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# BOTULINUM TOXIN FOR TREATMENT OF COCONTRACTIONS RELATED TO OBSTETRICAL BRACHIAL PLEXOPATHY

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ABSTRACT - Botulinum toxin type A was recently introduced for treatment of biceps - triceps muscle cocontraction, which compromises elbow function in children with obstetrical brachial plexopathy. This is our preliminary experience with this new approach. Eight children were treated with 2 - 3 U/kg of botulinum toxin injected in the triceps (4 patients) and biceps (4 patients) muscle, divided in 2 or 3 sites. All patients submitted to triceps injections showed a long-lasting improvement of active elbow flexion and none required new injections, after a follow-up of 3 to 18 months. Three of the patients submitted to biceps injections showed some improvement of elbow extension, but none developed anti-gravitational strength for elbow extension and the effect lasted only three to five months. One patient showed no response to triceps injections. Our data suggest that botulinum toxin can be useful in some children that have persistent disability secondary to obstetrical brachial plexopathy.

KEY WORDS: botulinum toxin type A, obstetric paralysis, drug therapy.

**Toxina botulínica para tratamento das co-contrações relacionadas à plexopatia braquial obstétrica**

RESUMO - A toxina botulínica do tipo A foi introduzida recentemente para o tratamento das co-contrações entre os músculos biceps e triceps, que comprometem a função do cotovelo nas crianças com plexopatia braquial obstétrica. Apresentamos nossa experiência preliminar com esta abordagem. Oito crianças foram tratadas com 2 - 3 U/kg de toxina botulínica injetada nos músculos triceps (4 pacientes) e biceps (4 pacientes), divididas em 2 ou 3 sítios. Todos os pacientes submetidos a injeções no triceps apresentaram melhora persistente da flexão do cotovelo e nenhum precisou de novas aplicações após seguimento de 3 a 18 meses. Três pacientes submetidos a aplicações no biceps apresentaram melhora na extensão do cotovelo, mas nenhum adquiriu força antigravitacional e o efeito durou apenas 3 a 5 meses. Um paciente não respondeu às injeções. Nossos dados sugerem que a toxina botulínica pode ser útil no tratamento de algumas crianças com seqüelas de plexopatia braquial obstétrica.

PALAVRAS-CHAVE: toxina botulínica tipo A, paralisia obstétrica, terapia por drogas.

The incidence of obstetrical brachial plexopathy (OBP) in developed countries is around 0.15% and has not been reduced despite progress in obstetrics[1]. Upper brachial plexus lesions (C5-C6) are almost always present in OBP, either in isolated form, or in association with middle (C7) and lower (C8-T1) brachial plexus lesions[2]. Most of the patients with OBP will fully recover after a few months[3], but 5% to 25% will remain handicapped[1,3].

Treatment of OBP patients includes one or more of the followings: physiotherapy, reconstructive plexus surgery and correction of secondary deformities. The use of botulinum toxin type A (BTA) was recently introduced to treat biceps - triceps muscle cocontractions and improve the functional performance of these children[4,5].

This is a report of our preliminary experience with this new approach.

## METHOD

The eight subjects were selected among 72 patients with OBP followed at the Neurology Department of Hospital das Clínicas of the University of São Paulo, between June 2000 and June 2004.

Patients selected for muscle injections had clinical or electromyographic evidence of biceps - triceps cocontraction and poor elbow function. The parents provided informed consent. We injected 2 - 3 U/kg of BTA

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*Table 1. Muscle strength of biceps and triceps muscles before and after BTA injections in the triceps muscle.*

| Case number | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Biceps power* before injection | 2- | 2- | 2- | 3 |
| Biceps power* after injection | 3 | 2+ | 4 | 4 |
| Triceps power* before injection | 3 | 4 | 4 | 3 |
| Triceps power* after injection | 3 | 3 | 3 | 2+ |

* Assessed by the Medical Research Council scale (0 - 5 points).

*Table 2. Muscle strength of biceps and triceps muscles before and after BTA injections in the biceps muscle.*

| Case number | 5 | 6 | 7 | 8 |
|---|---|---|---|---|
| Triceps power* before injection | 2- | 1 | 2- | 2+ |
| Triceps power* after injection | 2+ | 2- | 2+ | 2+ |
| Biceps power* before injection | 4 | 4 | 4 | 4 |
| Biceps power* after injection | 3 | 3 | 3 | 4 |

* Assessed by the Medical Research Council scale (0 - 5 points).

(Botox®, Allergan), divided in two or three sites. The same neurologists examined the children during the follow up. The parents were monthly instructed to do home based physiotherapy by the same physical therapist. Some of the patients also attended physiotherapy sessions outside the hospital (cases 1, 2 and 7). Outcome assessment was made using the Medical Research Council scale (grades 0 - 5). Grade 2 (movement without anti-gravitational force) was divided in two: 2- (less than 50% of active range of movement) and 2+ (more than 50% of active range of movement).

## RESULTS

The results of biceps and triceps strength before and after BTA injections in biceps and triceps muscles are shown respectively in Tables 1 and 2. We also assessed if the child was able to perform hand - mouth contact in the sitting position.

*Triceps injections*

*Case 1.* A 24 months old girl with a left C5-C7 OBP was submitted to a brachial plexus neurolysis at 10 months of age. She showed a typical "waiter's tip" posture with elbow hyperextension. The biceps muscle did not have anti-gravitational strength, despite electromyographic evidence of good reinnervation. She also showed clear evidence of cocontraction on surface electromyography (Figure). One month after the injection of BTA, she had developed anti-gravitational strength of the biceps muscle and was able to perform hand-mouth contact in the sitting position. Triceps muscle strength was not apparently reduced. The benefit has persisted for up 18 months without further injections of BTA.

*Case 2.* A girl of 16 months of age with a right C5-C6 OBP was submitted to a brachial plexus neurolysis at six months of age, without improvement of the biceps function. One month after the injection of BTA, she was able to perform hand-mouth contact in the lying supine position. The arm function continued to improve during the next 5 months, while she was submitted to intense physiotherapy, including biceps muscle electrical stimulation. After 6 months, she was able to perform hand-mouth contact in the sitting position, although with excessive shoulder abduction (trumpet sign). The benefit has persisted for up 16 months without further injections of BTA.

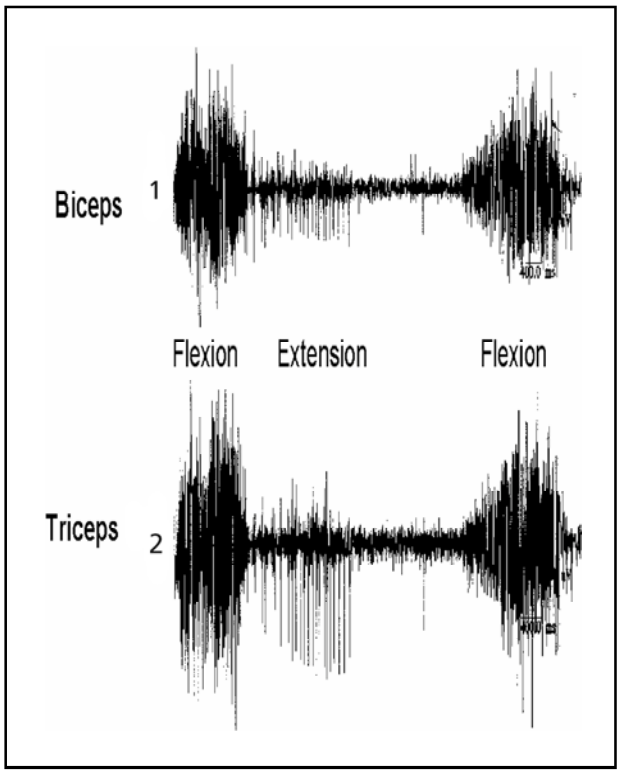


*Figure. Two channels surface electromyography of biceps (channel 1) and triceps (channel 2) muscles from Patient 1, before the use of BTA. Note the biceps - triceps cocontraction and the pronounced triceps activation during elbow flexion.*

*Case 3.* A girl of 23 months of age with a right C5-T1 OBP, had a quick and spontaneous recovery

at the C8-T1 level. The C5-C6 level remained profoundly weak and, at 10 months of age, she had a surgical brachial plexus neurolysis performed. Post-operatively, she improved muscle power, but still could not flex the elbow against gravity. Ten days after the injection of BTA, she showed a marked improvement of biceps muscle strength and was able to easily perform hand-mouth contact in sitting position. The benefit persisted for at least 3 months, when she was lost to follow-up.

*Case 4.* A 16 months old girl, with a left C5-C7 OPB and no previous brachial plexus surgery, had evidence of intense biceps – triceps cocontraction, characterized clinically by a "frozen-like" elbow. One month after the injection of BTA, her biceps strength improved (grade 3 to grade 4), but she still had some clinical evidence of biceps –triceps cocontraction and was unable to perform hand-mouth contact. The benefit has persisted after 9 months of follow-up.

*Biceps injections*

*Case 5.* A 2 years old girl with a right C5-C7 OBP. She had a surgical brachial plexus neurolysis performed at the age of 11 months, with little benefit. She also had marked biceps – triceps cocontraction, with a flexed elbow posture. After the injection, she showed a better posture and was able to extend the elbow forward. The effect was lost after 5 months.

*Case 6.* A 5 years old girl with a right C5-T1 OBP. She had a fixed elbow flexion and marked biceps hypertrophy. After one month, she showed a better posture and was able to extend the elbow downward. After 6 months, the effect was lost and she was submitted to new injections. The benefit was reestablished.

*Case 7.* A girl of 22 months of age and a left C5-C7 OBP. She had severe C7 involvement and developed a biceps retraction (10º of elbow flexion). After the injections, she developed a better posture and was able to extend the elbow. The effect disappeared after 3 months, and she was submitted to new injections. The benefit was then reestablished.

*Case 8.* A 2 years old boy with a left C5-C7 OBP. He had a surgical brachial plexus neurolysis performed at the age of 9 months, and the C5-C6 level showed improvement. Elbow extension remained weak, with signs of cocontraction. There was no improvement after the use of BTA in the biceps muscle and the parents declined further injections.

## DISCUSSION

The functional benefits observed with triceps injections were higher than with biceps injections. The results of the use of BTA in the biceps muscle were clinically unimpressive: one patient showed no response and no patient developed anti-gravitational strength for elbow extension. We were unable to find an adequate explanation for this discrepancy. Patients with fixed elbow flexion posture usually have a pronounced C7 level lesion. This is a known risk factor for poor prognosis[6]. Biceps BTA injections can improve the range of elbow extension, but this effect usually lasts only a few months, as expected. On the other hand, triceps BTA injections seem to have a persistent benefit that is not related only to the pharmacological effect of BTA. The inhibition of cocontractions may improve motor control and provide a window for neuronal plasticity.

Patients with OBP that do not recover until one year of age usually have a persistent weakness of both biceps and triceps muscles. The use of BTA for weak muscles may seem paradoxical, but is a well-established fact in patients with central weakness and spasticity[7]. The objective of BTA injections in our cases was to reduce the abnormal contraction of overactive muscles, therefore balancing the forces acting at the elbow.

Many patients present severe weakness despite clear evidence of extensive muscle reinnervation documented by electromyographic studies[8]. Simultaneous contraction of antagonist muscles has been postulated as a probable cause of this discrepancy. Two different mechanisms may be responsible for this phenomenon. Developmental apraxia is a central motor program deficiency secondary to poor sensory-motor stimulation of the brain during a critical period of neuronal maturation[9]. The second proposed mechanism is aberrant reinnervation[10]. It has been well documented in patients with brachial plexus lesions, and can occur either spontaneously, or induced by brachial plexus reconstructive surgery. Regenerating motor axons may not reach their original target muscle, and the resulting motor unit would have a function different of its original program. This program can be eventually changed by neuronal plasticity, unless a complex misdirection pattern is present[8]. In this situation, due to abnormal motor branching, the same motor neuron is responsible for innervation of muscles with antagonic function. The mech-

anisms involved in cocontractions are probably not mutually excluding. Aberrant reinnervation could be also responsible for bad sensory feedback that could affect the central motor programming[8].

Rollnik et al. treated six girls with OBP (age: 2 to 4 years) administering BTA to the triceps muscle (Dysport®, Ipsen), with an average dose of 40U[4]. All patients showed an improvement of elbow flexion strength and range of motion, and no adverse side effects were reported. The improvement persisted for more than one year after the last injection in all cases. The reason for this long lasting effect was unknown and the authors believe that it was related to neuronal plasticity. The patients were selected among 482 children referred to a hand surgery center, but only 12 cases had "severe biceps - triceps cocontractions".

Desiato and Risina treated 50 children of less than 14 years old with BTA and current neuro-rehabilitation[5]. The treatment aimed the shoulder adductors, elbow flexors and elbow pronators muscles. These muscles are related to some of the most common long-term deformities seen in patients with severe OPB. The mean doses for elbow flexors were 93 U or 5.7 U/kg (Dysport®, Ipsen). Repeated injections were performed in 30 patients after 3 to 5 months. They demonstrated a significant gain in active range of motion in their patients. All patients showed an initial benefit phase, lasting up to 14 days. After that, 70% of their patients showed a step-like improvement, while the benefit decreased in the remaining 30%. Beyond the improvement of the range of active motion, the acquired motor performances did not abate during the decreasing benefit period of BTA in most young patients.

In conclusion, our results suggest that this new form of therapy can be useful in the treatment of selected children with OBP.

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