ORIGINAL ARTICLE

Neuromuscular block practice in the treatment of spasticity in Brazil

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ABSTRACT

Botulinum toxin type A (TBA) is one of the most effective and safe treatments for spasticity. To evaluate some scales can be used, as the Modified Ashworth Scale (MAS). Therapeutic success in the application depends on the correct identification of the problem and biomechanical application of the affected muscle, which can be done by surface palpation techniques or auxiliary methods such as electromyography. **Objective:** To evaluate the methods of TBA applications for the treatment of spasticity performed in the practice of medical rehabilitation for children and adults. **Methods:** exploratory, cross-sectional study with a convenience sample size recruited in scientific events in Rio de Janeiro, São Paulo, Goiânia, Belo Horizonte, Curitiba and Ribeirão Preto (Brazil). Questionnaires regarding the treatment of spasticity containing multiple choice questions about groups of patients and treated muscles were applied. Responses were analyzed for frequency for each answer. No association test of variables or hypothesis were used. **Results:** 49 questionnaires were analyzed. 47% apply TBA for less than five years. The most used technique for locating points of application was muscular palpation (80%). To quantify the functional gains, 78% reported the use the MAS scale. 57% applies in adults and children. The most common children age group treated was 5-10 years (83%) and the most treated muscle group was the triceps surae (73.8%). Regarding the use of phenol, 16 used with a frequency of 1 to 5 patients per month. 45% of applicators used phenol associeted with TBA. **Conclusion:** The TBA is widely used in the treatment of spasticity, however there is no standardization in the form of application, method of analyzing the treatment success or the necessity of a combined agent.

Keywords: Botulinum Toxins, Type A, Neuromuscular Blockade, Muscle Spasticity

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INTRODUCTION

The Botulinum Toxin Type A (TBA) is one of the most effective treatment for spasticity and focal dystonia caused by injuries in the central nervous system, such as stroke, multiple sclerosis, spinal cord injury, cerebral palsy and traumatic brain injury, whereas systemic drugs do not achieve a suitable muscle relaxation and may cause inconvenient side effects. With a relatively simple administration, due to its diffusion properties, its mechanism consists in the interruption of the cholinergic transmission of the neuromuscular junction neurons, causing a reduction in the transmission of the physiological information of muscle contraction. The result is a tonus reduction of the muscle where the TBA was injected.[1]

Concerning the spasticity evaluation, the most commonly used tool is the Modified Ashworth Scale (MAS), however its reproducibility may be compromised due to the rater experience and to the patient characteristics at the moment of the evaluation. Alternatively, other scales, as Tardieu, can be used, but tools that preferably evaluate the performance for executing activities, like the functional independence indexes, gait quality, or motor abilities of the upper limbs, may be selected.[2] Recently, the recommendation of the Goal Attainment Score (GAS) has been released, a scale with the advantage to evaluate the achievement of rehabilitation goals overlooking varied aspects, such as pain, articular amplitude, active and passive function, and gait.[3]

The therapeutic success of the botulinum toxin depends on the correct identification of the biomechanical problem, as well as the muscle choice and the adequate application of the medicine, what can be done by palpation techniques, anatomic topographical reference points, or auxiliary tools for increasing the accuracy of the needle placement, such as electromyography, electrical stimulation, and ultrasonography.[4] The computerized tomography and the fluoroscopy may be used, however they are limited, once they cause radiation exposition with repetitive treatment, high cost, and little availability.[4]

OBJECTIVE

Evaluate the methodology of botulinum toxin application and other types of spasticity treatments, as phenol, usually applied in the clinical rehabilitation practices in children and adults in Brazil.

METHODS

This was an exploratory cross sectional study, whose sample was conveniently estimated, in which questionnaires regarding the professional practice of rehabilitation medical doctors in applying botulinum toxin and other nerve blocks for treating spasticity of adults and children in Brazil.

The questionnaires comprised multiple choice, self-applied questions regarding the most prevalent type of patients and muscle group treated, the association with medical drugs and other nerve blocks, such as phenol and alcohol, instruments for functional and spasticity evaluation, the use of anesthesia, and methods for muscle localization. The distribution of the questionnaires occurred in scientific events in August, 2015: a sequence of five courses lectured by the Spanish neuropediatrician Samuel Ignácio Pascual Pascual concerning his experience in the clinic and in scientific publications about the pediatric spasticity treatment in rehabilitation services of *Rio de Janeiro*, *São Paulo*, *Goiânia*, *Belo Horizonte* and *Curitiba* and an advanced spasticity course in *Ribeirão Preto* for medical doctors who were licensed to apply the botulinum toxin.

The answers to the questionnaire were compiled in electronic sheets and further analyzed on the frequency of answers for each question. When appropriate, we used the mean and standard deviation as measures of central tendency and data dispersion. No variables correlation tests were used.

RESULTS

Most of the medical doctors who responded the questionnaire were physiatrists (49%, Table 1) and a bimodal curve rose regarding their experience on performing the procedures, once 47% reported less than 5 years of experience, and 45% had more than 10 years of experience in applying the botulinum toxin. Concerning the method for identifying the location on the muscle to be treated, 80% of the medical doctors preferred the muscle palpation and use of anatomic topographical reference points, followed by electrostimulation (26%) with tools offered by their institutions (70%), and those who used to choose more than one localization technique, according to the muscle or body region.

The combined use of phenol for neurolysis was chosen as a possible treatment alternative by 16 medical doctors, from which 73% reported its use in 1 to 5 patients a week. The isolated use of phenolic block was described by 55% of the medical doctors, whereas 45% of them reported its use combined with botulinum toxin. The most commonly blocked nerves are the anterior branch of obturator nerve (67.2% of the patients), motor branch of the sciatic nerve (35%), musculocutaneous nerve (20.6%), femoral nerve (18%), motor branch of the tibialis posterior nerve (15%) and motor points in 10% (Table 2).

Thirty percent of the medical doctors assist children, exclusively, whereas 57% also assist adults. Half of the medical doctors who apply the toxin in children reported they use anesthetics that can be topical, inhaled or intravenous and, in a week, no more than 10 children are treated by 95% of the participants of this study. The most common age group reported by the medical doctors are 5 to 10 years of age (83%), and regarding their functional classification, most of them are rated as GMFCS III (46.5%).

For quantifying the functional gain, 84% of the professionals use spasticity scales, and the most frequently reported were MAS (78%) and Tardieu (7%). Others prefer scales and quantifying methods as GAS (9%), Gross Motor Function Classification System (GMFCS - 7%), Manual Ability Classification Score (MACS - 4%), and goniometry (2%) (Table 3).

The use of computer aided gait analysis before the application of the botulinum toxin, especially when there are suspicions complex cases with surgery indication, was reported only by 13% of the professionals. For the treatment of the spasticity, the muscle groups more frequently reported were triceps surae muscle (73.8%), adductors (59%), hamstring muscle (52.6%), wrist flexors and extensors (37.9%), elbow flexors and extensors (37.8%), fingers flexors and extensors (33.5%), and hip flexors (27.3%) (Table 4).

DISCUSSION

The use of botulinum toxin in patients with spasticity due to cerebral palsy, stroke, traumatic brain injury, or spinal cord injury demonstrates great therapeutic value.[5]

In Brazil, the introduction of TBA occurred in 1994 in a clinical research and in 1996 for

Table 1. Medical specialty of the participants

Medical Specialty	
Physiatrist	49%
Neurologist	14%
Orthopedist	16%
Others - Not informed	21%

Table 2. Frequency of peripheral nerves chosen for applying phenol in the spasticity treatment

Nerves	
Anterior branch of obturator nerve	67.2%
Motor branch of the sciatic nerve	35%
Musculocutaneous nerve	20.6%
Femoral nerve	18%
Motor branch of the tibialis posterior nerve	15%
Motor points	10%

Table 3. Frequently used scales for quantifying the gain in spasticity treatment

Scales for Quantifying Gain	Use Frequency
MAS	78%
Tardieu	7%
GAS	9%
GMFCS	7%
MACS	4%
Goniometry	2%

Table 4. Muscle selection frequency for application of botulinum toxin in children

Muscles and Muscle groups	Selection frequency for treatment
Triceps surae	73.8%
Adductors	59%
Hamstring muscle	52.5%
Wrist flexors and/or extensors	37.9%
Elbow flexors and/or extensors	37.8%
Fingers flexors and/or extensors	33.5%
Hip flexors	27.3%

clinical use, therefore, there is a group of medical doctors with solid experience in using this medicine, having had contact with the various ways of administration, and choosing, as time passed, to use the strategies that seemed more practical or appropriate. Concomitantly, the is another group of younger professionals who is being trained by the previous generation and retaining this experience, adapted to the Brazilian reality. This study is the first to try to understand the practices that are being used for this intervention by medical doctors in Brazil. In the present, the use or electromyography is being discussed, as an auxiliary exam for defining the spastic target muscles where toxin must be applied, more transparently unveiling the motor point.

The experience achieved in several referral centers has shown that the use of the botulinum toxin with the aid of the EMG have more adequate results when compared to the application solely guided by the clinical neurologic exam.[5] For comparing the effects over spasticity of the application of botulinum toxin with and without the EMG for guiding the needle, a randomized controlled clinical trial was executed in a Tertiary University Hospital in Greece, in which 27 adult hemiplegic patients with spasticity due to brain or spinal injury were included.

The application of botulinum toxin was performed in spastic muscles with and without the aid of electroneuromyography (ENMG). The modified Ashworth scale and the Barthel index were used to assess each patient before and after the application. The patients were randomized to receive the toxin with ENMG guidance or with anatomical muscular palpation. The follow up, which occurred 3 weeks after the application, has shown that the spasticity had reduced in both groups, but a greater reduction was found in the group which received the application with the aid of ENMG.[6]

In the present study, we have shown that only 4% of the professionals use the ENMG in the therapeutic practice. In addition to request specific qualification, the costs for this type of procedure is greater, either concerning the equipment and needle or concerning time, what may explain the preference of 80% of Brazilian professionals for applying the toxin using the palpation method, without, however, comparing the improvements of spasticity and functionality.

Concerning the evaluation or quantification scales for spasticity, this study confirms a universal tendency, i.e. the MAS is the most widely used or evaluating spasticity. A passive movement of the extremity is performed and the moment of the articular amplitude in which the resistance appears is evaluated. This is an ordinal scale ranging from 0 to 4. Oppositely, the Tardieu scale is measured in degrees by the goniometry of the articular movement amplitude evaluating the intensity of the muscle reaction against slow elongation or the fastest possible strain. As it is a quantitative scale, it allows the identification of slight changes, what makes it recommendable for use in research. Nonetheless, the simplicity and the strong clinical significance favors the preference MAS and not the other scales.

The functional repercussion of the spasticity in walking subjects may be analyzed with a simple clinical observation or with more detailed manners, such as a laboratory for computerized gait analysis, where the primary alterations and the compensatory reactions are more precisely and sensibly observed and quantified.[7] In our study, the professionals reported to use primarily the MAS, combined with other functional scales.[8]

The neurolytic block with phenol, when well prescribed, establishes a tool with excellent cost-benefit relation, with good margin of safety and rare complications, especially when applied by qualified professionals. The

comparison of chemical neurolysis with phenol and TBA for treating the spasticity of 67 patients has shown that both medical drugs were efficient in reducing the spasticity intensity in one (01) point, in average, of MAS.[9]

The effect time was at least 3 months for TBA and from 4 to 6 months for phenol. A longer follow up period is required for determining the mean effect time of the applications. Most of the patients reported the decrease in hypertonia and some functional improvement.[10] However, many professionals still report not being confident enough to use the neurolytic block, once the botulinum toxin is considered even safer concerning the side effects frequency or because the professionals do not have the electrical stimulator in their private clinics, accessing this resource only in the rehabilitation services they may work for.

Regarding the use of phenol, 32.5 of the responders reported they use for controlling the spasticity. It is prescribed preferably for neurolysis of nerves with greater motor component, once there is the concern of causing neuropathic pain when the nerves have greater sensorial component. Considering its proven efficacy, the first and most remarkable advantage of phenol is its price. In its presentation as water solution with phenol at 5%, its cost is from one to two hundred times cheaper than an application of botulinum toxin with the same objective. This characteristic is substantial due to the financial frailty endured by the public health services in Brazil, in which the general rule is the abundance of patients and the shortage of resources. Moreover, the muscle groups which are relaxed by the neurolysis with phenol or alcohol are large, as the hip adductors, or the elbow flexors, which would need large doses of TBA. For these reasons, the botulinum toxin should be reserved to those situations which in fact require its use, as in the most distal portions of the limbs, were the nerves have the sensorial component more prominent and the risk for the development of neuropathic pain is larger. Nonetheless, merits of phenol, such as extended effect length and its immediate effect over the relaxation of the muscle tonus, cannot be ignored.

Also, the development of antibodies against phenol has never been described, what eliminates the need of large intervals between applications, allowing the so called 'retouch' with short periods in between the applications. However, its effect can be transitory in some few patients and in some cases, lasting no longer than two days of relaxation effect. This phenomenon, besides not have been totally elucidated, apparently has no relation with the dose or with a possible imprecise application technique. The application of phenol can be done over peripheral nerves or muscular motor points, with the aid of an electric stimulator connected to a Teflon isolated needle for its correct positioning. The application over motor branches can also be performed directly over the surgically exposed nerves.

In the clinical practice, difficulties in the application of phenol with electrical stimulator in children are observed, once the discomfort of the electrical stimulation and the difficulty in understanding the procedure reduce the children cooperation. In this cases, an inhaled anesthesia in a surgical room may be a solution for diminishing the patient suffering and increase the precision in localizing the motor points and assure efficacy.

Concerning the spasticity treatment in children, the cerebral palsy is the most prevalent motor disturbance which leads to disability, and the spasticity is the most frequent motor disorder, what may occur isolatedly or combined with dystonia, athetosis or ataxia. The routine use of botulinum toxin in children with cerebral palsy begun a little more than one decade ago, although it has been used for more than twenty years for other purposes. Currently, it is consensus that the botulinum toxin application should occur preferably between 2 and 6 years of age, especially in the lower limbs, as to optimize the motor improvements and avoid the installation of retractions and contractures.[11]

Even though some studies have demonstrated that the procedure for applying the botulinum toxin in children may be considered traumatic, either for the child or for their parents, the cost-benefit relation of this treatment must be taken into consideration, given that the results of botulinum toxin application for spasticity treatment provides functional improvements.[12]

CONCLUSION

This is the first study aiming to clarify the practice of neuromuscular block in Brazil. Even though there is no standardization in the procedure, most of the medical doctors employ the same the same manner to identify the application points, to evaluate the patients' characteristics regarding the age and motor impairment, and define the application point.

According to the professionals who responded the interview, 80% of the medical doctors prefer the muscle palpation technique and the use of anatomic topographical reference points, showing this treatment is more economical and has a suitable cost-benefit relation once it requires no equipment, besides the need for specialized trainings for its application in the clinical practice.

The use of phenol blocks for treating spasticity is a relevant alternative that should be acknowledged, due to its low cost if compared to TBA, and due to its possibility to be applied in shorter periods between two applications, as already described in other researches.

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