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Short Communication

A Valuable Guide in the Therapeutic Application of Botulinum Neurotoxin: Ultrasonography

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ABSTRACT

In recent years, the rate of administration of Botulinum neurotoxin type A injection in the cosmetic field have increased significantly, with rare but important complications ranging from ptosis to acute respiratory distress syndrome. Particularly in functional treatments with therapeutic goals such as focal spasticity and dystonia management, the systemic complication rate is much higher compared to cosmetic cases. Therefore, it is recommended that these procedures be performed under guidance. Ultrasound, with its advantages in safety, practicality, and efficacy, especially in interventional procedures where pharmacological agents are delivered to target tissues, is increasingly becoming an important guide. We discuss how using ultrasound guidance can improve safety and efficacy of Botulinum neurotoxin type A injection.

Keywords: Botulinum neurotoxin type A; Ultrasonography; Ultrasound; Spasticity; Dystonia; Systemic complication; Acute Respiratory Distress Syndrome (ARDS)

ABOUT THE STUDY

Botulinum Neurotoxin Type A (BoNTA) is an endotoxin produced by the anaerobic bacterium *Clostridium botulinum*. This endotoxin is a dimeric protein that blocks the release of acetylcholine, thereby reducing the contraction of the motor unit [1]. It prevents the release of membrane-bound acetylcholine at the neuromuscular junction of striated muscles, resulting in chemical denervation and paralysis of the muscles. Blockage of transmission at the neuromuscular junction begins within hours and is completed in approximately 2-4 weeks. The function of the paralyzed target muscle begins to return in about 3 months and is usually completed within 6 months [2]. Therefore, BoNTA is frequently used therapeutically for the management of movement disorders such as spasticity and dystonia, where undesired muscle activities are observed, in addition to cosmetic purposes [3]. Treatment is generally safe and well-tolerated by patients when used appropriately; however, rare and serious side effects such as systemic complications, muscle weakness, and allergic reactions may occur. These side effects are often dose-dependent and may worsen in patients with a history of multiple diseases [1].

When determining the groups to be avoided for BoNTA applications, attention is generally paid to individuals with tracheostomies, respiratory muscle weakness or difficulty breathing, allergic predisposition, and immunosuppressed individuals. Particularly feared are distant muscle involvement due to systemic retrograde spread [4]. However, in a case report published recently, a patient diagnosed with central pontine myelinolysis following direct pulmonary complications after the application of 300 units of BoNTA to the calf muscles was reported [5]. This injection was performed using a blind injection technique based on anatomical landmarks without the use of injection instrument guidance. Although rare, cases like this one occasionally raise safety concerns regarding BoNTA applications. In recent years, BoNTA applications, which have significantly increased in the cosmetic field due to aesthetic concerns, especially when used for therapeutic purposes in interventions for spasticity and dystonia, result in a much higher rate of systemic side effects [1]. Therefore, it is strongly recommended to perform these applications under guidance, such as Ultrasound (US) or electrical stimulation, for both safety and efficacy [6-8].

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With its numerous advantages and practicality, US is becoming increasingly preferred as a significant guide in interventional procedures [9-11]. Particularly, the ability to visualize the tissue where the injector is located in real-time makes US an invaluable guide for BoNTA applications targeting muscles. Through US, injection safety and comfort are enhanced by avoiding contact with bone, nerves, and vessels [12]. Moreover, by observing pre-defined innervation zones within the target muscles, efficient injections can be performed, as demonstrated by some studies [13]. These targets are anatomically predetermined and then combined with the two-dimensional real-time imaging advantage provided by US. As described in relevant articles, specific injection techniques such as multiple injections from different points or the "seeding technique" can be easily performed with US guidance, thereby significantly increasing both the safety and efficiency of the procedure [13].

In our clinic, BoNTA applications targeting spastic muscles in pediatric and adult patients have been performed with US imaging guidance for pharmacological safety and efficacy for a long time, rather than blind injection based on anatomical landmarks.

CONCLUSION

Especially in the cosmetic field and in pathologies targeting functional gains such as spasticity, the use of BoNTA is increasing day by day, and albeit rare, it is prone to a wide range of complications from ptosis to undesired muscle group injection, to ARDS. Therefore, like many other pharmacological agent applications, in the therapeutic application of BoNTA, we recommend the use of US as a practical guide for both safety and efficacy.

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