Physical Therapy for an Adult with Chronic Stroke after Botulinum Toxin Injection for Spasticity: A Case Report

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ABSTRACT

Purpose: In this case report, we describe the type and duration of a physical therapy and botulinum toxin type A (BoNTA) intervention directed at lower limb spasticity and the gait and balance improvement in a patient post-stroke. Treatment of focal spasticity with BoNTA intramuscular injections combined with physical therapy is recommended by rehabilitation experts. However, the optimal type and duration of physical therapy intervention to optimize any functional gains that follow chemodenervation induced by BoNTA has not been established. **Method:** One individual with chronic stroke who received BoNTA injections for upper and lower extremity spasticity was included. Physical therapy intervention consisted of 45- to 60-min sessions twice weekly for 12 weeks, based on the Bobath–neurodevelopmental therapy approach, and an activity-based home program. **Results:** After BoNTA injections and physical therapy, the patient made clinically significant improvements in balance and gait speed and became more independent with his ambulation. **Conclusions:** This case report demonstrates that physical therapy after BoNTA injections can result in significant functional improvements for individuals with spasticity after chronic stroke that may not be possible with BoNTA injections alone.

Key Words: botulinum toxins; muscle spasticity; stroke.

RÉSUMÉ

Objectif : Dans ce rapport de cas, nous décrivons le type et la durée d'une intervention combinant la physiothérapie et l'administration de toxine botulique de type-A (BoNTA) pour contrer la spasticité des membres inférieurs et améliorer la démarche et l'équilibre après un incident vasculaire cérébral. Les experts de la réadaptation recommandent de traiter la spasticité focale par des injections intramusculaires de BoNTA combinées à la physiothérapie. La durée et le type optimaux de l'intervention de physiothérapie visant à optimiser tout gain fonctionnel qui suit la chimiodénervation provoquée par la BoNTA n'ont toutefois pas été établis. **Méthode :** Une personne victime d'accidents vasculaires cérébraux chroniques qui a reçu des injections de BoNTA contre la spasticité des membres supérieurs et inférieurs a été incluse. Le traitement de physiothérapie a consisté en deux séances hebdomadaires de 45 à 60 minutes pendant 12 semaines, basé sur la stratégie Bobath-NDT et en un programme d'activité à domicile. **Résultats :** À la suite des injections de BoNTA et de la physiothérapie, le patient a réalisé des améliorations cliniques importantes au niveau de l'équilibre et de la vitesse de la démarche et est devenu plus autonome dans son ambulation. **Conclusions :** Ce rapport de cas démontre que la physiothérapie suivant des injections de BoNTA peut entraîner une importante amélioration fonctionnelle chez les personnes qui ont une spasticité consécutive à des accidents vasculaires cérébraux chroniques, amélioration qui pourrait ne pas être possible à la suite d'injections de BoNTA seulement.

BACKGROUND AND PURPOSE

Spasticity, one of the positive symptoms of an upper motor neuron disorder, is characterized by a velocity-dependent increased resistance to passive stretch.¹ Spasticity can have profound adverse impacts on health outcomes and quality of life. The traditional non-surgical rehabilitation approach for spasticity has included physical and occupational therapy in combination with phar-

macotherapy, including botulinum toxin type A (BoNTA) intramuscular injections. BoNTA—a potent neurotoxin that blocks local synaptic transmission at cholinergic terminals—has been shown to be safe and effective in treating focal or multi-focal spasticity. It causes fully reversible chemodenervation of injected agonist muscles without adversely affecting the antagonistic muscles. The effects of chemodenervation are seen within 1 week and

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are reported to last 3–6 months; long-term use of BoNTA appears to be safe.²

BoNTA treatment alone can lead to reductions in symptoms (e.g., spasms, pain) and improvements in passive function (e.g., increased joint range of motion [ROM], hygiene, and dressing), but its effect on active limb function remains unclear.³ The increase in available ROM and relief of related symptoms afforded by BoNTA injections can make an important contribution to a comprehensive rehabilitation program by creating an opportunity to maximize the gains made during rehabilitation.⁴ Recent guidelines and a consensus statement on managing spasticity with BoNTA have advocated a holistic multidisciplinary rehabilitation approach that uses physical and occupational therapy, casting, and motor training to increase the likelihood of achieving treatment goals.⁵ However, these guidelines lack detailed recommendations on the type of motor training and the type, duration, and frequency of physical and occupational therapy used to complement BoNTA injections.⁵ The evidence to support the use of multidisciplinary therapy programs after BoNTA is of low quality: A Cochrane review of multidisciplinary programs after BoNTA found low-quality evidence to support the use of modified constraint-induced movement therapy (vs. neurodevelopmental therapy [NDT]), task practice with functional electrical stimulation (vs. task practice alone), and occupational and manual therapy with dynamic elbow extension splinting (vs. occupational therapy alone).³ However, there is clearly a lack of research documenting the nature, type, and frequency of physical therapy interventions after BoNTA injections.

Previous studies examining the effect of multidisciplinary therapy programs after BoNTA have focused on upper limb rehabilitation; no study to date has addressed rehabilitation of the lower limbs.³ Stroke affects both upper and lower limbs, however, and our clinical observations indicate that spasticity is frequently seen in lower limb muscles such as ankle plantar flexors and toe flexors. Because physical therapy is one of the interventions recommended after BoNTA injections,⁵ it is important to determine the type of physical therapy intervention that optimizes functional recovery. The purpose of this case report, therefore, was to describe a physical therapy intervention with a chronic stroke patient after BoNTA injections.

METHODS

A patient discharged from care at a comprehensive spasticity management clinic provided informed consent for us to conduct a retrospective review of his chart and to publish our findings. This case report describes the outpatient physiotherapy and BoNTA intervention and outcomes for one patient 5 years post-stroke.

Case description

The patient was a 68-year-old man who sustained a right cerebral infarct in 2008. He lived in a two-level

Table 1 Site and Dosage of Intramuscular BoNTA Injections

Muscle	No. of sites	No. of BoNTA units injected
Flexor carpi radialis	2	50
Flexor carpi ulnaris	1	25
Flexor digitorum superficialis	4	50
Medial head of gastrocnemius	3	75
Lateral head of gastrocnemius	3	75
Soleus	4	100
Tibialis posterior	2	50
Extensor hallucis longus	2	50

BoNTA = botulinum toxin type a.

Table 2 Summary of Improvements in Response to BoNTA and Physical Therapy

Assessment	Initial	Discharge
BBS	46/56	51/56*
2MWT	42.37 m with SPC (no AFO)	61.26 m* with no gait aid + left AFO
Gait speed	0.35 m/s	0.51 m/s*
TUG	25 s using SPC (no AFO)	16 s* with no gait aid + left AFO

*Indicates clinically meaningful change^{6–8}

BBS = Berg Balance Scale; 2MWT = 2-minute walk test; SPC = single-point cane; AFO = ankle-foot orthosis; TUG = Timed up-and-go test.

home with his wife and ambulated independently with a single-point cane for outdoor mobility. He had been a patient at our tertiary care facility in a comprehensive spasticity management clinic since February 2011 and was receiving BoNTA injections into his left upper extremity (UE) and lower extremity (LE) muscles (see dose details in Table 1). He was referred to outpatient physical therapy in August 2012 for balance and gait assessment and retraining after a recent set of BoNTA injections delivered using electromyography guidance and electrical stimulation.

On assessment, he was cognitively intact and presented with mild spasticity (1/4 on the Modified Ashworth Scale) in the left ankle plantar flexors, invertors, and toe flexors. His left arm and hand were assessed at Stage 2 (spasticity is present; minimal active movement) on the Chedoke–McMaster Stroke Assessment; his leg and foot were assessed at Stage 3 (spasticity is marked; some active movement, primarily into the extension synergy). He had decreased standing balance, decreased gait speed, and decreased independence with ambulation (see Table 2).

The patient's goal was to strengthen his left LE to improve his walking. He reported decreased muscle tone in his left UE and LE after injections. The physical therapy goals were to increase gait speed, improve balance, and increase independence with ambulation so that the patient could walk independently in his home without a gait aid.

Intervention

Physical therapy intervention began in the first week of September 2012, 12 days after the patient received BoNTA injections, and consisted of 45- to 60-minute sessions with a physical therapist twice a week for 12 weeks.

Physical therapy treatment was based on the Bobath-NDT approach and began with sit-to-stand with forced use of the left LE (achieved by placing the right foot on a 5.08 cm [2"] step) and decreased reliance on the right UE (by raising the right arm above shoulder height). Other PT interventions were gait training with a walking pole and a left ankle-foot orthosis (AFO); treadmill training (with a safety harness) at 1.3–1.5 km/h for two 5-minute intervals, focusing on increasing left stance time and extension and abduction through the left hip in stance phase; recumbent arm and leg stepping machine (10–15 min at Levels 2–3 with use of bilateral UE and LE); and bed mobility (rolling to right side through left UE reach pattern and left unilateral bridging). Sitting balance and trunk control were addressed through lateral weight shifting and weight bearing through the left UE while reaching within and outside of the patient's base of support.

Gait training was progressed to using an AFO without a gait aid; training left single-leg stance with facilitation of weight shift to the left with left hip extension and abduction with no UE support; and mobilization of left talocrural, subtalar, and calcaneocuboid joints (Maitland Grade 3, 3 × 10 repetitions for 10 s at each joint) with the patient in sitting to improve dorsiflexion and eversion. Balance exercises were incorporated throughout, including tandem walking; side stepping; gait training on even, uneven, and foam surfaces; throwing and catching; and placing alternate feet on a 20.32 cm (8") step with and without UE support. Sessions were roughly divided into one-third strengthening and balance training, one-third gait training, and one-third conditioning on recumbent arm and leg stepping machine, although this varied slightly depending on patient presentation at each session.

The patient was also instructed in a home exercise program, to be done twice daily, that involved balance exercises (e.g., side steps, single-leg stance, tandem gait, walking on toes and heels), stretching for all injected muscles (5 × 60-s holds⁹), and left leg endurance training (bridging with the right LE slightly in front of the left to force use of the left LE—3 × 15 repetitions).

Outcome measures

The treating physiotherapist performed standardized clinical measurements on the first day before intervention and on last day immediately after intervention, as reported in Table 2.

RESULTS

Table 1 reports the BoNTA dosage, and Table 2 describes results for outcome measures before and after the intervention. The patient achieved his PT goals and

made clinically significant improvements in balance and gait speed. He was able to ambulate without a single-point cane, using an AFO, for >75 m by discharge at 12 weeks post-BoNTA. At discharge, the patient also reported feeling more confident in his ability to walk outdoors and over uneven surfaces.

CONCLUSION

This case report demonstrates that PT after BoNTA injections can produce significant functional improvements for patients with spasticity that may not be possible with BoNTA injections alone. As suggested in the literature,⁵ BoNTA can decrease muscle tone and improve passive ROM, but function-based therapeutic intervention is needed to improve volitional movements. Although the patient described here had been receiving BoNTA injections for more than a year, any changes in balance or gait observed before PT began were unremarkable; however, clinically meaningful improvements in balance,⁶ gait speed,⁷ and independence with ambulation⁸ were achieved after the addition of PT intervention.

This report describes a single case and therefore may not generalize to other people with spasticity. This particular patient was extremely motivated, and it is possible that the results achieved might have been less significant had he participated less actively in the therapeutic process. It is also possible that such thorough and intense PT alone might have induced clinical improvement independent of BoNTA injections.¹⁰

In addition, the outcome measurements were conducted by the treating physiotherapist, who was thus not blinded to the treatment the patient was receiving. Observing the improvements that the patient made over the course of the treatment may have biased the subjective outcomes. In combination with functional and task-based therapies, BoNTA has the potential to facilitate neurologic change and improve function of limbs for people experiencing increased levels of spasticity. Further research is needed to explore standardized timing and protocols for therapeutic interventions after BoNTA injections.

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