

EDITORIAL

The role of Botulinum toxin injection in achieving balanced muscle function

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This special issue of *Disability and Rehabilitation* reports contemporary muscle applications of Botulinum toxin for managing muscle overactivity and associated muscle imbalance. *Clostridium botulinum*, a gram-positive anaerobic bacterium, produces a potent poison, Botulinum toxin, which, when ingested, can induce transient muscle weakness, which in severe cases can be life-threatening. Despite this potential risk, minute doses of the purified neurotoxin confer an option for efficacious treatment of painful muscle spasms, focal muscle overactivity, and muscle imbalance of neurological and musculoskeletal origin. Intramuscular injection with therapeutic preparations of Botulinum toxin decreases contractile activity by blocking acetylcholine release at the neuromuscular junction, rendering the muscle relatively weakened for a variable period until the nerve terminal has recovered.

In many conditions treated using Botulinum toxin injection, the main goal is to achieve a balance between the activity of a tight/short/overactive agonist and a weak/lengthened/inhibited antagonist, with synergistic muscles often contributing in a variety of complex ways. This special issue addresses a range of conditions where the main goal of treatment is to achieve a better balance of muscle function and, as a consequence, better movement control.

In the preface to this material, Dr Alan Scott, describes the development of the therapeutic application of this toxin based upon pioneering studies using Botulinum toxin type A in monkeys and subsequently in humans to treat strabismus. From these fundamental origins, clinical applications have broadened extensively and continue to expand. Some of these applications are highlighted in sections within this issue and give insights into indications,

efficacy and future issues for the therapeutic use of Botulinum toxin.

The pharmacological basis for Botulinum toxin is reviewed by Dressler and Benecke who describe the versatility of its applications; including the potential to block cholinergic neuromuscular innervation of intra- and extrafusal muscle fibres as well as cholinergic autonomic innervation of sweat, lacrimal, and salivary glands and smooth muscles. In general it would appear that long-term clinical application does not produce additive adverse effects, although the potential for autoimmunity remains a problem in some applications. The development of commercial preparations of Botulinum toxin type B has offered options for individuals with auto-resistance and there is some evidence that this serotype may be more efficacious in the treatment of autonomic disorders.

The role of Botulinum toxin injection in the management of axial and cervical dystonia is reviewed by Benecke and Dressler. Intramuscular injection of Botulinum toxin has revolutionized the treatment of this group of conditions. Precise identification of dystonic muscles and careful quantification of their involvement is necessary to optimize patient outcomes. Sheehan reports on the pathophysiology of the excessive and inappropriate muscle contractions which occur during fine motor tasks in individuals with focal task specific hand dystonia; and the efficacy of Botulinum toxin therapy, at least in the short term, in conjunction with other therapeutic approaches for this cohort.

Gracies and colleagues provide an overview of the role of Botulinum toxin therapy in the management of muscle imbalance in the lower limb in adult onset central nervous system injury/dysfunction. These authors point to the key interactions between muscle overactivity, adaptive shortening and loss of strength

and dexterity in producing disablement in this cohort. Considerable evidence for the efficacy of combined treatment approaches, including the use of intramuscular injection of Botulinum toxin, exists to reduce these impairments in the lower limb; however precise guidelines for both short and long term use remain to be clarified.

Turner-Stokes and Ashford describe the role of *serial* injection of Botulinum toxin therapy in the management of muscle imbalance in the upper limb following acquired brain injury. In the case series reported, reduced pain, and improved motor function in the arm was associated with significant improvements in overall function and self-care. The necessity for individualized goal setting, and measurement of goal attainment as an outcome of treatment, is emphasized by these case descriptions.

In the paediatric clinical setting, Botulinum toxin injection has an established role as part of the management of muscle overactivity. Gibson et al. outline recommendations for Botulinum toxin treatment for disabling motor disturbances in children with cerebral palsy, and highlight the important role that this intervention has to facilitate other therapeutic approaches including physical and occupational therapy and surgical correction.

Kowal and colleagues report the efficacy of Botulinum toxin injection in managing eye motility disorders; particularly strabismus, and the considerable utility of this intervention as an alternative to surgery in carefully selected cases.

Muscle overactivity also has the potential to disturb mechanical functioning of the musculoskeletal system. The principle of muscle dominance with resultant imbalance and joint dysfunction applies well to the elite sports setting where disabling abnormal motor patterns can arise, as discussed by Cullen and co-authors. The potential applications for Botulinum toxin treatment may be expanded through the interaction of different clinical groups involved in the rehabilitation of biomechanically-based disorders, and associated altered movement patterns.

In conclusion, intramuscular injection of Botulinum toxin has rapidly become an indispensable part of the treatment strategy for muscle overactivity and associated muscle imbalance. Clinical applications which extend well beyond the treatment of spastic or overactive muscles in neurological patient groups are foreshadowed in this supplement.

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