss it openly with the expert speakers and other delegates in the afternoon open forum session.

For programme and registration details please contact:

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