166 - BOTULINUN TOXIN *A* EFFECTS AND PHYSIOTHERAPY ON MUSCLE TONUS AND STRENGTH IN A SPASTIC DIPLEGIC CHILD

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INTRODUCTION

Spasticity in the cerebral palsy occurs due to the deinhibition of medular reflexes caused by a non-progressive brain damage (PREISS ET AL., 2003). While the lesion to the cerebrum is static, the musculoskeletal manifestations are progressive (BACHE ET AL., 2003). According to Bjornson et al. (2007) there are alterations in the neuromuscular junction that are responsible by the spasticity and alterations in the muscular force. This way, the selective motor control can be injured or inadequate, diminishing the joint mobility (ROSE & GAMBLE, 1998). The compromise of the mobility acts in the neuromuscular system causing increase of the spasticity, weakness, disorder of muscular activation, co-contraction (defined like the loss of the selective recruitment of the agonists muscles) and also to musculoskeletal compromises as shortened muscles (SHUMWAY-COOK & WOOLACOTT, 2003). The techniques of handling utilized at present for patients with cerebral palsy aim mainly at modulating the tonus for better conditions of voluntary contraction to the individual and improves daily living activities, including gait. When botulinun toxin A (BTA) is injected into the muscles the release of acetylcholine is blocked, resulting in a relaxation of overactive muscles. The injection take effect within a few days and last until new nerve endings grow back and the affected muscles recover by the formation of new axons endings, which usually takes around 12-16 weeks. Functional benefits, however, usually last longer than this (GIANNI, 2000). The use of the BTA is widely utilized in spastic diplegy. The chosen muscle is normally the gastrocnemius because its high tonus alterations. Silva Junior et al. (2003) concluded that the application of BTA in the gastrocnemius of spastic diplegy associated the physiotherapy decrease the deformity in equinus, showing improvement of the gait. Sutherlands et al. (1999) verified increased dorsiflexion during in swing phase of the gait in infants with cerebral palsy. These results with the use of the BTA alone were possible due to the association of the physiotherapy.

The physiotherapy associated to the application of BTA is defended by many specialists in the rehabilitation of these infants since this procedure shows satisfactory results (CALDERÓN-GONZÁLEZ & CALDERÓN-SEPÚLVEDA, 2002). The conventional physiotherapy utilizes kinesiotherapy having as its foundation the neurophysiology and neural plasticity. The Neurodevelopmental Concept (Bobath) is defended by many researches as being appropriate for improvement of tonus and movement disturbances in infants. The handlings aim at promotion of feedback of the specific movement as a function of different experiences and postural anticipations (GUSMAN, 1998). The Bobath concept is based in facilitations of the normal movement and inhibition of the abnormal.

The physiotherapy and the BTA act straightly in the muscular tonus. Studies as the of Bjornson et al. (2007) found decrease of seriousness of the tonus after treatment with BTA and physical therapy in child with cerebral palsy. However, it was not found many studies that document qualitative alterations in the muscular force. Ross & Engsberg (2002) and Bella & Eichenberger (2002) showed that the physiotherapy promoted the diminution of the tonus and the increase of force in the muscles evaluated. This study assessed the effect of the application of the BTA with the physiotherapy in the modulation of the tonus and of muscular force.

METHODS

One seven-year-old male with spastic diplegy participated in the study. His parents signed an informed consent, with the objectives and procedures of the research. The subject was an assiduous patient of the sector of Physiotherapy in Pediatrics of the Hospital of Clinics of the State University of Campinas (UNICAMP) from two years of age onwards. The study was carried out in the Laboratory of Gait of this same institution. Evaluation of the tonus of lower limbs had as reference the Scale of Espasticity of Durigon and Piemonte (1993). This scale classifies the tonus according to restraint to the passive movement of the muscle quizzed and the region of restraint (Table 1), was associated to a score varying from 1 to 8: the higher the score the higher the spasticy degree. For the evaluation of the tonus, the patient were positioned comfortably in supine about a stretcher. The therapist positioned the segment to be evaluated, stabilizing its proximal segment and carring out passive movements in the distal segment applying low or high velocity. The muscular groups evaluated were: plantiflexors; dorsiflexors; inversors and eversors of feet; flexors and extensors of knees; flexors, extensors, external and internal rotators, aductors and abductors of hips, bilaterally. The same muscular groups were evaluated on the basis of the scale of force (table 2) of Daniels Williams and Worthingham (1987). For the evaluation of force, the patient was also positioned in supine in the stretcher and the therapist requested the movement of the segment. While the infant was carring out the movement, the therapist resisted it against the gravity. Also it was related score to the (0 to 5) of force for the elaboration of the descriptive graphics (score varying from 1 to 10).

Table 1 - Classification and score of the tonus based in the scale of Durigon & Piemonte (1993). *AOM = amplitude of movement.

Classification	Passive Movement	Score
Hipotony	No resistance	1
Normal tonus	No alterations	2
Light spasticity	Resistance in 1/3 of AOM/low velocity of movement	3
Light spasticity +	Resistance in 1/3 of AOM/low velocity of movement	4
Moderated spasticity	Resistance in 1/2 of AOM/low velocity of movement	5
Moderated spasticity +	Resistance in 1/2 of AOM/high velocity movement	6
Seriousness spasticity	Resistance in all AOM/low velocity movement	7
Seriousness spasticity +	Resistance in all AOM/high velocity movement	8

Table 2 - Classification and score of force based in the scale of Daniels Williams & Worthingham(1987).*AOM = amplitude of movement.

Movement condition	Score
Against higher resistance / complete AOM	10
Against higher resistance / incomplete AOM	9
Against resistance / complete AOM	8
Against resistance / incomplete AOM	7
Against gravity / complete AOM	6
Against gravity / incomplete AOM	5
In favor of gravity / complete AOM	4
In favor of gravity / incomplete AOM	3
Trace of muscular contraction	2
No muscular contraction	1

The infant was submitted to tonus evaluation; muscular force and kinematic analysis of the gait, before application of TBA bilaterally in the gastrocnemius and four months after. Durind this period the child carried out physiotherapy. A protocol of kinesiotherapic exercises based on " Neurodevelopmental Bobath" and "Proprioceptive Neuromuscular Facilitation" (KNOTT & VOSS, 1968) was elaborated, whose purposes were: mobility of trunk, pelvis and scapula; gain or maintenance of amplitude of movment of loer limbs; strengthening, mainly of lower limbs and modulation of muscular tonus. The responsible by the patient received a schedule of exercises to be performed daily at home. The infant frequented the sessions twice weekly during four months. Twenty-five physiotherapy sessions were carried out. Passive markers were affixed at the following anatomical points: grater trocanter, lateral condyle, base of the calcaneus, base of the head of the first metatarso and lateral malleolus. The signs were processed with the Gait Analysis software, which carries out the integration of 3 video cameras. Frequency of data acquisition was set at 60 Hz.

RESULTS

Figures 1 and 2 describe scores regarding tonus and forces before and after experimental treatment. Figure 3 shows data of the right lower limb, with increase of muscular force in most of the muscular groups with the exception of the of hip flexors that decreased one point. The knee flexors and the hip aductors that already defeated the gravity, however in incomplete arch of movement (score 5), were observed to carry out the whole arch of movement (score 6). The hip extensors was the muscular group that increased force in a more noticeable way, shifting from a score of 3 (movement in favor of the gravity) to 7 (defeats resistance in incomplete arch of movement). The hip abductors that presented only a vestige of muscular contraction showed to be able to defeat the gravity force in incomplete arch of movement after treatment. The knee flexors and the extensors of hip diminished of a light spasticity for normal tonus. The abductors of hip shifted from moderate spasticity plus to moderated, while the knee extensores kept the light spasticity observed in the initial evaluation.

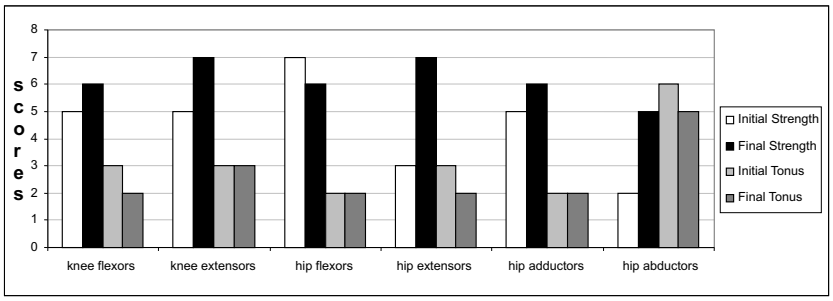
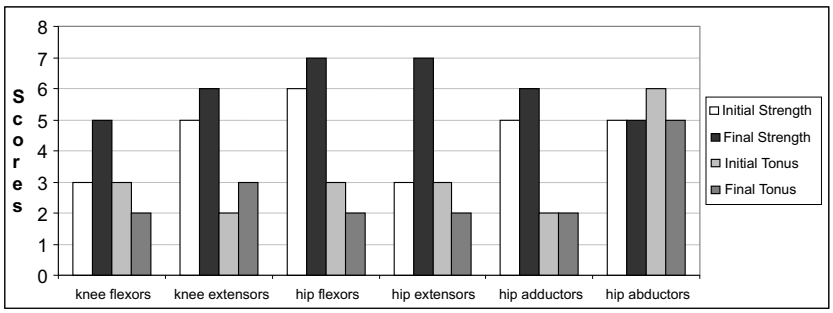


Figure 1 - Tonus and force of muscular groups of the right lower limb.

Figure 4 presents the scores of the left lower limb. Regarding force had increased in all of the muscular groups with the exception of the abductors of hip that kept score 5. The extensors of knees and the aductors of hips passed it defeat the gravity in all the arch of the movement (score 5 for 6). The muscular group that showed bigger gain was the extensores of hip that carried out movement in favor of the gravity in incomplete arch of movement (score 3), passing it defeat the resistance in incomplete arch of movement (score 7). The evaluation of the muscular tonus showed decrease in the majority of the muscular groups, passing from a light spasticity for a normotonia. It was the case of the flexors of knee, flexors and extensors of hip.



Figures 2 - Tonus and forces of muscular groups of the left lower limb.

The graphics obtained by the software of the kinematic analysis were analyzed qualitatively. It was observed that amplitude of active movement of the right knee increased in the second evaluation, being that the inflection angle diminished in 20°. Moreover, the right knee kept stretched by a longer period. Regarding rotation of the hip, we found diminution of the internal rotation during all gait, being that in the second evaluation the patient initiated the cycle with the neutral hip. Before handling the child carried out plantiflexion and eversion during barely all gait, mainly in the phase of support. In the second evaluation noticed itself a smaller plantiflexion in the swing phase bilaterally. Already, in the left knee, it was observed that increased of the amplitude of active movement after the handling, being that the degree of inflection diminished in 30°. Furthermore, the left knee was kept stretched by longer period. In the second evaluation we found a higher amplitude of movement of the left hip, since it was adduced

until achieving neutrality in the medium swing.

DISCUSSION

In the develoment of children suffering form cerebral palsy, in which it is of major importance to promote muscle stretching so that muscle and the bone growth go in parallel, use of BTA is useful for development of flexibility, force and tonus. Previously such problems were corrected with orthopedic surgical procedures in lower ages in these children, what in the long range, brought as inconvenient the recurrence of muscular shortning and loss of power, with progressive worsening of function, specially for gait. Moreover, many times occurred excessive stretchings that resulted in inversion of the deformities, with major functional damage to these patients (GIANNI, 2000).

Application of the BTA exclusively, however, is not capable to produce satisfactory results. In a review by Dood, Taylor, and Damiano, (2002), it was concluded that the physical therapy improves muscular force in children with cerebral palsy. Therefore, the handling analyzed in this study probably favored the muscular antagonist activation and more adequate articular positioning in the gait. Silva Junior et al. (2003) concluded in his study that the application of the BTA to gastrocnemius of spastic diplegics associated with the physiotherapy diminished the deformity in equinus having repercussions in the improvement of the gait. Associating data obtained in the clinical evaluation of the force and tonus with the kinematics, it was verified profit of muscular force in the flexors and extensors of knee bilaterally. This helped the diminution of the inflection of knees during the whole gait. It is believed that the patient activate more adequately the agonistas and antagonists, mainly during the swing phase . The decrease of tonus of knee flexors was a factor that influenced straightly the increase of the control extensor. According with obtained data, most muscular groups that presented profit of muscular force diminished concomitantly the rank of the spasticity, which is accordance with Bella and Eichenberger (2002). The diminution of spasticity favors the muscular activation of the antagonist and agonista musculature (SHAMP, 1990). Clinical facts showed increase of the force of the hip extensors bilaterally and left hip flexors. Tonus was diminished in all these muscular groups, with the exception of the right hip flexors, which was already normal before treatment. Kinematic data of the right lower limb showed better control in the stretch of the hip, mainly between the terminal support phase and initial swing. That is, the right hip kept longer period in stretch. In addition, in the final swing had a significant diminution of the inflection of the hip. Another hypothesis for the diminution of the inflection of hip and of right knee would be due to the increase of the amplitude of movement of the ankle after the handling. According to Shumway-Cook and Woollacoot (2003) diminution of the plantiflexion prevents inflection of hip and of knee as a compensation, in order to do not drag the ankles. In the left lower limb we also observed increased force of the agonistas and antagonists, with concomitant decrease of the tonus, however the amplitude of movement of the hip was not altered. Perhaps this result is due to the left ankle, that despite of the increase of the amplitude of movement still in excessive plantiflexion due to the deformity articulate. Therefore, the hip had that maintain the inflection of hip for do not drag the ankles in the floor. The data regarding aduction and abduction of the hips show improvement of force and diminution of tonus, favoring a better joint positioning during the gait.

CONCLUSION

Application of BTA in gastrocnemius bilaterally associated with the physiotherapy influenced the increase of the force and diminution of the espasticidade of the majority of the muscular groups of the lower limbs, beyond the increase of the articular amplitude. It is believed that the therapy favored extension of the musculature and joint positioning providing functional and adequate length of the muscular groups. Clinical evaluation showed to be coherent with kinematics, increasing understanding of the factors that interfere in the abnormal gait and helping a better handling. This fact is important to the therapist that do not possess advanced technology like the laboratory of gait for evaluate his patients, therefore carrying out a qualitative evaluation of tonus and force one can relate improvement of performance and muscular activation during the gait.

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BOTULINUN TOXIN *A* EFFECTS AND PHYSIOTHERAPY ON MUSCLE TONUS AND STRENGTH IN A SPASTIC DIPLEGIC CHILD

ABSTRACT

The objective of this case study was analyze qualitatively the alterations of the tonus, force and joint amplitude of the lower limbs after application of the BTA. A seven years child of the male sex with spastic diplegy was selected for participate of the study. The child was submitted to two evaluations: before of the application of the BTA in gastrocnemius bilaterally and another one after four months. During these four months the child participated regularly of the physical therapy, three times weekly that consisted of kinesioterapy based in the Bobath Neurodevelopmental Concept. The study had qualitative character having like dependent variables: force, muscular tonus and the angular variation of the lower. The gait was evaluetad by means of the three cameras of 60Hz with acquisition and processing by the software QView and construction of the graphics by the QGait, with markers in lower limbs and pelvis. For the evaluation of the muscular tonus utilized itself to scale of Durigon & Piemonte (1993) and of the forces by means of the scale of Daniels & Worthingham (1987). The result showed that associated with the decrease of the tonus it was observed increased of force of the majority of the muscular groups evaluated. Concomitantly, it observed itself increase in the amplitude of movement of the hip, knee and ankle in the sagital plane. This indicates that the physical therapy program proposed associated to the application of the BTA resulted in the increase of force of the muscular groups evaluated.

KEY-WORDS: Botulinun Toxin *A*, Physiotherapy, Spastic Diplegic.

BOTULINUN TOXINE *A* ET PHYSIOTHéRAPIE ET EFFETS SUR LE TONUS ET LA FORCE MUSCULAIRE EN DIPLéGIE SPASTIQUE UN ENFANT

RÉSUMÉ

L'objectif de cette étude de cas était analyse qualitativement les changements du ton, la force et l'amplitude articulent des membres plus bas pulvérise l'application du BTA. Un enfante du sexe mâle de sept années majeures avec la paralysie diplégie spastique a été choisi pour participe de l'étude. Le enfante a été soumis à deux évaluations: avant de l'application du botulínica de toxine *A* dans gastrocnêmios bilatéralement et un autre l'un après quatre mois. Pendant ces quatre mois que le bébé a participé régulièrement des services fisioterapêuticos, trois fois hebdomadaire qu'a consisté en cinesioterapia a basé dans le Neurodevelopmental Concept Bobath. L'étude a eu avoir de caractère qualitatif comme les variables dépendantes: la force, le ton musculaire et la variation angulaire des articulations des membres plus bas. Il lui-même est évalué il va au moyen des trois appareils photo de 60Hz avec l'acquisition et traitant par le QView et la construction de logiciel des graphiques par le QGait, avec les bornes dans plus bas les membres et pelve. Pour l'évaluation du ton musculaire est utilisé lui-même escalader de Durigon & Piemonte (1993) et des forces au moyen de l'échelle de Daniels & Worthingham (1987). Le résultat a montré qu'a associé l'affaiblissement du ton que j'avais augmenté de force de la majorité des groupes musculaires évalués. Concomitamment, il a observé que lui-même augmente dans l'amplitude de mouvement des articulations de l'hanche, le genou et la cheville dans le sagital de projet. Ceci indique que le cinesioterapêutico de programme a proposé associé à l'application du t a eu pour résultat l'augmentation de force des groupes musculaires évalués.

MOTS-CLES: Botulinun Toxines *A*, physiothérapie, Diplégie Spastique.

BOTULINUN TOXINA *A* EFECTOS Y FISIOTERAPIA EN EL TONO MUSCULAR Y LA FUERZA EN UN ESPáSTICA DIPLEGIC NIñO

RESUMEN

El objetivo de este estudio fue analizar cualitativamente las modificaciones del tono, la fuerza y la amplitud articular del miembros inferiores después de la aplicación de BTA. Uno niño del sexo masculino de siete años de edad con diparesia espástica fue escogido para participar del estudio. El niño fue sometido a dos evaluaciones: antes de la aplicación del toxina botulínica *A* en gastrocnemius bilateralmente y otra después de cuatro meses. Durante estos cuatro meses que el niño participó regularmente del tratamiento de fisioterapia, tres veces por semana que consistió en cinesioterapia fue basada en el Concepto Neuroevolutivo Bobath. El estudio tuvo tener cualitativo de carácter como variables dependientes: la fuerza, el tono muscular y la variación angular de las articulaciones de los miembros inferiores. Fue evaluado por medio de las tres cámaras de 60 Hz con la adquisición y procesando por el software QView para la construcción del gráfico por el QGait, con marcadores en miembros inferiores y pelve. Para la evaluación del tono muscular fue utilizado la escala de Durigon & Piemonte (1993) y las fuerzas por medio de la escala de Daniels & Worthingham (1987). El resultado mostró que la disminución del tono fue asociada con el aumento de la fuerza de la mayoría de los grupos musculares evaluados. Concomitantemente, fue observado aumento en la amplitud del movimiento de las articulaciones de la cadera, la rodilla y el tobillo en el plano sagital. Esto indica que el programa propuso asociado con la aplicación de la BTA tuvo como resultado el aumento de la fuerza de los grupos musculares evaluados.

PALABRAS-CLAVE: Botulínica Toxina *A*, Fisioterapia, Diaplejía Espástica.

EFEITO DE APLICAçãO DE TOXINA BOTULíNICA *A* E FISIOTERAPIA SOBRE O TÔNUS E A FORÇA MUSCULAR EM UMA CRIANÇA DIPARÉTICA ESPÁSTICA

RESUMO

O objetivo deste estudo de caso foi analisar qualitativamente as alterações do tônus, força e amplitude articular dos membros inferiores após aplicação da TBA. Uma criança do sexo masculino de sete anos de idade com paralisia cerebral diparética espástica foi selecionada para participar do estudo. A criança foi submetida a duas avaliações: antes da aplicação da toxina botulínica A em gastrocnêmios bilateralmente e outra após quatro meses. Durante estes quatro meses a criança participou regularmente dos atendimentos fisioterapêuticos, três vezes por semana que consistia de cinesioterapia baseada no Conceito Neuroevolutivo Bobath. O estudo teve caráter qualitativo tendo como variáveis dependentes: força, tônus muscular e a variação angular das articulações dos membros inferiores. Avaliou-se a marcha por meio da três câmeras de 60 Hz com aquisição e processamento pelo software QView e construção dos gráficos pelo QGait, com marcadores em membros inferiores e pelve. Para a avaliação do tônus muscular utilizou-se a escala de Durigon e Piemonte (1993) e da força por meio da escala de Daniels e Worthingham (1987). O resultado demonstrou que associada a diminuição do tônus houve aumento de força da maioria dos grupos musculares avaliados. Concomitantemente, observou-se aumento na amplitude de movimento das articulações do quadril, joelho e tornozelo no plano sagital. Isto indica que o programa cinesioterapêutico proposto associado à aplicação da TBA resultou no aumento de força dos grupos musculares avaliados.

PALAVRAS CHAVE: Toxina Botulínica *A*, Fisioterapia, Diparética Espástica.